27th Congress, 3d Session. Rep. No. 43. Ho. of Reps.

COAST SURVEY.

JANUARY 12, 1843.
Laid upon the table.

Mr. Mallory, from the Select Committee on the Coast Survey, reported in part the following proceedings, in obedience to the resolution of the House of Representatives, 2d session 27th Congress, February 19, 1842, viz:

CONGRESS OF THE UNITED STATES.

IN THE HOUSE OF REPRESENTATIVES UNITED STATES,
February 19, 1842.

On motion of Mr. Mallory,

Ordered, That the letter of the Secretary of the Treasury laid before the House on the 3d of January, transmitting a report of F. R. Hassler, superintendent of the coast survey, showing the progress made in that work, and the report from the Secretary of the Treasury laid before the House on the 31st of January, 1842, in relation to the expenditures on account of the survey of the coast, be referred to a select committee.

Mr. Mallory,
Mr. Wise,
Mr. Cushing,
Mr. Aycrigg, and
Mr. Holmes,

were appointed said committee.

Attest: M. S. CLARKE, *Clerk*.

The committee, thus organized, instructed the chairman to request the attendance of Mr. F. R. Hassler, and such of his assistants as the superintendent might designate.

On motion of Mr. Cushing, it was further

Resolved, That the chairman be directed to address a letter, in the name of the committee, to the President of the United States, requesting him (if compatible, in his judgment, with the public service) to communicate to the committee the following information, viz:

1. A list of all persons, other than officers of the navy and army, employed in the coast survey, from its commencement to the present time, the order or orders under which they were employed, and the amount of compensation, regular and extra, paid to each.

2. A list of all such persons who hold, or have held, other civil appointments, and their pay and emoluments under such other civil appointment, held during their employment in the coast survey, with the time and orders for their appointment and pay.

3. A list of all officers of the navy employed in the coast survey, their navy pay during their service in the coast survey, and the additional pay of each on the coast survey.

4. A list of all officers of the army employed in the coast survey, their

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army pay and emoluments, in dollars and cents, whilst so employed, and the additional pay of each for service in the coast survey.

5. The time when and the authority under which all appointments and allowances of pay, regular, extra, or for arrearages, in the coast survey, were made.

And, on motion of Mr. Wise, that the President be requested to cause the proper Department to answer—

1. Whether a part of the topographical corps of the army can be detached for the purpose of the coast survey.

2. Whether the expense of the service of the coast survey will probably be reduced by detaching a part of the topographical corps.

3. Whether the expense of the service of the coast survey will probably be reduced by employing other persons than officers of the army and navy to perform the duties which they are now employed to perform in the coast survey.

In compliance with this resolution, the above interrogatories were transmitted to the President of the United States, with the letter hereunto annexed:

HOUSE OF REPRESENTATIVES, *March* 12, 1842.

SIR: I have the honor to enclose to you the within resolutions of a select committee of the House of Representatives on the subject of the coast survey.

The committee decided to address these resolutions to you, in consideration of the fact that the act of Congress authorizing the survey placed it under your direct and immediate control.

I beg leave to add, that, if consistent with your views, it would be acceptable to the committee to receive the information called for by either of the resolutions, so soon as it shall be ready, without waiting for the other.

I am, with the highest respect,

F. MALLORY, *Chairman*.

To the PRESIDENT.

Upon the motion of Mr. Wise, it was

Resolved, That the committee would proceed in the following order of inquiry:

1. The progress which has been made in the survey of the coast.

2. The number, location, and length, of the several base lines measured for the triangulation.

3. The number of stations occupied for triangulation.

4. The observations made for, and the corrections applied to, the triangulations.

5. The astronomical observations made for the determination of latitude and longitude.

6. The work done by each corps employed in the service.

7. A description of the charts published, if any.

8. The amount of money expended, from time to time, since the commencement of the work.

9. The sums appropriated for instruments and books.

10. The names of all persons employed, distinguishing such as were of the army or navy, together with their salaries or other compensation.

11. By whom appointed.

12. The direct appropriations for the survey, and the indirect expenditures upon it, by reason of the employment thereon of public vessels and officers.

13. The probable length of time required to complete the survey.

14. The probable amount of money required to complete the same in the mode heretofore pursued.

15. Any other mode of survey which shall have for its object the acquisition of the greatest amount of information in the shortest time, and at the least expense.

THURSDAY, *March* 17, 1842.

Present: Mr. Mallory, Mr. Wise, Mr. Holmes, Mr. Aycrigg.

Mr. Hassler appeared before the committee, agreeably to the request of the chairman, made by order of the committee at former meeting.

Examination of F. R. Hassler.

1. Question by Mr. Mallory. Have you deviated in any way from the original plan adopted in 1807?

Answer. Not in the least.

2. Question by same. Is not the work now conducted on a more extended plan than was originally intended, and does it not embrace objects not originally contemplated by the Government?

Answer. Not in the least.

3. Question by same. Is it intended that the present coast survey shall furnish the necessary data for the measurement of an arc of the meridian or a parallel of latitude?

Answer. No.

4. Question by same. Is there any necessary connexion between such measurement and a hydrographic survey of the coast?

Answer. No.

5. Question by same. Could an arc of the meridian or parallel of latitude be measured with more facility, expedition, and economy, if disconnected from all other objects?

Answer. Yes.

6. Question by Mr. Aycrigg. You refer in your report (Doc. No. 28) to a number of volumes in which the work is contained; is the work in those volumes reduced?

Answer. They are reduced.

7. Question by Mr. Mallory. Where are these papers kept?

Answer. In my office.

8. Question by same. Are they safe from fire?

Answer. Yes.

9. Question by same. Are there any duplicates of these papers?

Answer. Some; of the greater part.

10. Question by same. Of what papers are there duplicates?

Answer. Of all, except the last year's work.

11. Question by Mr. Aycrigg. Is the Government in possession of any of the data, or are they in your possession?

Answer. They are in the office—a house rented by the Treasury Department—and under the care of persons in the employment of Government.

12. Question by Mr. Mallory. Whom do you mean when you say "persons in the employment of Government?"

Answer. Myself and my assistants.

13. Question by same. Suppose the house should be burnt, and papers destroyed, would not Government sustain great loss?

Answer. Yes; but I conceive the house completely safe, proper measures being taken to guard against fire. The houses have been slated with this view.

14. Question by same. Have any other maps or charts been published, besides those of New Haven, Newark, and Bridgeport?

Answer. No other.

The hour of 12 having arrived, the committee adjourned to meet on this day week.

THURSDAY, *March* 24, 1842.

Examination of Mr. Hassler continued.

At subsequent meeting of the committee, the following questions were propounded to Mr. Hassler by various members of the committee, whose answers were as stated:

1. Question. Have any maps been prepared and completed, so as to be ready for publication, other than the three published; and if so, what?

Answer. Yes: 1. A complete map of New York harbor is engraving. 2 A partial map of the entrance of New York has been prepared and delivered to the Auditor for the light-house bureau. 3. One of the Thames river, in Connecticut, nearly ready for delivery, on order of the Secretary. 4. One for the Topographical bureau, for the site of fortifications of the entrance of New York harbor, at Sandy Hook. 5. One of the north shore of Long Island sound, at New London, called for by the Secretary of the Treasury. The four last named were prepared for the offices.

2. Question. Is either of the eight maps above named so far correct and complete in itself as to be of any utility in and for the localities to which it applies?

Answer. To be sure; each is complete, and of use in itself.

3. Question. Are these all on the same scale, or otherwise?

Answer. They are not all on the same scale, but some larger and some smaller, according to the purpose for which they were respectively intended.

4. Question. Is there any objection to the publication of definite and successive parts of the work as they may be completed, as the map of New York now in the engraver's hands?

Answer. No, not in the least, so soon as the engraving is finished.

5. Question. Is it necessary to complete the survey of Delaware bay before it can be practicable to publish a chart of Long Island sound?

Answer. No.

6. Question. Is there any objection to the publication of the work connected with the maps as they are published?

Answer. No; it is proper to publish the data on which the chart is constructed, in order to verify its correctness, and as a guide for the use of it.

7. Question. Has the work of mensuration and triangulation connected with the maps of Bridgeport, New Haven, and Newark, been published with them?

Answer. No.

8. Question. Has any part of the mensuration of the survey, and of the other scientific elements of the work, been published?

Answer. No.

9. Question. Has any systematically full part of the work between two base lines and two astronomical stations been completed as yet?

Answer. No; the locality of the coast hitherto surveyed has not permitted it.

10. Question. Where is your furthest eastwardly astronomical station on the coast?

Answer. Mount Carmel, near New Haven.

11. Question. Where is your next astronomical station, proceeding southwestwardly?

Answer. Tashua, near Bridgeport.

12. Question. Where your next?

Answer. West Hill, on Long Island.

13. Question. Where the next?

Answer. Buttermilk Hill, near Tarrytown, New York.

14. Question. Any other?

Answer. Yes; Weasel Mount, near Paterson, New Jersey, and none southwest of that.

15. Question. How many base lines have been measured in the survey?

Answer. Two in 1817 and one in 1834.

16. Question. Between what points is the base line measured in 1834?

Answer. On the beach at Fire Island light-house, Long Island; and the line measured is eight and three-quarters miles in length, running eastwardly from the light-house.

17. Question. Where are the base lines of 1817?

Answer. One in English Neighborhood, New Jersey, and the other at Gravesend beach, Long Island.

18. Question. Has any use been made of the two last-named base lines in the work of the survey?

Answer. Yes; for the beginning, in 1833.

19. Question. What objection is there to publishing the details and mathematical elements of the work, as completed, from Point Judith to New York harbor?

Answer. The main triangulation has not been completed so far as Point Judith, but only the secondary. The main triangulation has been completed only between Friar's Head, opposite New Haven, and Mount Carmel, in Connecticut, eastwardly, and Mount Holly, New Jersey, and Yards, (Newton township, near Philadelphia,) southwestwardly. The secondary triangulation has been completed from Point Judith to Cape Henlopen, on the coast, and from New York across to the head of the Chesapeake.

20. Question. What reason is there for concealing from the public the elements of the work between Friar's Head and Mount Holly?

Answer. None.

21. Question. Has it been published?

Answer. No; it is not proper.

22. Question. Why is it not proper?

Answer. Because it will introduce imitations of the work, to the detriment of its validity.

23. Question. Imitations by whom?

Answer. By common chart sellers, or others.

24. Question. How is the survey injured by individuals publishing charts copied from those of the survey?

Answer. Because the maps would not be official.

25. Question. Would not the publication of the data with the maps enable scientific men to judge of the accuracy of the work?

Answer. Of course.

26. Question. Would not the withholding of the data until the completion of the survey enable the operator to force results?

Answer. No; in the manner in which the work is carried on it cannot be.

27. Question. Can scientific men judge of the accuracy of the work unless the mathematical elements of it be published?

Answer. No.

28. Question. Have the mathematical elements of the charts of Bridgeport, New Haven, and Newark, been published?

Answer. No; that will come into the general account.

29. Question. When do you propose to publish such a general account?

Answer. So soon as I shall have reached the verification base on the Chesapeake.

30. Question. When do you expect to reach that point?

Answer. In a few years.

31. Question. When do you expect to complete the Delaware?

Answer. If I can get out in season, by the end of this year.

32. Question. What prevents your getting out in season?

Answer. The want of money, nearly all the appropriation having been expended.

33. Question. Does the work on the weights and measures occupy any of your time, which might be appropriated to the survey?

Answer. No. It does not take any of my time.

34. Question. How much of your time is devoted personally to the coast survey?

Answer. All the time, except the inspection and reporting on the weights and measures.

35. Question. How much time does it take to inspect and report upon the weights and measures?

Answer. About half an hour in the morning and half an hour in the afternoon of the day, but not of each day. This is only while I am in the office. I am generally in the field from the middle of May to that of December; sometimes I am in the field to the end of December.

36. Question. At what time in the spring do the different corps start on their duties?

Answer. Generally in April, remaining until the middle or end of November.

37. Question. Did you lose part of a year last year; and if so, why?

Answer. I lost the most of last year's work, in order to answer the resolution of the House of Representatives on the coast survey of June 24, 1841, and by the fever which seized me in October.

38. Question. At what time did you take the field last year, and how much of your time did the resolution occupy?

Answer. I did not take the field until the middle of September. The resolution occupied me three or four weeks. I was also detained to make a report on weights and measures.

39. Question. Is the work in the office now in such a state of forward-

ness as not to interfere with the commencement of the field work this year, so soon as the season will permit the work to go on?

Answer. Not in the least.

40. Question. Why is not the main triangulation up with the secondary?

Answer. On account of the difficulty of finding suitable elevations on both sides of the Delaware.

41. Question. Who conducts the main triangulation?

Answer. I myself, according to positive stipulation.

42. Question. Why is not the main triangulation carried as far eastward as the secondary?

Answer. Because it was not needed.

43. Question. When will it be needed?

Answer. So soon as the junction is made with the base line on the Chesapeake.

44. Question. When that junction is made, do you propose to suspend the work south, and go back east, or to have two parties?

Answer. When the junction is made, while the secondary triangulation goes on south, I shall continue the primary triangulation east.

45. Question. Cannot the main triangulation be carried on except under your immediate personal supervision?

Answer. Not in the present state of things.

46. Question. Why not?

Answer. Because there is no body to do it, and the circumstances are contrary.

47. Question. Is there nobody else attached to the survey who can do it?

Answer. Not now.

48. Question. What are the contrary circumstances spoken of?

Answer. Want of money; that is, of a larger appropriation.

49. Question. Must the main triangulation be suspended eastward until you can take it up personally?

Answer. In the present state of things, yes.

50. Question. In what portion of the field work have you been personally employed the last year?

Answer. At Yards, behind Philadelphia.

51. Question. Where the year before?

Answer. Willow Grove and Mount Holly.

52. Question. Where do you propose to employ yourself on the field work the present year?

Answer. South of Yards and of Mount Holly, on both sides of the Delaware.

53. Question. What is the precise duty or part of the work performed by you at Yards and at Mount Holly?

Answer. Measuring the angles of the main triangulation.

54. Question. How many assistants were there in the party in which you operated last year?

Answer. None. I did the work alone; that is, I did the mathematical work alone.

55. Question. Is there any person in the coast survey competent to take charge of and continue the work, if you should cease to do it?

Answer. Not as yet.

56. Question. Do you mean to be understood that without your personal

superintendence the work would cease, and that no man can take it up, continue, and complete it?

Answer. Not honorably.

57. Question. Is there any profound secret in the mensuration of triangles and the making of astronomical observations, known to you alone of all mankind?

Answer. Science is a public thing, but it requires study to be perfect in it.

58. Question. Is there any person in the survey who is pursuing such a line of observation and study as to be in the way of learning to measure triangles and take observations, hereafter, in your stead?

Answer. I give them all instruction which they will accept.

59. Question. Does no one in the survey but you measure triangles or take observations?

Answer. Every one of the principal assistants take the secondary triangles.

60. Question. What difference is there in the mathematical elements of primary and of secondary triangles?

Answer. The larger triangles require more attention to the figure of the earth and to the mathematical elements arising from it.

61. Question. Does geodesy apply to the main triangulation and not to the secondary?

Answer. More especially, but not exclusively.

62. Question. How long will it take to finish the work along the whole coast of the United States, going on at the rate of time and appropriation heretofore used?

Answer. That nobody can say, in either one way or another.

63. Question. What is the whole extent of the general coast, from Passamaquoddy to the Sabine, not including rivers?

Answer. I cannot tell.

64. Question. What proportion of the entire coast of the United States has thus far been surveyed?

Answer. I cannot say.

65. Question. You have said that the latitude and longitude of Cape Hatteras was erroneous in the charts. How did you ascertain it?

Answer. By having attempted to make a union of the Northern and Southern maps, which join at that place, in 1828.

66. Question. How long before the survey will reach Cape Hatteras?

Answer. It is impossible to say—it is too vague a guess.

67. Question. Have you any personal knowledge of the location of the Southern coast?

Answer. I have never been any further south than Norfolk.

68. Question. You have said that it was difficult to find suitable elevation on both sides of the Delaware, which cause prevented the main triangulation from keeping up with the secondary, (No. 40:) how do you propose to obviate similar difficulties on the flat coast of the South?

Answer. By care and assiduity, and by the methods used on the Jersey sea coast.

69. Question. Is that work on the Jersey sea coast a primary or a secondary triangulation?

Answer. It is secondary triangulation.

70. Question. What is the peculiarity of the methods used on the Jersey sea coast, where there is a deficiency of natural elevations?

Answer. By adapting the triangulation to any locality which may be found favorable.

71. Question. You do not specify any of the means you propose to recur to at the South, in the absence of natural elevations. Do you decline to state what they are?

Answer. No.

72. Question. What are they, then?

Answer. By mixed astronomical and geodetical observations.

73. Question. Why were not such means used to overcome the impediments to the completion of the main triangulation on the Delaware?

Answer. Because they would not apply with propriety. There are better means.

74. Question. What are those better means?

Answer. By meeting those localities by triangulation from the south side of the locality.

75. Question. You say that the peculiar methods by which you propose to overcome the difficulties on the Southern coast are mixed astronomical and geodetical observations; are not such the general means used every where in the survey?

Answer. The means of both are different in the two cases.

76. Question. What is the object of the second base line?

Answer. The verification of the whole work, which is in the system of all such works.

77. Question. If the object be to verify the survey, and suppose it does not agree, what is the consequence?

Answer. That the error, if any, is to be investigated.

78. Question. It is stated in one of your reports that the survey extends over 11,000 square miles; is that mapped?

Answer. Yes, to be sure.

79. Question. What benefit results to navigation by having all the details of the topography of the country?

Answer. There is no more topography in the maps than what is necessary for that object.

80. Question. Cannot a portion of the topography be dispensed with without detriment to the object of a knowledge of the coast for navigation?

Answer. Not to that extent to which it is carried now. I could not dispense with any of the topography as it is now done.

81. Question. Do not the hydrographical parties have to wait for those engaged on the topography?

Answer. They cannot go six inches without it, but they do not wait; the topographical part has always been ahead.

82. Question. What distance from the coast have they carried the soundings?

Answer. Until they were out of sight of land; I mean the points given to them as guides. Those points are made to be seen as far as possible. We elevate signals thirty feet, or more.

The committee wish you to state the time each year, since the recommencement of the work in 1832, at which you have taken the field, and also the time each party has commenced its work; also, the whole number of months occupied by yourself in making the main triangulation.

83. Question. You have sounded from Point Judith to Egg Harbor, along the coast; have those soundings been extended as far out as you intend?

Answer. They are complete for the detailed maps, but they have not been carried out so far as I intend.

84. Question. How much further do you intend to carry the soundings?

Answer. To the Gulf stream.

85. Question. What will be the probable time required to extend the soundings, with the same force now employed, so far as you intend?

Answer. As this kind of work is to be done by astronomical observations, it depends entirely on the weather.

86. Question. Where are these astronomical observations to be made?

Answer. Of course, on board the ship or sounding vessel, according to special instructions given to Lieutenant Gedney, in writing, last summer.

87. Question by Mr. Wise. For the present, is it necessary, in order to carry the survey south, to extend the soundings to the Gulf stream? And, ultimately, will the survey of the coast not be complete without extending the soundings to the Gulf stream?

Answer. No, to the first clause of the question. As to the second clause, I answer, that the survey is, in that respect, ad libitum.

88. Question by Mr. Wise. By your answer to the second clause, am I to understand you as saying that the Government may carry the survey as far out into the ocean as it chooses, but that the survey, as far as it goes, wherever it stops, will be complete?

Answer. Yes.

89. Question by Mr. Mallory. Do you propose this or the next year to carry on these deep soundings, by employing any of your present force?

Answer. Whenever any fit vessel is disposable, without otherwise impeding the work.

90. Question by Mr. Mallory. Is it probable that any such vessel will be disposable for that purpose during this or the next year?

Answer. It is likely, but it depends on the weather.

91. Question. Of how many points in the United States have the latitude and longitude been ascertained and verified in the course of the survey?

Answer. The calculation of the triangles in my work gives, in ultimate result, the latitude and longitude of each point of the triangle, primary and secondary, according to my special form of the work.

92. Question. Of the points of latitude and longitude thus determined, how many have been made public?

Answer. None; because it is not yet the proper time.

93. Question. Have you determined the latitude and longitude of any points on the coast; and if any, how many and what?

Answer. I have ascertained the latitude and longitude of points on the coast as well as inland, according as the triangle fell.

94. Question. Why have not these important points on the coast, thus determined, been made public?

Answer. The time of the publication is when the general account of triangulation is given, before which it will be of no use.

95. Question. Did the French, in the triangulation of their country, use mixed geodetical and astronomical observations?

Answer. Not in the form in which I have stated in the first part of my written explanation.

96. Question. Do you regard the survey as a great scientific enterprise,

embracing delicate problems of geodetic research, beyond what is necessary to an accurate but rapid survey of the coast for nautical purposes?

Answer. There is not a single movement in all I do which is not necessary for the honorable and faithful execution of the work.

97. Question. Is it intended as the basis of a topographical, military, and statistical survey of the whole United States?

Answer. That is the Government's business, and not mine.

98. Question. Is the survey conducted now with a view to any such ultimate purposes?

Answer. That is not given in any charges by the Government; therefore I do nothing with it.

99. Question. Was not the secondary triangulation along the Jersey shore found to be sufficiently accurate?

Answer. Yes.

100. Question. Was not the main triangulation through New Jersey made with a view to the topographical survey of that State?

Answer. No.

101. Question. Cannot the survey of the bays and rivers be postponed, without injury to the general work, till the survey of the coast proper is completed?

Answer. It is impossible, because no accuracy could be got for the coast.

102. Question. How many plates are now in the hands of the engraver?

Answer. Of actual copperplates, two.

103. Question. Do these contain the whole map you are now getting ready for publication?

Answer. No; the map of New York harbor will cover eight such plates.

104. Question. Why are not more preparing for publication?

Answer. They are in work; in a few days we can cut off a few more.

105. Question. How many engravers have you in employ?

Answer. Two; I would have more if I had the money.

106. Question. How long have these two been employed, and at what salary?

Answer. Since last January or December; one at $1,800, and the other at $1,300, per annum.

107. Question. Where did you procure the copper for the above engraving, and where the engravers?

Answer. The copperplates used were procured from Keim, in Philadelphia; the engravers from Hamburg, because they were the best, and best recommended.

108. Question. Cannot American engravers put on copper all map engraving which can be put on paper?

Answer. No.

109. Question. What is the ordinary amount of error in transferring from paper to copper?

Answer. In the way in which I do it there shall be none.

110. Question. Have the grossest errors in the position of places, stated in one of your reports to have been ascertained by you during the survey, been pointed out by you, for public information?

Answer. They have not yet been made public, but will be when the works relating to those places are published.

111. Question. Are the measures in the survey taken in French metres? If so, why?

Answer. Yes, because it is the only absolute standard; but the results are given in yards and metres both.

112. Question. In what parts of yards?

Answer. In decimal parts only.

113. Question. What reason is there why all the *data* must remain in your office?

Answer. Because they are in daily use there.

114. Question. Have you any reason to believe that the surveys made by Captains Gedney, Wilkes, and Glynn, are not sufficiently accurate for the purposes of navigation?

Answer. I know nothing in regard to them.

115. Question. Did the British officers survey the North sea after the same manner that you are now surveying the coast of the United States?

Answer. I am entirely unacquainted with what they did; there is nothing of it published.

116. Question. You stated in your printed report that you had accomplished more in a shorter time, and at less expense, than had been done in any other work of a similar kind; with what works do you make this comparison?

Answer. The English general survey of England, Ireland, and Scotland; the French survey of the inland and coast of France.

117. Question. How many hours per day do your subordinate parties work in the field, in favorable weather?

Answer. As many as possible.

118. Question. Are there any data to ascertain how many hours?

Answer. They keep an account, and will answer as to this.

119. Question. Does this survey employ the whole extent of your mathematical knowledge?

Answer. No.

120. Question. Do you think that, under the most favorable circumstances, and with continuance of a yearly appropriation of $100,000, the survey of the coast can be completed in twenty years?

Answer. Perhaps. The progress is slower at first, and the means increase as the work proceeds.

Questions by the committee. At what time has Mr. Hassler taken the field each year, since 1832? At what time each party? How many months in all has Mr. Hassler been employed in the main triangulation?

Times of going to the field work, and returning from it, each year.

In 1832.

September 25. Having received the instruments, I left Washington the 26th September, at 8 o'clock, A. M., to reconnoitre for the continuance of my works of 1817, towards the east of it; returned to Washington the 31st January, 1833, in the evening.

1833.

April 5th. Left Washington for the first beginning of actual primary triangulation; returned to Washington the 3d January, 1834, in the evening.

1834.

After having finished all the preparations and comparisons for the measurement of the base line, I left the 29th May, at 9 o'clock, A. M., having made also stations; returned 21st January, 1835, in the evening.

1835.

There being much calculation to be made, and many arrangements for the organization of the parties, the State of Maryland having offered an arrangement, to join the survey of that State with that of the coast survey, I went out only at different intervals, to reconnoitre the country in Maryland, and until Washington, and the outer bays, accompanied by Mr. J. H. Alexander, of Baltimore, until late in the fall and winter.

1836.

The present office was established. I left 17th August, and returned the 8th January, 1837.

1837.

I left Washington 4th June, and returned 5th January, 1838.

1838.

I left Washington July 19th, and returned 24th December, 1838.

1839.

I left Washington the 9th June, and returned the 5th January, 1840.

1840.

I left Washington the 17th September, 1840, and arrived again at Washington the 20th January, 1841.

1841.

I left Washington 29th August, 1841, and returned 22d December, 1841.

This enumeration shows how the office work has increased since the beginning, when the elements for it were first to be collected in the field. In the progressed state of the work, the calculations, making of projections, to take to the field for the topographic and hydrographic works, their plotting, and working out, &c., require as much, and in most cases even more, work in the office than out of doors, so that indeed the going out for the field work is considered a real relief from the harder and tedious works of the office.

For the time of the going out or returning of the assistants, for their part of the work, they must be called up themselves individually; it is easily comprehended that they depend entirely on the favorable or unfavorable season for the going out as well as for the return.

F. R. HASSLER.

WASHINGTON CITY, *March* 30, 1842.

APRIL 15, 1842.

Present: Mr. Cushing, Mr. Aycrigg.

James Ferguson examined.

1. Question How long have you been employed in the coast survey? Answer. Since 10th May, 1833.

2. Question. In what capacity?

Answer. As a principal assistant; one of the three principal assistants.

3. Question. What particular part of the duty do you at present perform?

Answer. Making the secondary triangulation.

4. Question. Who makes the primary?

Answer. Mr. Hassler.

5. Question. Is there any essential difference in the scientific principles of the primary and the secondary triangulation; and if so, what?

Answer. The primary requires an instrument of great power, and of nicer graduation; there is no other difference. There is no difference in the mathematical elements.

6. Question. Cannot any scientific person, who is competent in and well practised in the secondary triangulation, perform the primary?

Answer. The primary requires more mathematical knowledge than the secondary, and greater knowledge of practical means; but to the whole question, I answer, yes.

7. Question. If Mr. Hassler should die, must the survey stop, for want of any person in the survey, or in the country, to take it up and carry it on?

Answer. No.

8. Question. Which has proceeded furthest in advance, the primary or the secondary triangulation?

Answer. The secondary. I add, that the secondary is necessarily imperfect, inasmuch as it depends on the primary for its verification.

9. Question. If the primary had preceded the secondary, might not the latter have been verified as it proceeded?

Answer. Certainly.

10. Question. Why has the primary been allowed to remain in arrears of the secondary triangulation?

Answer. I cannot say.

11. Question. Is not the secondary triangulation sufficiently accurate for all practical purposes in the publication of a map of the work so far as it has gone?

Answer. Yes; for all practical purposes.

12. Question. From what point to what point on the coast have the secondary triangulation and the hydrographical survey been completed?

Answer. The secondary triangulation has been completed from Point Judith, including the sound and both sides of Long Island, to Cape May, covering both shores of New Jersey, and including the whole of the Delaware on both sides; and it also crosses the peninsula to the Chesapeake, where it is now in progress, but not yet completed. I refer to the officers engaged in the hydrographical work for answer as to that part of the question.

13. Question. Do you expect that any perceptible error in the secondary triangulation will be detected by the further progress of the primary?

Answer. I should think the maximum error would not exceed five feet in the whole distance. This I infer from the work already verified, where the error proved to be no greater than this. I refer in this to my own work; but the other may be, for aught I know, more accurate still.

14. Question. Did you use the main triangulation as the basis of your work (the secondary triangulation) when you commenced?

Answer. Yes.

15. Question. Do you not in fact proceed in the secondary triangulation at present in the same manner as in the primary?

Answer. The only difference is the difference of the instruments.

16. Question. You have exhibited to the committee abstracts of the whole work on the coast, from Point Judith to Cape May; what objection is there to the publication of those abstracts?

Answer. The first objection is, that no base of verification has yet been measured; the second is, that we are uncertain as to the difference in any meridian in this country and any in Europe, to a minute and a half in longitude; and the third is, that we have not yet determined the ellipticity of the earth.

17. Question. Is either of those things necessary to give practical utility to the soundings and distances in particular bays or harbors?

Answer. Perhaps not; but the superintendent will of course take care of his character as a man of science.

18. Question. In your opinion, ought the practical use of the work, by its publication, to mariners, to be deferred indefinitely, for the supposed purpose of allowing the superintendent to take care of his character as a man of science?

Answer. No.

19. Question. Has the character of the superintendent as a man of science suffered by the publication of the charts of New Haven and Bridgeport, and Newark bay?

Answer. No.

20. Question. If not, what injury would it do to his character as a man of science to publish a chart of New York harbor?

Answer. None; such a map is now in the engraver's hands, for publication.

21. Question. What injury, by the publication of charts of the whole coast, from Point Judith to the Delaware?

Answer. If it were practicable, none.

22. Question. Do you furnish the points of observation to the sounding parties yourselves?

Answer. They are ascertained by us, reported to Mr. Hassler, and by him furnished to the sounding parties.

23. Question. Do you reduce your own observations?

Answer. Yes, certainly.

24. Question. Have you been engaged in Maryland in 1835?

Answer. No; I came in Maryland in 1839.

25. Question. Was any body else engaged in Maryland in 1835?

Answer. Only Mr. Hassler, with Mr. James H. Alexander, as a mere reconnoissance.

26. Question. Has there been any difficulty in procuring suitable points for observation as far as the main triangulation has proceeded?

Answer. Yes; since we entered the valley of the Delaware.

27. Question. Where first?

Answer. At Mount Rose, near Princeton, in New Jersey; some in opening the line from Newtown; then at Willow Grove and at Stony Hill; some difficulty in connecting Mount Holly with the point below; a good deal at Yards. These obstructions could not have occupied more than five months.

28. Question. When is it you propose to measure a base of verification?

Answer. It is spoken of for this year.

29. Question. Why has it not been done sooner?

Answer. The work has not been sufficiently advanced. It has been thought desirable to obtain such a line on the Chesapeake.

30. Question. What is the present condition of the place of the original base line?

Answer. I have not been there since 1836. Then the beach was considerably washed, but the points were undisturbed. Now, I understand, the beach is changed, and the base in danger; but the elements of it will be preserved by the mountain base, inland from the original base.

31. Question. Will a minute and a half's difference between the European and American meridians show on ordinary maps?

Answer. Yes; it would be about a mile.

32. Question. Why has not this difference, in the course of the ten years since the resumption of the survey, been ascertained?

Answer. I cannot answer that. We have observed eclipses of the sun. We have made no other observations for the longitude.

33. Question. Have the observations thus made been reduced?

Answer. Yes, and calculated. I add, that, if we had considered it a sine qua non to determine the longitude, the time occupied in this way might have retarded the other work.

34. Question. But you have previously said that the want of the determination of this fact was one of the objections to publishing any part of the work.

Answer. I said it was an objection, but I did not mean to be understood as saying that it was an insuperable objection.

35. Question. Is the absence of a base of verification any insuperable objection to the publication of the work along Long Island sound?

Answer. I think not. I say no.

36. Question. Is the survey engaged now in measuring an arc of a great circle of the earth, with a view to ascertain its ellipticity?

Answer. That will be one result of the survey, and a very important one, in a scientific point of view.

37. Question. When will that result be reached?

Answer. It should await the measurement of the base of verification.

38. Question. Is it necessary to have measured such an arc, and verified the ellipticity of the earth, before it is possible to publish a map, for practical purposes of navigation, of Long Island sound?

Answer. I think not.

39. Question. Where are the results of the work, so far as completed, now kept?

Answer. In the depot of the survey, at Washington.

40. Question. Are they in duplicate?

Answer. Some; not all. The primary triangulation is all in duplicate. Of the secondary, mine is not. As to the rest, I do not know.

41. Question. Of that which is in duplicate, are both parts kept at the depot?

Answer. Yes.

42. Question. Several of the public buildings at Washington have from time to time been destroyed by fire; is the depot a fire-proof building?

Answer. No; it is not.

43. Question. If the results and other matters in the depot should be destroyed by fire, must not the work be done over again?

Answer. Yes. Precautions have been taken to enable the speedy removal of the papers, if the building take fire, by their being in cases on the ground floor.

44. Question. Of the work in duplicate, why is not one copy deposited for safe keeping in the Treasury Department?

Answer. I do not know.

45. Question. Is all the work in such a state that, if Mr. Hassler should die suddenly, it may be used, and reduced or calculated immediately by others?

Answer. Yes.

FRIDAY EVENING, *April* 15.

Examination of Mr. Ferguson continued.

Present: Mr. Cushing and Mr. Aycrigg.

[NOTE.—To make the evidence more distinct, from question No. 46 to question No. 74, it must be observed, that the statement after No. 74, (marked A,) the statement marked "to be annexed to Mr. Ferguson's evidence," and the statement marked "to be annexed to Mr. Ferguson's testimony," together with the chart of Newark bay, referred to in question No. 48, were presented at the beginning of this meeting; the statements having been previously prepared, in writing, by Mr. Ferguson, in answer to questions put to him by the committee at the previous meeting.]

46. Question. Is there any substantial and adequate reason why the mathematical elements of the work should not be published as parts of it are completed?

Answer. No other but that it will require time to put them in order.

47. Question. At what time in each season do you take the field?

Answer. This is stated in the schedule annexed, and marked A.

48. Question. There is shown by you a published chart of Newark bay, purporting to be an extract from the United States coast survey; is there any meridian on the map? (Annexed, and marked B.)

Answer. No.

49. Question. Is the latitude or longitude of any part of it given?

Answer. No.

50. Question. What is the length of Newark bay, as stated in this map, from Shuter's island to the confluence of the Passaic and Hackensack rivers?

Answer. It is, by the scale of the map, five miles and eighty-two-hundredths. But the scale is an erroneous one, and was not published or verified by the superintendent. The actual distance between the two points specified is five miles and six hundred and twenty-three thousandths, obtained by me by measuring on the original topographical map.

51. Question. Please to inspect the map of Newark bay, which is now shown to you, marked C.

Answer. It appears to be the same map, engraved from the same plate as B; but the scale is different, and is at the same time erroneous. It seems to be written $\frac{1}{20000}$ instead of $\frac{1}{10000}$, or erroneous in the proportion of 2 to 1, or about that.

52. Question. If the chart of New York, or any part of the coast, be

published, do you apprehend any dangerous error would be introduced by map sellers?

Answer. If published without care, there would, undoubtedly.

53. Question. Is it considered judicious to suppress the results of the survey, through fear that, if published, map sellers may make errors in copying the maps for sale?

Answer. No.

54. Question. Is the survey of any practical use, unless published?

Answer. Yes; in the experience acquired by the officers of the navy and others engaged on the survey. I am not aware of any other.

55. Question. Do you understand the proper uses of the survey to be confined to the instruction thus acquired by the officers engaged in it?

Answer. No; the uses are a knowledge of the coast for commerce and navigation, and a communication of it by a publication of the maps.

56. Question. Can the survey be of any practical use to the country at large, without the publication of charts and maps?

Answer. Certainly not.

57. Question. Where are the instruments used by you repaired?

Answer. At different places, but generally at the office of the survey here.

58. Question. Have you had any difficulty in procuring repairs at other places?

Answer. I have scarcely ever had occasion for repairs; I should think not exceeding five dollars in amount since 1833, when I entered the survey. All my instruments are of European manufacture. They are good instruments.

59. Question. What necessity is there of plane-table parties, except near the coast?

Answer. No absolute necessity, except for the secondary triangulation near the coast.

60. Question. How far in from the coast have plane-table parties gone on the survey?

Answer. I cannot say precisely. They are carried on by Mr. Gerdes, Mr. Sands, Mr. Boyd, Mr. Dickens, and Mr. Werner.

61. Question. Do the plane-table parties require much science?

Answer. They require practical skill.

62. Question. When a secondary triangulation precedes the primary, is it not a second without a first?

Answer. Technically, it is.

63. Question. Is it not working wrong end foremost for a secondary to precede a primary triangulation?

Answer. I think not, because the secondary loses none of its accuracy by the primary following it.

64. Question. Can you ascertain what the errors of the secondary are until you have the primary?

Answer. No.

65. Question. How are your distances measured?

Answer. In French metres. It is not the standard of the country, but it is the standard best authenticated, and best known in geodetic operations. Our standard is the English yard. The foot is the most common measure used in this country, both for scientific and practical purposes.

66. Question. Is the metre in common use in this country in any way?

Answer. No.

67. Question. Is it not as easy to convert yard measure into metres as metre measure into yards?

Answer. It is the same thing.

68. Question. In that case, what benefit is there in having the work of the survey in metres?

Answer. None but what I have given before.

69. Question. What is the standard used in the English survey?

Answer. Either the English yard or foot.

70. Question. What is the object of the proposed second base line?

Answer. To verify the work.

71. Question. Cannot the work proceed north and south at the same time?

Answer. Not at present, without a larger appropriation and more persons; at least, that is my opinion.

72. Question. Have you a general knowledge of the configuration of the coast?

Answer. Yes, to Cape Henry.

73. Question. On what part of the coast, north or south, can the work be carried on most easily?

Answer. At the north, by reason of the nature of the coast.

74. Question. Of how many points on the coast has the survey ascertained the latitude and longitude?

Answer. I should think my own points were five hundred; and, altogether, a thousand.

A.

Year.	Time of taking field.	Time of going home.
1833	May 10	December 28.
1834	February 20	December 3.
1835	April 6	January 10, 1836.
1836	May 1	December 9.
1837	April 25	November 25.
1838	May 20	November 19.
1839	April 15	November 29.
1840*	June 16	December 22.
1841	February 15	December 12.

It must be understood that these dates are given from recollection, and can only be relied on as accurate within a day or two.

*This year I was detained longer from field work, to calculate triangles necessary for the map of New York.

Number of stations made in each year.

In 1833	24
In 1834	64
In 1835	26
In 1836	28
In 1837	13
In 1838	10
In 1839	15
In 1840	16
In 1841	7
	203

[To be annexed to Mr. Ferguson's evidence.]

To the question of the committee, "What is the distance between Shuter's island and the point at the confluence of the Passaic and Hackensack rivers, and what the mean width of the bay of Newark?" Mr. Ferguson answers:

That the distance between the above points is 5.623 statute miles, and the mean width of the bay of Newark 1.37 mile.

That on a map of the said bay, printed at the request of the collector of Newark, the distance between Shuter's island and the point between the Hackensack and Passaic is 5.82 statute miles; but that this map has an erroneous scale attached to it, and was not published or verified by the superintendent of the survey. The map appears conformable to the original of the survey, but the scale given for it is incorrect.

To the question of the committee, "How many points were determined in 1833 in the main triangulation, and what distance were they apart; what extent of country did they cover; what number in 1834, 1835, 1836, 1837, 1838, 1839, 1840, and 1841; and what extent of country do they cover?" Mr. Ferguson answers:

That the part of the question *as to the distances "apart"* is answered by giving, in the following schedule, the length of the longest and shortest lines of the survey each year; that it is difficult to divide the works of successive years from each other; and that the computations are given in gross in square statute miles, presuming that the committee merely wished an approximate and comparable estimate.

In 1833, length of longest line, miles	41.3	Square miles covered, 1,350
length of shortest line, miles	7.2	
In 1834, 1835, and 1836, though other stations were occupied, the primary triangulation did not cover any additional space.		
In 1837, length of longest line, miles	20.69	Square miles, 318
length of shortest line, miles	8.73	
In 1838, length of longest line, miles	38.41	Square miles, 300
length of shortest line, miles	23.29	
In 1839, length of longest line, miles	31.00	Square miles, 1,070
length of shortest line, miles	10.93	
In 1840, length of longest line, miles	18.51	Square miles, 209
length of shortest line, miles	12.30	

In 1841, length of longest line, miles - 31.02 length of shortest line, miles - 17.07	Square miles,	330
Square miles covered by whole primary triangulation -		3,577

It is but fair, and perhaps also necessary, to state to the committee that the effect of the primary triangulation, in the progress of the survey, is not properly estimated by the number of square miles within the polygon which it makes, but by the quantity of secondary triangulation for which it afforded the bases. In this view of the subject, the number of square miles covered in each year would be much increased.

[To be annexed to Mr. Ferguson's testimony.]

1833—Buttermilk.
Round.
Bald.
Tashua.
Mount Carmel.
Ruland.
West Hills.
1834—Base measured.
1835—Reconnoissance in Maryland.
1836—West Hills.
1837—Ruland.
East base.
West base.
Harrow.
1838—Weasel.
Springfield.
1839—Beacon Hill.
Disborough.
Stony Hill.
Mount Rose.
Newtown.
Willow Grove.
1840—Willow Grove.*
Mount Holly.
1841—Yard.

NEWARK, *April* 18, 1842.

DEAR SIR: Your letter of the 16th I received this morning. I am not in possession of any map of Newark bay furnished from the coast survey. A short time after that survey was completed, I addressed the Secretary of the Treasury, requesting such a copy, for reasons then mentioned; he referred my letter to Mr. Hassler, who replied, that the coast survey being a public work and property, such extracts should not be given except upon call of Congress; and such work being under his charge and responsibility, he should be called upon by the proper Department, &c. I very much regretted that it could not be furnished, as our vessels were subject to repeated accidents and delays, by reason of the shoals, which could have been avoided by such information. I presume that Mr. H. would be willing to facilitate any mode you may take to procure such extract, as he expressed himself to me.

I am, dear sir, very respectfully, your obedient servant,

ARCHER GIFFORD.

Hon. JOHN. B. AYCRIGG.

* The station of Willow Grove was occupied both in 1839 and 1840.

FRIDAY EVENING, *April* 15, 1842.

Present: Mr. Cushing, Mr. Aycrigg.

Examination of Mr. Blunt.

1. Question. Do you know any sufficient reason why maps and other results of the survey should be withheld from the public knowledge?

Answer. None, when they are in sufficiently complete state to be useful to navigators.

2. Question. Is any part of the survey sufficiently complete for that now?

Answer. Yes.

3. Question. How much?

Answer. New York harbor is being reduced for the engravers. Long Island sound is capable of being reduced from Point Judith to New York. The outer coast is already complete, so far as expressed, from Montauk point to Great Egg Harbor, I believe, with exception of off-shore soundings.

4. Question. How far inland from the coast has any part of the work been carried?

Answer. I am unable to say, except in regard to the secondary triangulation, which I have in part conducted. I am one of the principal assistants.

5. Question. Are you acquainted with hydrographical surveys in England?

Answer. Yes.

6. Question. Do they publish results as soon as ascertained?

Answer. They are published in sheets so soon as completed, to be useful to navigation.

7. Question. Can copies or information be obtained by individuals?

Answer. Yes; I have known copies to be obtained repeatedly for my brother, who is a chart seller; as from the Thunder and from the Blossom.

8. Question. Does the hydrographical office in England derive any profit from the sale of the charts?

Answer. I think £200 or £300 per annum. The charts are published under the direction of the Admiralty, with the seal of the Admiralty to authenticate them.

9. Question. Have you applied at any time, as an individual, to the hydrographic office?

Answer. Captain Beaufort offered to give me personally any information I desired. This was when I was a private individual, before being connected with the survey.

10. Question. In your opinion, could the work be extended north and south at the same time?

Answer. It might, with more force; and with the present force, if the line of verification were not to be measured. We can proceed more rapidly at the north than at the south with the triangulation.

11. Question. In going south, do you apprehend any difficulty in the hydrographical part of the work, as distinct from the topographical? Cannot the mere coast survey be prosecuted without leaving the coast and going inland?

Answer. No.

12. Question. How do you propose to survey the coast of Virginia?

Answer. By carrying a series of triangles down the Chesapeake bay, and

by extending them up or down the valleys of the rivers, as circumstances will allow.

13. Question. What natural elevations have you in lower Virginia?

Answer. None of any consequence.

14. Question. What do you propose to use as a substitute?

Answer. Artificial elevations and signals.

15. Question. In what way do you propose to triangulate the region of Dismal Swamp, and similar regions of country?

Answer. I have no knowledge in regard to that region.

16. Question. Are we not greatly deficient in knowledge of soundings in Buzzard's bay, Nantucket shoals, Cape Cod, and Massachusetts bay?

Answer. Yes.

17. Question. Is not a knowledge of those soundings of the greatest importance to navigation?

Answer. Yes; it is more wanted there than any where else. More tonnage passes. Most vessels from Europe, for New York and Philadelphia, come between the Gulf stream and Nantucket shoals, in addition to the navigation north of Cape Cod. Most of the coasting trade comes through the Vineyard.

18. Question. What amount of work or repairs have you had done in the office here to instruments?

Answer. Nothing but the mounting of one telescope, which came from Europe without a stand. I have had no difficulty in obtaining repairs elsewhere, if needed.

19. Question. Should you think it necessary to have a mechanician with you in the field?

Answer. To measure the base line it might be desirable; not otherwise.

20. Question. Was any copper imported for the engraving from Vienna?

Answer. Yes.

21. Question. Was it used?

Answer. No.

22. Question. Why not?

Answer. It was not considered suitable.

23. Question. Can good copper for engraving be procured in this country?

Answer. Yes.

24. Question. Have you had any practice as an engraver?

Answer. Yes.

25. Question. Can impressions be taken from a plate in an unfinished state, to show the progress of the work?

Answer. Yes.

26. Question. Can impressions be taken from the plates now engraving in the survey?

Answer. Yes, without injury to them.

27. Question. How long will it take to furnish the eight plates of the harbor of New York, with the present force, at the rate it now goes on?

Answer. I cannot state by conjecture. I should think about three years.

28. Question. Is it not possible to have the work done accurately and more rapidly than at present, if more hands were put on the work?

Answer. Yes.

29. Question. Is it necessary to have a workshop for the repair of instruments at the office?

Answer. I am not able to say. There are some instruments for which it is convenient.

30. Question. In what time could the New York map be finished?

Answer. There might be an engraver for each plate.

31. Question. Of what use are the plane tables, so far as regards navigation?

Answer. I do not consider it of any use to extend the survey any further back than the slope of the hills at the head of navigation.

32. Question. Are the plane tables further back?

Answer. I do not know how far back. I presume they are.

33. Question. What is the signification of the words "primary triangulation?"

Answer. They signify the main series of triangles on which any work to be surveyed is based, extending as far as possible throughout the work.

34. Question. What is a secondary triangulation?

Answer. It is a series commenced within the primary triangles, extending in whole or in part through the same, and dependent on the primary series.

35. Question. Is it possible for a series of secondary triangles to exist where there are no primary ones?

Answer. No.

36. Question. Is not the use of secondary triangles for plane-table parties to furnish detailed points?

Answer. Yes.

37. Question. If in any work there be but one series of triangles, does any such fact exist as primary and secondary?

Answer. No.

38. Question. When you commenced, was not the secondary triangulation intended to be, as the name imports, secondary to and within a primary triangulation?

Answer. Yes.

39. Question. Is it so now?

Answer. East of New Haven I have extended a main triangulation to Newport, and filled up the same with a secondary series of triangles.

40. Question. Is the main triangulation determined by Mr. Hassler, and ending at Yards and Mount Holly, of the same nature as the main or as the secondary triangulation by you, east of New Haven?

Answer. The same as the main triangulation by me, east of New Haven.

APRIL 30, 1842.

Present: Mr. Cushing, Mr. Aycrigg.

Examination of Captain Swift.

1. Question. Are you employed in the coast survey; and if so, in what capacity, and since what time?

Answer. As an assistant, since 4th April, 1833. I am also the disbursing agent, since about 2d July, in the same year.

2. Question. Will you furnish to the committee an exhibit of the expenditure on the survey for the years 1841 and 1842; say of the appropriation of March, 1841, classifying the same so as to show the amoun

expended on the maritime, and the amount on the land part of the work; the amount on the primary and secondary triangulation, and on the plane tables; the amount for salaries, and for expenditure at the bureau; and in the same way of any and all other conveniently specified classes of expenditure?

Answer. The answer is annexed in the papers marked A 1 and A 2.

3. Question. Will you furnish to the committee a copy of a printed pamphlet on the coast survey, distributed among the members of the House in February last?

Answer. The pamphlet is annexed, (marked B.)

4. Question. Is there any sufficient reason for suppressing or omitting to publish the results of the survey as thus far ascertained, and as the same may continue to be obtained?

Answer. No, I think not.

5. Question. May not maps of specific completed parts of the survey be published, while the work is in progress on other parts of the coast?

Answer. Yes.

6. Question. Of how large a part of the coast is the survey now so far completed that such maps might be published?

Answer. The whole of Long Island sound, including both sides of Long Island, New York harbor, and a portion of the northern part of New Jersey, coast and interior.

7. Question. Might not the soundings, position of headlands, and the like, of all so much of the coast, be now published?

Answer. Yes.

8. Question. Is there any sufficient reason for withholding from Congress the mathematical elements of the survey, so far as completed?

Answer. No.

9. Question. In whose possession are those facts and *data* at this time?

Answer. They are at the office in Washington, so far as completed, and except so far as parts of the work now in progress are in the hands of the assistants.

10. Question. Are there duplicates of the observations, measurements, and other unpublished elements of the survey?

Answer. There are of parts, but I think not of the whole.

11. Question. Are the elements of the base line, and of other primary and essential parts of the work, in such form and situation as to be secure from loss by fire or otherwise, and be capable of being handed over to and understood by any competent successor of Mr. Hassler?

Answer. All this is in duplicate in the office, accessible to the assistants, and susceptible of being understood and used by them. No part of this has been published except the final result of the base measurement. The details have not been published. The papers are subject to the hazard of fire; but not more so, and perhaps less, than in some other buildings in Washington.

12. Question. Is there any objection to depositing one of the duplicates in each case in the safes of the Treasury Department?

Answer. No.

13. Question. Would not this be proper, to guard against accidents?

Answer. It certainly would add to the security.

14. Question. In what way are the principal duties of the survey subdivided between the superintendent and his assistants?

Answer. The duties of Mr. Hassler, in addition to the general supervision of the work, are the main triangulation, while the assistants are employed in the secondary triangulation and detailed surveys.

15. Question. Is the main triangulation in arrears of the secondary; and if so, why?

Answer. It is. I am not aware of the reason, except the illness of Mr. Hassler, and his inability to do it, caused thereby.

16. Question. Cannot that work be performed by one of his assistants?

Answer. Yes.

17. Question. How long has Mr. Hassler been so ill as not to be able to attend to that work?

Answer. It was in October of last year that he became ill. He was also ill the preceding year, in September.

18. Question. What prevented his taking the field and performing the work in the spring and summer of those two years?

Answer. I am unable to say.

19. Question. What sum is allowed to Mr. Hassler, annually, for expenses, exclusive of compensation?

Answer. Salary $3,000, and expenses $3,000.

20. Question. For what expenses is this $3,000 designed? Is it for personal expenses?

Answer. I suppose it is the expenses of living.

21. Question. Is he paid for other expenses when he goes into the field?

Answer. He is furnished with an instrument carriage and horses for the instruments and himself, and a baggage wagon besides, for instruments, at the public expense.

22. Question. Is it the same carriage which he is accustomed to use in Washington?

Answer. Yes.

23. Question. Are horses and men paid at the public expense for the carriage and wagon through the year?

Answer. Yes; four horses, one permanent driver, and one other man, who also assists about the office.

24. Question. Please to specify, in the answer to the 2d question, the whole of the expenditures on these carriages, horses, and men, as are of the classes of expenditures therein referred to.

Answer. It is contained in the paper annexed, and marked A.

25. Question. What are the precise duties performed by Mr. Hassler during the chief part of the year, in which he remains at Washington?

Answer. The weights and measures, and the computation of his own field work, and occasional general computation.

26. Question. Do not the assistants reduce and compute their own work?

Answer. Yes.

SATURDAY, *May* 13.

Present: Mr. Mallory, Mr. Cushing.

Continuation of the examination of Captain Swift.

27. Question. Do you wish to add any explanation to the papers now produced in answer to the 1st question, and marked A 1 and A 2?

Answer. In comparing the accounts in the papers marked A 1 and A 2, and in the printed sheet B, there is a discrepancy in the sums, assigned to

the secondary triangulation and plane-table parties, respectively. The manuscript (marked A 1 and A 2) is the later and correct statement, the statement in B being an approximate estimate, made up before the complete settlement of the accounts.

28. Question. Does the whole amount expended pass through your hands, and how is it drawn from the Treasury, and on what vouchers paid?

Answer. All the expenditure for work on shore passes through my hands, also the per diem allowance of the officers on board the vessels, and the extra compensation of the lieutenant commandant; but the other payments, in the hydrographical part of the work, do not pass through my hands, being made by the commander of the vessels. The money expended by me is received by me from the Treasury, on requisition made by me on the Department. All the disbursements, except for salaries, &c., fixed at the Treasury Department, are made under the authority of Mr. Hassler.

29. Question. Who prescribes the number of subordinate persons to be employed, and the amount of miscellaneous expenses to be incurred?

Answer. The assistant in charge of each party, subject to the control of the disbursing officer.

30. Question. Who appoints the persons employed in the survey?

Answer. Mr. Hassler.

31. Question. Who fixes their compensation?

Answer. If below $1,000, Mr. Hassler; if more, it is referred to the Department. Such is the practice, so far as I know.

32. Question. Is it necessary to have an instrument maker's shop in the survey?

Answer. I think it is both economical and convenient. An amount of work was done there the last year fully equal to the cost of maintaining the shop.

33. Question. Cannot some portion of the topography of the survey be dispensed with without detriment to the hydrographic part of the work?

Answer. I conceive that the plane-table survey is useful, but it may not be necessary for any hydrographical object that it should be so far extended.

34. Question. What, then, is it useful for?

Answer. I do not know any thing, except that it contributes to a more exact knowledge of the topography of the country adjacent to the coast.

A 1.

Statement of the expenditures made for the survey of the coast of the United States, and for engraving the chart of the harbor of New York, during the year 1841 *and a part of* 1842.

Amount expended by Captain W. H. Swift, from 1st January, 1841, to 31st December, 1841 - - - - -	$80,639 13	
Amount expended by Commander Thomas R. Gedney, 17th May, 1841, to 31st March, 1842 - - - - -	9,162 42	
Amount expended by Lieut. Commandant Geo. S. Blake, 11th March, 1841, to 28th February, 1842 - - - -	4,766 77	
		$94,568 32

Details of the expenditures.

For the main triangulation, including the compensation of the superintendent, the heliotropers, and hands employed therein, and all incidental expenses, except horses, wagons, and harness, and repairs of same, and pay and subsistence of driver - - -	$9,289 87	
For horse keeping, (4 horses,) repairs of one instrument carriage, one wagon, harness, and pay and subsistence of driver - - -	1,445 98	
		$10,735 85
For the secondary triangulation, including the compensation of the assistants, heliotropers, and hands employed therein, and all incidental expenses, except horses and wagons, harness, and repairs of ditto - - - - -	20,656 14	
For horses, horse keeping, repairs of wagons, and harness, pay and subsistence of 2 drivers, (3 wagons and 5 horses) - - -	2,160 74	
		22,816 88
For the plane-table surveys, including the compensation of the assistants and the hands employed therein, and all incidental expenses - -		17,212 29
For the hydrographic surveys: Amount paid by Capt. Swift to the naval assistants, for the authorized allowance of $627 per annum to the lieut. commandants, and of $1 per day to the lieutenants and passed midshipmen -	8,644 94	
For amount paid by Commander T. R. Gedney, from 17th May, 1841, to 31st March, 1842, for repairs of 2 vessels, sails, boats, pilotage, and incidental expenses, (Washington and Jersey)	9,162 42	
For amount paid by Lieut. Com't G. S. Blake, for same from 11th March, 1841, to February 28, 1842, (schooners Gallatin and Nautilus) -	4,766 77	
		22,574 13
For expenses of the coast survey office, including rent, fuel, lights, and attendance - - - - - -		1,999 17
For expenses of the instrument maker's shop, including the compensation of the persons employed therein, and the cost of tools and materials purchased for same - -		2,318 11
For compensation and expenses of the persons employed in engraving the chart of the harbor of New York - -		2,011 14
For the *general expenses* of the work, including the compensation of all assistants and others not embraced in the preceding schedule, and all purchases and expenditures not specified in same - - - - - - -		14,900 75
		94,568 32

W. H. SWIFT,
Disbursing Officer Coast Survey.

WASHINGTON, *May* 4, 1842.

A 2.

List of all persons employed in the survey of the coast of the United States on the 1st April, 1842, and the annual compensation paid to them by Captain W. H. Swift, disbursing officer, from the appropriation therefor, made March, 1841.

F. R. Hassler, superintendent, $3,000 salary, $3,000 expenses	$6,000 00
Captain W. H. Swift, assistant and disbursing officer, 2½ per cent. upon disbursements	1,908 60
James Ferguson, assistant	4,000 00
Edmund Blunt, do	4,000 00
Lt. Thomas J. Page, do	500 00
C. M. Eakin do	3,000 00
Charles Renard, do	3,000 00
W. M. Boyce, do	2,000 00
J. J. S. Hassler, do	2,000 00
John Farley, do	2,000 00
Lt. B. F. Sands, do	
Thomas W. Werner, do	1,500 00
H. L. Dickens, do	1,500 00
F. H. Gerdes, do	1,500 00
Samuel Hein, clerk, $1,000 per annum, $4 per week for board in Washington	1,208 00
William Windeman, instrument maker, $800 per annum, $4 per week board in Washington	1,008 00
Thomas McDonald, artificer and heliotroper, $600 per annum; and $4 per week for board in Washington	808 00
Selman Seibert, engraver	1,800 00
Albert Rolle, do	1,300 00
Ludolf Muller, calculator and heliotroper, $800 per annum, and $4 per week for board in Washington	1,008 00
C. F. Flint, copyist (of calculations) and heliotroper, $600 per annum, and $4 per week for board	808 00
W. Jacobi, employed in the instrument maker's shop, and heliotroper, $2 50 per working day	782 50
Samuel Schmid, copyist (of calculations) and heliotroper, $300 per annum, and $4 per week for board in Washington	508 00
Gustavus Windeman, heliotroper and filer in the instrument maker's shop, $300 per annum, and $4 per week board	508 00
H. L. Whiting, draughtsman and heliotroper, $300 per annum, and $4 per week for board	508 00
Edward Sweeney, driver, (main triangulation,) $18 per month, and $4 per week for board in Washington	404 00
William Greason, messenger, $18 per month, and $4 per week for board in Washington	404 00
Christopher Kuft, fire maker, watchman, &c., $18 per month, and $4 per week for board in Washington	404 00
George Kangnau, fire maker, watchman, &c., (temporarily employed since 1st January, 1842,) $18 per month, and $4 per week for board in Washington.	

Hydrographic surveys.

Commander Thomas R. Gedney.	
Lieutenant Commandant G. S. Blake - - - -	$627 00
Lieutenant G. M. Bache - - - - -	365 00
Lieutenant J. K. Mitchell - - - - -	365 00
Lieutenant H. S. Stellingen - - - - -	365 00
Lieutenant John M. Dale - - - - -	365 00
Lieutenant E. G. Parrott - - - - -	365 00
Passed Midshipman H. H. Lewis - - - -	365 00
Passed Midshipman W. A. Bartlett - - - -	365 00

W. H. SWIFT,
Disbursing Officer Coast Survey.

WASHINGTON, *May* 4, 1842.

When an assistant or other person attached to the work is ordered by the superintendent from one place to another on public duty, the actual amount paid for railroad, steamboat, or stage fare, is refunded to the person incurring such expense.

W. H. SWIFT.

B.

Remarks upon the survey of the coast of the United States.

1. The law authorizing the survey of the coast was passed February 10, 1807.

2. Circular letters were addressed by the Treasury Department to various scientific men in the United States, asking for a plan of operations. Thirteen such were received, and submitted to a committee of learned men in Philadelphia, with the late Professor Patterson at their head. After full consideration, the plan proposed by Mr. Hassler was adopted.

3. From the passage of the law until 1811, no active steps were taken, in consequence, principally, of the unsettled state of the country.

4. In August, 1811, Mr. Hassler was sent to England to procure instruments, in accordance with the plan proposed by him in 1807. These instruments had all to be *constructed;* and, for the purpose of superintending the same, he remained in England until 1815, at which time he returned to the United States, with all the instruments and appendages requisite for the work. The war, want of remittances for payment of the instruments purchased, the difficulty of procuring suitable artists to construct the same, &c., conspired to protract his stay in England nearly two years beyond the time which he had allotted to this part of his labor.

5. In August, 1816, Mr. Hassler was appointed to superintend the survey of the coast, under the law of 1807. The necessary preparations for the work, including reconnoitring, &c., consumed the time between August, 1816, and April, 1817. At that period a proper locality for a base line was discovered in New Jersey, and in July of the same year the actual triangulation was commenced.

6. April 14, 1818, that part of the law which authorized the employ-

ment of persons other than those belonging to the army and navy was *repealed*, and thus was Mr. Hassler's connexion with the coast survey closed.

7. Up to this period, the whole amount expended for the work was $55,634; of this amount, $37,549 had been expended for instruments and the expenses of procuring the same, leaving about $18,000 for the cost of the survey, equipment for the field, &c.

8. In 1819, Mr. Hassler presented to the American Philosophical Society of Philadelphia his papers upon the coast survey, describing the method and means by which it had been designed to conduct the work, together with full descriptions of the instruments, with drawings of same, examples of the journals of observations, &c. These papers were published by the society, in their volume of Transactions for 1825, and are now in the Library of Congress; they contain much valuable and interesting information upon the subject. They were reviewed by the principal astronomers of Europe—Bessel, Struve, Schumacher, Ferrusac, Francoeur, Krusenstern, &c.—all uniting in the opinion that the plan of Mr. Hassler was of the first order, and that the instruments were in every manner adapted to the purpose for which they were designed. In 1832 a distinguished astronomer of France, now employed by the Government of the United States, declared that the instruments planned by Mr. Hassler for the coast survey, and executed under his eye, were, when constructed, *twenty years in advance of the science of Europe.*

9. In 1827, the survey of the coast, after a lapse of ten years, again excited public attention. The Secretary of the Navy, (Mr. Southard,) in describing certain surveys which had been made by naval officers for an especial purpose, stated in his annual report that "the time within which it was supposed desirable to make them, [the surveys,] and the means granted by the appropriation, did not permit them to be so made as to furnish perfect surveys and charts of those harbors; *nor can such surveys be made without the aid of the means contemplated by the act of 10th February, 1807, to provide for surveying the coast of the United States.*"

In 1828, the Committee on Naval Affairs addressed a letter to the Secretary of the Navy, (Mr. Southard,) asking information in reference to the survey of the coast, to wit: whether it ought to be made; the best plan for making it; what progress had heretofore been made, &c. In reply, he proceeds to say, after referring to a list of maps and charts: "Of the whole of the maps and charts in possession of the Government, it may be remarked that they 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 shore, 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.*"

10. In answer to the question, "Whether, in the opinion of the Department, such survey ought to be made?" the Secretary replies: "Upon this point no doubt is entertained. It is called for by regard to our commercial

and naval interests, and to our means of national defence. I do not understand that you require a statement in detail of the reasons for this opinion; they will readily suggest themselves to every mind."

11. July 10, 1832, the law of 1807 was revived, and the employment of such "astronomers and other persons" as the President should deem proper was again authorized.

12. At the request of the Treasury Department, Mr. Hassler submitted a plan of operations for the work, being, in fact, the same which he had proposed in 1816. On the 9th August, of same year, he was again appointed to the survey, and to carry into effect the law of July 10. Prior to this period he had been employed by the Treasury Department in making comparisons of the various weights and measures in use at the several custom-houses, with a view to the construction of uniform standards of the same for the Union.

13. The two works, of the coast survey and that of the construction of standard weights and measures, being, by their nature, intimately connected, and the means of accomplishing each being in many instances the same, Mr. Hassler was charged by the Treasury Department with the execution of both; and, since the period referred to, the two works have received his whole attention.

14. Since 1832 the survey of the coast has been diligently prosecuted. The remainder of the season, between August and December of that year, was employed in reconnoitring and other preparations; and early in the following year (1833) the triangulation was recommenced, and has been making steady progress from that time to the present. In 1834 a new base line was measured on Long Island, and the secondary triangulation, hydrographical work, and plane-table surveys, have also been in active progress, *pari passu*.

15. By the official statement of the Secretary of the Treasury, (Doc. 57, H. R., Jan. 31, 1842,) it will be seen that the aggregate amount expended from 1808 to 30th June, 1841, is $512,731 68; of this sum, by the same statement,* $33,723 05 has been expended for the purchase of "instruments, books, and repairs of instruments." This, with various sums expended for 5 surveying vessels, 20 boats, with all the requisite accompaniments, and the necessary equipment for the several parties engaged in the secondary triangulation and plane-table work, makes a gross sum which exceeds $120,000, for objects of a *permanent* nature, now the property of the coast survey. This would reduce the amount expended upon the work itself to $392,731 68; if to this sum be added the whole amount of the estimate of the Secretary of the Navy, for difference between shore pay and sea pay of the officers, and for pay and rations of the crews of the several vessels, from 1834 to 1841, ($114,584,) we shall have a total sum expended of $507,315 68, for about 11 years of actual work, or about $46,000 per annum.

16. When the operations of the coast survey, under Mr. Hassler, were suspended in 1818, by the repeal of a portion of the law, the system which he had adopted was also suspended, and thenceforward detached portions of the coast were assigned for survey to naval officers, from time to time. Indeed, this same system, which was condemned so thoroughly by Mr.

* There is an error in this part of the Register's statement; for the *original* collection of instruments cost $37,549, and additional instruments have since been procured.

Southard in 1828, and for which the sound reasons quoted from his report, at the 4th page of this paper, were given, is still pursued—at what expense exactly we have not the means of stating. An approximate estimate may be formed, however, from the following facts: The direct expenditures, as exhibited by the printed statements in the office of the Register of the Treasury, from 1818 to 1841, are $63,520 20; the incidental or indirect expenditures do not appear, but perhaps an idea of the extent of the same may be formed upon the following data: In 1832, $5,000 were appropriated for the survey of Narragansett bay, in Rhode Island. There were employed in this work, 1 post captain, 3 lieutenants, 5 passed midshipmen, and 18 seamen, for one season, say six months. This appropriation of $5,000 is nearly $\frac{1}{13}$th of the whole amount of *direct* expenditures. Adopting the same principles in computing the cost of the work chargeable to the naval establishment, which the Secretary of the Navy adopted in stating $114,584 as the amount properly chargeable to the coast survey, for difference between sea and shore pay, and subsistence of officers, and pay and rations of seamen, we shall have a gross sum, for six months, of upwards of $4,000. Therefore, for every $5,000 expended directly for the work, we should add $4,000; and this, for the $63,520 20, amounts to $50,800. It may be inferred, also, that nothing is included in the above $63,520 20 for purchase or repairs of vessels, equipment, &c., these being provided, as usual, in the general expenses of the naval establishment; on the contrary, both purchases and repairs of vessels, boats, furniture, &c., is chargeable upon the coast survey fund, for all which now belongs to the work. Here, then, we have a sum of $114,320 as the cost of some detached surveys of portions of the coast. Surveys of this nature, and those which are executed upon proper principles, are so unlike in character that they do not admit of comparison.

We proceed now to state briefly the principles upon which the survey of the coast is conducted.

The principle upon which the survey of the coast is conducted is, essentially, that which is known as the trigonometric method. By the relations which subsist between the sides and angles of a triangle, we are enabled, from certain known data, previously determined by actual measurement, to compute certain other parts which are unknown. For example: in a given triangle, by measuring one of the sides and the angles, the two remaining sides can be determined by computation. These computed sides then serve as bases for other triangles, and subsequently, by measuring the angles *alone* in the triangles thus formed, the work is extended *ad libitum*. This is called a triangulation, and may be made upon any part of the earth's surface upon which a line of a given extent can be measured.

A triangulation may be complete in itself, and, when the necessary corrections have been made for the figure of the earth, the actual distance between two points can be accurately determined. But this, alone, is not all that is required; it is necessary to ascertain the true position of the district or country triangulated upon the earth's surface—that is to say, its latitude and its longitude. The first of these is independent, it being simply its distance from the equator; while the second is not independent, but refers to the position of some other point on the earth's surface, and under another meridian. This latter place, or meridian, may be assumed at will; and the question then to be determined is simply the difference *in time* between the two places of observation; and this being converted into de-,

grees constitutes the longitude, or rather the difference of longitude between two places.

For these determinations, observations upon the heavenly bodies must be resorted to. It is not necessary, however, that celestial observations should be made at every point determined by the triangulation; on the contrary, a few well-determined positions, ascertained by a long series of observations, often repeated, are sufficient, the connexion between the same being determined by the triangulation; hence the survey of the coast, as now conducted, is made by combined or mixed geodetic and astronomical observations.

Here, then, is the essential difference between a survey by triangulation and astronomical determinations, or even the so-called "chronometric survey," (a misnomer, by the way, for it is not a *survey*.) One consists in a *connected* work, carried on upon the earth's surface, and made by means of an uninterrupted series of triangles; while the other is composed of a collection of observations upon the celestial bodies, made at detached points, each place of observation being independent of the other. In the first method the connexion is complete, while in the others there is no connexion whatever.

To the question, whether the mode of making the survey of the coast by triangulation is better than any other, it may be said to be the *only* truly correct method which can be pursued. It is the only method by which a *connexion* in the work can be preserved. Of its accuracy the proofs are continually before the observer, and an error need not be extended beyond a single triangle. The three angles are measured in every principal triangle of the work; and, as this is all the *measurement* which takes place after the base is determined, it is obvious that the observer has his proofs of correctness continually at hand. There can be no *cooking* of observations, as is sometimes practised in astronomical determinations.

An idea of the exceeding accuracy attainable in works of the nature referred to may be formed by referring to the account of the measurement made by the French astronomers of the arc of the meridian between Dunkirk and Cabrera, for the determination of the figure of the earth, being 12 degrees of latitude in extent. After a great number of triangles had been measured, and an extent of about 500 miles upon the meridian determined, (between Melun and Perpignan,) a base of *verification*, as it is denominated, was measured at Perpignan. This verification consisted in *measuring* with the greatest accuracy one of the sides of a triangle in the series, which had been previously determined by computation from the original base. The difference between this computed side and the actual measurement was less than 2 feet.*

In the work of the survey of the coast, the *secondary* triangulation now encompasses the southern part of the State of New Jersey, from Staten island to Cape May; one series of triangles was carried around on the east or coast side, while a second was carried down the Delaware river and bay, uniting near the southern point of the State. The length of the side of the triangle which was common to both series was, of course, determined by each chain of triangles—one by the coast, and the other by the Delaware bay; the difference between the two determinations was two metres, or about six feet. In the primary triangles this difference will, from present appearances, be less than one foot.

* La Place.

Surveys of all the countries of Europe have been or are being made by the system of triangulation, to wit: Austria, Russia, Sweden, Denmark, Hanover, Prussia, Swabia, Bohemia and the States of Germany generally, Italy, Naples and Sicily, Switzerland, France, England, the British possessions in India, and the French colony in Algiers.

"Europe is covered with well-connected series of triangulations—from the south of Sicily to the polar circle; from Ireland, through England, France, Germany, to the interior of Russia; from Bordeaux to the frontier of Turkey, and in all the intermediate parts."

Some of the practical benefits which have resulted from the coast survey are already apparent. The discovery of the ship channel into the harbor of New York, the better determinations of the channels into Delaware bay, and the detection of the grossest errors in the existing charts of that bay, constitute a portion of the advantages which have already been derived from this work.

The engraving of the chart of the bay and harbor of New York, with the country adjacent to the same, within a circuit of twenty miles, is now in progress; two sheets, embracing the entrance to the harbor, with the channel delineated thereon, are already in a state of great forwardness, and, in all probabilty, will be completed by the 1st of June, 1842.

To the question, "Whether no other mode exists by which accurate results can be obtained within less time than they can be furnished by a trigonometrical survey," the answer is, *No.* There is no *short* method by which these results are attainable. It is not the "quantity" of triangles alone which determines the industry or skill of the observer, but the quality. To make the triangulation of a given district of country with the least possible number of well-conditioned triangles, is one of the important problems to be solved; quality, again, and not quantity, is the essential requisite.

Usually, the experience of the world is justly considered when any great object is to be attempted or effected. Why should it be excluded from the category, in judging the merits of this magnificent work? We have the combined testimony of all the science of Europe in favor of making surveys by triangulations, and, in fact, the positive assertion that it is the *only* proper method. Why should we not adopt the conclusions of nations which, to say the least, are older in these matters than we ourselves are, rather than to resort to methods which are a century behind the age we live in?

Why, with the great advantages which the "chronometric system" is said to possess, is it not adopted by those who are best capable of judging it by its merits? Rather let the whole work be destroyed, than to suffer it to be done discreditably. If we cannot make it in a manner which shall bear the scrutiny of the scientific world, let it rest for another fifteen years. Sextants and chronometers are invaluable instruments in their proper sphere, but they certainly do not furnish the means by which triangulations are to be made, or corrected, or superseded, as some would seem to desire.

Organization of the work.

1. The main or *primary triangulation*, upon which all the work depends, is made up of triangles, having sides of from 10 to 50 miles in extent. The angles in these triangles are all measured by Mr. Hassler.

2. Within these main triangles, smaller triangles are formed; this constitutes the *secondary triangulation;* the sides of these vary in length from 2 to 10 miles. The angles of these triangles are measured by the assistants of Mr. Hassler; two and sometimes three parties are engaged in this part of the work; usually they enter the field in March and April, and leave the same for the calculations, &c., in the office, in December.

3. The secondary triangulation, in turn, forms the basis of the plane-table or topographical surveys; these include all the details of the ground, outline of the coast or shore, courses of bays, rivers, roads, &c. This portion of the work is distributed among 5 or 6 parties, each having a district of country allotted to it. A party consists of 1 assistant and 5 or 7 hands, according to the nature of the country to be surveyed. These parties usually take the field in April and May, and return to the office, to make up their plottings and maps of the work of the season, in November.

4. The hydrographic determinations are made entirely by the naval assistants of Mr. Hassler. Points on shore are furnished by the triangulation, both main and secondary, together with the coast or shore line from the plane-table surveys. By this means the sounding parties are enabled to determine the true position of their soundings, by measuring the angles subtended between stations previously established upon the shore. Two parties are engaged in the hydrographic part of the work, each being furnished with the necessary assistants from the navy, and with vessels, boats, &c., belonging to the coast survey. These parties are engaged in their labors upon the coast from April or May to November, according to the character of the weather; in the winter months they are employed in laying down upon their charts the results of the work of the season.

The triangulation now extends from Narragansett bay, Rhode Island, to Cape Henlopen, Delaware, on the coast, and from the neighborhood of New York to the head of Chesapeake bay, covering an area of about 11,000 square miles. The hydrographic surveys cover 5,600 square miles, and the topographical or plane table surveys 4,200 square miles. This work is represented upon upwards of 200 maps and charts, of various scales, according to the nature of the work, from $\frac{1}{5000}$ to $\frac{1}{100000}$; that is to say, one foot in extent upon the map will represent, according to the scale used, 5,000 feet, or 100,000 feet upon the earth's surface.

The actual length of coast line, (including Long Island,) already determined and laid down upon the map, is - - -	631	miles
Do. of the larger bays, rivers, and islands - - -	697	"
Total of shore line, coast, bay, &c. - - - -	1,328	"

Classification of the expenses.

The whole amount expended for the survey of the coast from the *appropriation* therefor, for the year 1841, was *$96,174 98.*

1. Of this sum, the general expenses of the work, including the main triangulation, compensation of all persons employed therein, instruments and books, and all expenses not enumerated in the items below, amounted to -	$32,671 09
2. The secondary triangulation, including compensation of persons therein employed, 3 parties - - -	19,352 06

3. The hydrographic surveys, including the cost of repairs of the vessels, boats, &c., and allowances to officers for expenses, 2 parties and 4 vessels - - - -	$25,459 16
4. Plane-table or topographical surveys, including compensation of all persons employed therein, 6 parties - -	18,692 67
	96,174 98

The conclusions which are deducible from the preceding remarks may be summarily stated thus:

1. Availing ourselves of the experience and practice of all European nations, it is just to conclude that the survey of the coast can only be made (if it shall be accurately executed) by a triangulation.

2. Conceding the ground that it is by a triangulation alone that exact results can be obtained, it may be shown, by a reference to the history of similar works, that the methods pursued in executing the survey of the coast of the United States are, in principle and in details, in accordance with the best of those adopted by other nations.

WASHINGTON, *February* 25, 1842.

[It is proper to state that this paper on the coast survey was prepared by Capt. Swift.]

MAY 2, 1842.

Present: Mr. Cushing, Mr. Aycrigg.

Examination of Captain Thomas R. Gedney.

1. Question. Are you an officer of the navy?

Answer. Yes.

2. Question. Are you now employed in the coast survey; and if so, since what time and in what capacity?

Answer. I have been employed in it since October, 1834, in charge of one of the hydrographical parties.

3. Question. How many of such parties are there?

Answer. Two. The other is commanded by Lieutenant Blake.

4. Question. How many persons, and what vessel or vessels, are employed in your party?

Answer. Last year I had two vessels, the schooner Jersey and the brig Washington, with, I think, fourteen officers, all told; and, I believe, thirty-two seamen and forty-four boys. This amount of force was necessary.

5. Question. What surveys have you made since October, 1834?

Answer. I have been engaged in making soundings. I commenced in Fire Island bay in 1834; then the outer coast of Long Island, in 1835, from Fire island to near New York; then the harbor and bay of New York, and to Montauk point, along the outer coast of Long Island, in part of 1835 and in 1836 and 1837; in 1838 and 1839, from Fisher's island to Block island and Point Judith; in 1840 and 1841, on the coast of New Jersey, as far as Egg Harbor. These soundings include also all the inland navigation from Fire island to Egg Harbor. In addition to this, in 1841, I performed a piece of detached work between Cape Henlopen and Cape May.

6. Question. Have you completed the soundings along the whole extent of coast from Point Judith to Egg Harbor?

Answer. Yes.

7. Question. Are those soundings, as verified by you, in a condition to be published?

Answer. Yes.

8. Question. Do you make any astronomical or other observations on the coast?

Answer. No, except so far as may be needful to keep my own time.

9. Question. Have any views of the coast been taken by you or from your vessels?

Answer. Yes. Mr. Farley has taken a panoramic view of the whole of Long Island and of all the light-houses wherever I have sounded. We have taken no other views, except of the entrance of the new channel in New York harbor.

10. Question. Is the coast of Long Island an easy or a difficult one?

Answer. I think it an easy one myself.

11. Question. What is the chief occasion of wrecks on Long Island?

Answer. When vessels are running in, and are caught by a heavy south-easter, it is difficult to get out, from the trending of the two coasts of Long Island and of New Jersey, and the current setting from New Jersey coast, by reason of which vessels, being thus embayed, are apt to be driven on shore.

12. Question. Have you sounded Jamaica bay?

Answer. Yes, in 1835.

13. Question. What depth of water did you carry into that bay?

Answer. Six feet at low water, eleven and a half at high water, in common tides. At the present time, the depth at low water is seventeen feet.

14. Question. Would not the knowledge of the actual depth of the water in the channel leading into Jamaica bay be useful to a vessel which was unable to claw off the coast?

Answer. Yes; it might preserve a vessel from being stranded.

15. Question. What amount of repairs of instruments have you had done at the office of the coast survey?

Answer. I cannot say.

16. Question. Have you had other repairs done elsewhere; and if so, by whom, and to what amount?

Answer. I have had repairs done for our, or my, party, the last year, to the amount of forty or fifty dollars, by Mr. Montandon, and by George Blunt, of New York, it having been convenient to have this done on the spot there.

17. Question. How far inland do any of the points extend which you have used, as furnished you by any of the triangulating parties?

Answer. Some of them have been from ten to twelve miles inland. They were used for measuring angles from the vessel and from different points. The points which I occupied for measuring were generally on the coast, within a quarter of a mile of the beach.

18. Question. Please to describe your mode of proceeding in this respect.

Answer. I have three officers on shore, at three different stations, with a sextant and a watch each, and a boy with a spyglass also to each station. I then am anchored or lying to off shore in my vessel. I make a signal

in the morning, when I get under way, to commence work, I knowing that the men are at their stations by their hoisting a signal flag for that purpose. I commence by running up a signal; so soon as the signal starts from the mast head, the officers on the shore measure the angle between the brig and one of the stations, and the officers on board the brig, two of them, then measure each of them an angle between the stations on shore, so as to give in all five angles; each officer, as well on shore as on board, marking the time, to see that they agree. Meanwhile I am taking my soundings, on the change of which the signals are repeated and new angles taken as before. In these observations I consider the vessel as a fixed point. This system of operation I have been able to carry out as far as twelve or fourteen miles seawards, which is the greatest distance I have gone. I can see the land inland about ten or twelve miles from the shore, along that part of the coast sounded by me; but if the land were higher the distance seen would be much greater.

19. Question. Did you sound the new channel, commonly called Gedney's channel?

Answer. Yes.

20. Question. Would you have been able, with the ordinary facilities for sounding, to ascertain that channel, without the previous triangulation of the coast?

Answer. Yes; I could have buoyed it out so far as to make it equally useful to navigation.

21. Question. Is the knowledge of that channel of great importance to the shipping of New York?

Answer. I think it is.

22. Question. Could not a master of a vessel, when employed off the harbor of New York, with such information as a good chart of the harbor would furnish, run his vessel in with tolerable safety by that channel?

Answer. Yes.

23. Question. Do you know any reason why a chart of that channel has not been published?

Answer. I do not know any, unless it be that it was not ready. Mr. Hassler has charge of that; I have not.

24. Question. When did you sound out that channel?

Answer. In 1835.

25. Question. Is not the channel as good now as when you first sounded it?

Answer. Yes; I sounded it again last year, for the purpose of ascertaining the fact, and found it so.

26. Question. Is the line of the coast, where examined by you, fixed or subject to change?

Answer. The beach itself, at the mouth of small inlets, is subject to change, with severe gales of wind.

27. Question. Is the topography of the country within the coast of any importance to navigators?

Answer. It is not, except for four or five miles, or where there is any remarkable eminence or other object inland.

28. Question. Is it customary to lay down the topography of the country on the charts of navigators?

Answer. I have never seen it in any charts except of islands. In charts

of the West India and other islands it is sometimes given; but in those cases it is not necessary for purposes of navigation.

29. How long do you continue sounding, one year with another?

Answer. I generally commence in May, and leave off early in November.

30. Question. Are you able to keep up with the triangulation?

Answer. Yes; and I have been in advance of the plane-table parties.

31. Question. Are the plane-table parties necessary to the soundings?

Answer. Yes.

32. Question. If you had occasion to sound at a greater distance from the shore than 12 or 14 miles, how would you proceed?

Answer. I should employ small vessels, anchoring them to serve as fixed points; or it might be done by means of chronometers, starting from some given or known point.

33. Question. What proportion of the year, and of the day in each year, have you been able to make your observations, and carry on the work?

Answer. The answer to this question is annexed in paper marked A.

34. Question. Have not your operations along the coast either corrected errors in printed charts or added many new and more complete soundings to those heretofore published in any chart?

Answer. I believe they have.

35. Question. Do you know any reason why the soundings taken by you should not be published?

Answer. I do not.

MONDAY, *May* 2, 1842.

Present: Mr. Cushing, Mr. Aycrigg.

Examination of Lieutenant George Blake.

1. Question. Are you an officer of the navy, employed in the coast survey; and if so, in what capacity, and since what time, and on what part of the coast?

Answer. I am a lieutenant in the navy, and have had charge of a hydrographical party from 1835 to the present time; I have been in Long Island sound and Fisher's Island sound, and in Delaware river and bay.

2. Question. What vessel or vessels, and what number of officers and men, have you under your command?

Answer. My force has varied very much; I had last year the schooners Gallatin and Nautilus, with nine officers and forty-one men.

3. Question. Have you been engaged in the outer or the inner waters?

Answer. The inner altogether.

4. Question. What proportion of instruments have you had made or repaired at the office in Washington?

Answer. I have seldom had any sextants or glasses repaired there; but a large part of the drawing instruments have been made there, to the value or cost of say $500 at any private establishment, that is, during the whole time I have been in the survey.

5. Question. Have any views of rocks, shoals, or other dangerous places, been taken from your vessels?

Answer. No; views have been taken of all the light-houses.

6. Question. Have you, in the examination of Delaware bay, discovered any great errors in the supposed location of any shoals?

Answer. Yes; very great.

7. Question. In what cases?

Answer. In that of Cross ledge, especially; but there is no proper chart of Delaware bay; the only one extant is a mere rude sketch. The error in the case of Cross ledge was four miles, I think.

8. Question. Is it not important that these errors should immediately be made known, and a correct chart of the bay published?

Answer. Yes, undoubtedly.

9. Question. Do you know of any reason for withholding from the public a knowledge of the soundings of Delaware bay, as far as verified by you?

Answer. I know of none.

10. Question. Can a topographical map, so constructed as to give in detail a full and self-explaining picture of the country, that, with the map before the eye, the military operations may be properly judged and guided in the cabinet, be obtained, in carrying on the coast survey, without adding greatly to the expense, and materially delaying the execution of the work?

Answer. No, it cannot.

MONDAY, *May* 30, 1842.

Present: Mr. Mallory, Mr. Aycrigg.

Mr. W. J. Stone's examination.

1. Question. Map marked exhibit C being shown, witness is asked if he recollects the map.

Answer. Yes.

2. Question. Who engraved the map?

Answer. I did.

3. Question. Is that an exact copy of the original sent to you from the House of Representatives?

Answer. It is.

4. Question. How long did it take you to engrave and print this map?

Answer. In from seven to ten days it was fully executed and delivered to the House.

5. Question. With what person connected with the coast survey did you communicate at the time you engraved this map?

Answer. Mr. Hassler. I called on him, and had a conversation on the subject.

6. Question. Exhibit B being shown and examined, he is asked if that in an impression from the same plate.

Answer. Yes.

7. Question. Will you please to examine exhibit B, and see if there is any difference between this and exhibit C?

Answer. The only difference that I can perceive is, that another scale has been put in the place of the one engraved by myself, which was copied from the original.

8. Question. In what manner was that alteration made?

Answer. By cutting out the engraved scale and inserting one with the pen. The engraved scale on exhibit C is 3 inches to the mile; while the scale inserted with the pen is $\frac{1}{100000}$ th, being, in fact, 6 inches to the mile, instead of 3.

9. Question. Have you the original extract sent to you from the office of the coast survey?

Answer. I have.

10. Question. Are there engravers in the United States competent to execute, faithfully and correctly, any work like that required for the coast survey?

Answer. Yes; as well as it can be done in any part of the world.

11. Question. What is considered a liberal salary for a good workman?

Answer. About $1,200 per annum.

12. Question. Is there any difficulty in getting good copper in the United States for engraving purposes?

Answer. No difficulty whatever.

13. Question. How long will it take to engrave the map of the harbor of New York, and what will it cost?

Answer. I cannot answer without examining the chart.

The chairman then gave Mr. Stone a note to Mr. Hassler, of the following tenor, as near as remembered, viz: requesting Mr. Hassler to permit Mr. Stone to examine the manuscript chart of the harbor of New York.

The committee then adjourned.

THURSDAY, *June* 2, 1842.

Present: Mr. Mallory, Mr. Cushing, Mr. Aycrigg.

William J. Stone in examination.

1. Question. What is your business and residence?

Answer. I reside in Washington, and I am an engraver.

2. Question. How long have you followed that business here?

Answer. From twenty-three to twenty-four years.

3. Question. Have you been accustomed to engrave maps and charts?

Answer. Yes; that has been my chief, and is, at present, my only business; I having abandoned other branches of engraving, to devote myself to that.

4. Question. Is there any difficulty in procuring competent map engravers in the United States?

Answer. None.

5. Question. Do you know of any special superiority of German engravers over those of the United States?

Answer. No; I consider the American workmen better, cleaner, and more rapid.

6. Question. Please to look at the map hereto annexed, and marked A. William J. Stone, and state whether it is the original map sent from the House to you, and from which you engraved the map of Newark bay, as mentioned in the first part of your testimony.

Answer. It is.

7. Question. What is the scale on that manuscript map?

Answer. Of three inches to the mile, as on the map I engraved.

8. Question. Annexed is a map of Cape Cod, (marked B, William J. Stone:) did you engrave that?

Answer. Yes.

9. Question. How long does it take, in your establishment, to engrave such a map?

Answer. About two months.

10. Question. What are the dimensions of that map?

Answer. Thirty inches by thirty-six inches.

11. Question. When were you summoned by the committee to attend and be examined?

Answer. I received Mr. Mallory's letter on Monday, the 30th May, and attended that morning.

12. Question. Was that the first intimation you received on the subject?

Answer. Yes.

13. Question. Have you had previously any conversation with any member of the committee on the subject of the examination?

Answer. Never, of any kind whatever.

14. Question. Had you any knowledge of the purpose for which you were summoned?

Answer. No.

15. Question. Did you, as requested by the committee, call on Mr. Hassler, and present the note of the chairman?

Answer. I did.

16. Question. What occurred?

Answer. The interview was so disagreeable, that I would rather not describe it, unless it be insisted on by the committee.

The chairman therefore propounded to the committee the following question: Shall Mr. Stone be required to state what occurred in his interview with Mr. Hassler? and it was determined in the affirmative—Mr. Mallory, Mr. Aycrigg, and Mr. Cushing, present, and voting.

The question being again propounded to Mr. Stone, he answered as follows:

I went to Mr. Hassler's office, and knocked at the door. A servant showed me into his room, and asked me to sit down, and in a minute or two Mr. Hassler came in. I then handed him Mr. Mallory's letter. Mr. H. read it, and immediately fell into a violent rage, and swore that I should not see the map, neither should the committee have it. After much rudeness and violent language, both towards the committee and me, Mr. Farley came in, and Mr. H. handed him the letter. After some further conversation, Lieutenant Page came in, and Mr. H. showed him the letter, and further conversation ensued. At length Mr. H. permitted me to examine the map, which I did; and on my departure, he handed me a letter for the chairman of the committee, which I delivered to Mr. Aycrigg. This letter is annexed, and marked C, F. Mallory.

17. Question. How long would it take to engrave such a map, and what would it cost?

Answer. It would require about a year, I think. There are eight plates, each of 22½ by 32½ inches, making 5,912 superficial inches, which, at 3 cents per inch, would be $177 36, for the *copper*; the engraving, the sum of $4,132. This estimate is given for the execution of the work in the best and most accurate manner, understanding that the parallels of latitude and

longitude, with their subdivisions, are marked in by an officer of the survey, and the engraving is to exactly correspond with the same, which must ensure an accurate chart. I have made a liberal estimate, to enable the engraver to enter minutely into detail, and to do justice to himself and to the Government.

WASHINGTON CITY, *March* 23, 1842.

SIR: Among the questions put to me in the committee's meeting, there was one, at least, which appeared much insisted upon, and by circumstances was rather discussed than answered.

It seemed to put in doubt the propriety of the journals, and other works of the coast survey, to remain in the coast survey office, and requesting them to be delivered to the Treasury Department for safety. I will here supply more distinct answers.

1. This office here is one of the offices of the Treasury Department, exactly as much as any of the rooms in the Treasury building itself.

2. The extension of the Treasury Department works has obliged to have a number of other offices out of the yet unfinished Treasury building proper, so is this office.

3. The foreign standards of weights and measures have just now been transported from the Treasury building to this office, for their more proper and more appropriated safe keeping.

4. There are three houses, adjoining each other, rented by the Department, two at the expense of the coast survey, and one at the expense of the weight and measure works and the foundry establishment, besides its access to the street.

5. The total of the buildings adapted themselves so peculiarly to the use of both works, that no building in the city could, in any way, equal the conveniences they afford, by their present distribution.

6. Various arrangements have been made, at public expense, as well as at the expense of the owner, to adapt them the better; one story was elevated, to procure drawing rooms superior to any I know of; for better security, the roofs have been slated; and, in general, every arrangement made for convenience and security.

7. In every one of the three buildings, which connect all through with one another, two persons at least sleep; these are assistants, clerk, workmen, and I myself, so that the buildings are well watched all night.

8. The maps and many other valuable objects, are placed so that even in the extreme case of fire, they would be saved with the greatest ease.

9. The whole of the coast survey work must, in all cases, and at all times, be of the easiest access, nay, present, during the whole time that the work is going on, still more so than in any other office such may be required.

10. In requiring place in the Treasury building only to deposite the foreign standards, which had been expunged from the State Department to the Patent Office, where they were exposed to damage, I could not get a well appropriated place for want of room.

11. The lower vaults of the Treasury building, where I got a place to deposite the weight and measure standards, packed up and not yet sent off, could not but with difficulty be got, and such an one would not do,

because of their not being sufficiently dry and aired for paper, the maps especially would be utterly destroyed.

12. To displace the works from the office would be laying great impediment in the way of the work, and expose the parts deposited to *dilapidation* and *abuse*.

13. Every time that a certain systematically full part of the work, between two base lines, and two astronomical stations, will be executed, a full report will be made, and it is hoped published by Congress, which will rest that part forever, and then the documents of that part may be placed into some specially selected place of deposite, as original record, but until that time they *must remain* in the office in which they originate.

14. It would be the most effective mode of clearing up any subject whatsoever, that may be desired, and come in question, if the committee would be so kind to come over to the office, which is so near the Capitol, and visit all the parts of the work, as they are in activity, and constantly in evidence for every visiter.

F. R. HASSLER.

Hon. F. MALLORY,
Chairman of the Select Committee
of Investigation of the Coast Survey.

WASHINGTON CITY, *March* 30, 1842.

I must add a more detailed answer to that question which asked me "How I would proceed in the Southern coast, where marshes, woods, &c., presented peculiar impediments?" I answered to it: "By mixed astronomical and geodetical observations." This question was followed by that: "Is that not more or less the case with all the coast survey?"

This question showed that the nature of the scientific principles to be applied and indicated by my answer were unknown. I must therefore *explain:* what is called, in mathematical practice, MIXED astronomical and geodetical observations, is, when both these elements concur in the *same individual determination;* this is the case in the application of a problem of practical mathematics, which I have applied in Switzerland and in this country, on Weasel mountain, (to the full knowledge of my assistants,) to obtain the junctions of my works of 1817 with those of 1833, in the beginning, when I had not yet a new base line nor sufficient angles; it was equally successful in both cases.

It consists in "one geodetic line being given in position and length, the latitude of either point being known, the latitude and the angle, the line subtends from a third point, being observed, together with the azimuth of either end point, to determine the place of observation." From such a result new connexions are then opened further onwards; other similar problems may be made.

This is what I was beginning to express when I was stopped, under the denomination of entering into arguments, which Mr. Cushing refused to hear.

That I should expose it from its elementary principles, is what I am sure the committee cannot intend, because it is a problem which, joining both branches of science, would require long deductions of principles, almost an elementary work, for persons not acquainted with the science.

In triangulation, the two kinds of observations, astronomical and geodetical, are *disconnected;* each operation is *separate*, and they are only compared to draw conclusions upon one another, for a new, different result, required to place the survey in general to its proper place upon earth; therefore the astronomical parts are only made at a few properly selected places, and with *general views* for the work, *not* for *details*, like in the other case, as I have stated in my answer to question 5, article 3d, of my report of December 2, 1841.

F. R. HASSLER.

Upon the question of limitation of the works for the survey of the coast.

WASHINGTON, *April*, 1842.

1st. The limitation to any determined distance from the coast would require that the mountains, which are indispensably necessary for the station points of the survey, be within that distance.

2d. This is well known not to be the fact, therefore also the limitation not adapted to the nature of the country, thence this limitation would become impossible to be observed, if even decreed.

3d. If even smaller elevations were found within these limits, which it might be said fit to substitute instead of the greater ones, it would be improper to use them otherwise than so as they are used now, namely, for secondary triangles, and the plane-table operations.

4th. These smaller elevations from their too great proximity would occasion triangles by far too small to give the accuracy required for the connexions of the work.

5th. The multiplication of the triangles would evidently also require a much greater length of time to execute them, because every one of them would require as much time and trouble as one of the large triangles, which might cover six or twelve of the small ones.

6th. With this increasing of the operations the necessity of cutting through woods, &c., increase actually in still greater proportion as the triangles themselves, and these cuttings are one of the great difficulties of the work.

7th. Such smaller triangles are even much more tedious to make properly than the large ones, therefore they consume each more time, and of necessity retard the work, by limiting the greater strides which the freedom of work at present admits.

8th. Upon the limitation of the work only in the *topographical part*, the same reasoning applies as to the more extensive operations; the inland bays, rivers, creeks, &c., which are navigable, are all so winding and very often hid in hardly approachable marshes, that to follow them, which often would be fully impossible, would necessarily take up much more time than to survey them by the general survey of the whole topography of the neighborhood.

9th. How far therefore this topography shall, can, or must, go, it is as impossible as improper to determine beforehand; without the special reference to any given locality nothing can be said about it in general terms.

10th. This reference to any given locality can only be decided by the operator upon the spot, and the special superintendent of the work, as has always been done hitherto.

11th. The topography has hitherto never yet been carried further than

the proper aim, and the principles of the work require; on the contrary, in several instances, an extension of the work has been specially desired.

12th. Any idea of limitation and distinction between the different parts of the works would never be understood by the uninformed people with whom the operators in the work must come in daily contact.

13th. Thence would result, that any owner of land, upon which an operator in the survey would have to go, could explain this limitation to his fancy or interest, and attack him, drag him to jail, and otherwise expose him to insult and ill-treatment, at his own option, as has been too often the case already.

14th. That even this accessory incident causes much loss of time, and forms an actual retardation of the work, is *self*-evident.

15th. The topographical part appears by experience to be that least objected to by the inhabitants, to judge from the manner in which the operators have been received, in comparison with the difficulties that have been laid in the way of the other parts of the work.

16th. In general, a limitation to three miles from the coast, as has been talked of, is a virtual abolition of the work itself, as well from the side of the natural as the moral difficulties it would suscitate, and the impossibility of giving to the work the required accuracy, nor would any other limitation be less injurious.

F. R. HASSLER.

WASHINGTON, *May* 30, 1842.

SIR: The unprovoked *insult* offered to me, by sending the engraver Stone to me to inspect the work of the coast survey in the map of New York, is too much, as well for the powers of the committee, as for the feelings of an honest man.

You know that the maps of the coast survey cannot be engraved but in the office under my own inspection. You know that the map in question is already cut up in plates, two of which are under the engraver's hands, nearly finished; two others just beginning; for two more the drawing is nearly finished; and two more are half finished drawings.

You know that the engraver Stone is in no way qualified to do such work, nor that I could be made responsible for any of his doings.

Hence you cannot otherwise but conclude that the measure you begin is destructive to the work, therefore to the execution and expenses hitherto incurred, therefore directly opposite to the aim professed by the committee to favor the coast survey work.

No man can expect that I, who am answerable for the work, could be compelled to give the final execution in the hands of a man in whom I have not the slightest reason to have any confidence whatever.

I consider the sending of Stone to *inspect my work, as he said first, as an unmerited insult*, and I am certain that every member of the committee, placed in my situation, would consider it so.

With best respects and good wishes, your obedient servant,

F. R. HASSLER.

Hon. FRANCIS MALLORY,
Chairman of the Committee on the Coast Survey.

Washington City, June 3, 1842.

Sir: Mr. Mallory having communicated to me the questions addressed to me in the committee, with my hasty answers at the time, according to the agreement, in order that I might add to my answers the explanations and extensions which they require, I have made the proper additions and remarks, and added to them some papers, (copies,) which I had given in to the committee at some times intermediate, with nearer particulars in some instances.

Mr. Mallory, chairman of the committee, being now absent for a fortnight, as he said, I take the liberty herewith to address to you the papers resulting from these additions, for the use of the committee, most likely best to circulate among the members, to cause as little delay as I can in the labors of the committee, to a final close, which would be desirable, to enable me to go to the field work time enough for my plans or projects of this season.

I suppose Mr. Stone will have made his report upon his *examination* of the manuscript map of New York, for which he has been sent to me in the name of the committee.

Mr. Mallory has also informed me that I should not leave here, because the committee would call me up in examination upon the works of the weights and measures. I, therefore, am now waiting, and like always in readiness to answer also upon this part of my works.

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

F. R. HASSLER.

Hon. Isaac E. Holmes,
Member of the Committee upon the Coast Survey.

Additions to the answers of F. R. Hassler to the questions of the Select Committee for the Coast Survey, May, 1842.

To 1 add: By my contract with the Government, I am bound to deliver nothing of the work but to the Government or its order, that is, the Treasury Department, with whom my contract is made. It is therefore through that medium that all publications, and whatever may have reference to them are to be ordered, that are to be executed by me in this respect.

To 2 add: But they must, for that purpose, at the time of their application for publication or otherwise, be reduced to the scale which their application will require; like that is always the case, no map being published so as it is surveyed.

To 3 add: It is evident in principle that the map of harbors must as well surveyed as published upon a much larger scale than those of a mere running coast.

To 4 add: It is necessary on the part of the Government to take proper measures to give, with the publication, guaranty to the public, for the authenticity of all that is published. (See answer to question 5 in my report of December, 1841.)

To 5 add: But the publication of the Delaware is of much more pressing importance.

To 6 add: But this cannot be done until a full system of main triangulation between two base lines is completed.

To 7. Because this was not a requisite in the case; the points used were all only detail points. What may be proper to be quoted of mathematical data, belongs to the general account of the work.

To 8 add: My papers upon various subjects relating to the survey of the coast of the United States, in the philosophical transactions of Philadelphia, 2d volume, new series, 1825, which are in duplo in the Library of Congress, give full account of these parts; what may become necessary to add after the present work, has to await its proper time. (Remark:) The word measuration is, in all these articles, used entirely against its sense in the science.

To 9 add: Nor is this proper to be done but at an appopriated distance from the first base line, and astronomical station of some amount proportionate to the work which is to be grounded upon it.

To 10, 11, 12, 13, add: These stations were not exclusively astronomical stations; the astronomical observations were intended more for preliminary determinations at the beginning, to guide the work, and to take advantage of the presence of the assistants, who were all present, to introduce them and to exercise them in this kind of observations. The main aim of these stations was the determination of main triangulation points.

To 12 add: There also a solar eclipse was observed.

To 14 add: Upon the station of Weasel mountain all the means for astronomical determinations and azimuths, were united, and a regular system of these observations executed, with its appropriated combinations, upon peculiar methods, which I made and prescribed, and which succeeded to satisfaction. The isolated observations of the preceding stations were of course reduced to this by way of comparison.

To 15 add: Those of 1817 were measured only preliminarily with the chain; still the verification proved very satisfactory, as the triangle results and the measurement differed less than 8 inches in about five miles. The base line of 1834 was measured with the microscopic apparatus, and exactly so as described in the papers of the philosophical transactions of 1825, quoted above.

To 16 add: From a point southeast of the light house, towards the sea, upon the sand along the sea eastwards, the points are marked by square-hewn red sandstone, of near four feet length, fixed solid in the ground. (See my 3d report, May 8, 1835.)

To 17 add: The end points of these are marked by hollow cones of stone ware.

To 18 add: It was, of course, proper to take advantage of this element on hand, to start the work more rapidly in 1833, by using determinations grounded upon these bases, so much the rather as they had proved exact; the use made of them in 1817 appears in the schedula of the triangulation which I handed in to the Treasury Department in 1818.

To 19 add: The remark to 6 applies here most forcibly, and upon a larger scale; such an account is to be given only when two bases are joined. I did it on a small scale in 1818, because I had, by way of precaution, measured two bases near each other, (see the reasons in my printed papers above quoted.) Now, in the renewed work, this must be done only when another large base line is measured, by the same means and methods as that on Fire Island beach has been, and at a distance from that, in proper proportion

with the extent to which the survey shall reach. There is a *lapsus calami* in the statement of my answer.

To 20, 21, and 22: For concealing. But it would be of no use whatsoever to any body except copyists, who would, by abusing the public property in the work, degrade it. It would be, therefore, an expense not only useless, but very detrimental. It will, besides, all appear in the account referred to in the addition to 19; in fact it would be highly improper to do it, before the publication of the more extensive system, of which it shall form a part in proper time. There is however no concealment about it.

To 23 add: It is the duty of the Government to let no parcelling out be possible, under penalty of seeing the Government's own work ultimately discredited; such a desire cannot be fairly entertained.

To 24 add: This quality of being official is absolutely required to give confidence to the public, therefore security to the navigation, (see question 5, in my report of December last.)

To 25 add: When the account of the modes, and of the means to their execution will be joined to them, which can be done only after a certain full system between two main bases, can be presented to the public.

To 26 add: Unless flagrant falsification, which men of science would discover immediately in the account rendered of the work, but in the map alone there lies no such verification, therefore also they are not admitted as any proof of the work; notwithstanding that in common habit, *in the offices here*, this is not regarded, nor any account of the mode of operating is asked.

To 27 add: Just therefore the hasty publication of an unfinished work has no value.

To 28 add: Like stated upon question 7, which is in fact the same.

To 29 add: Where I expect to find a proper locality to measure one, probably upon what is called Eastern shore.

To 30 add: Unless circumstances should decide me to accelerate still more, on the ground of finding better locality, therefore larger triangles, which would be more advantageous to join northerly from there the points, now reached from the north.

To 31 and 32 add: The secondary, plane-table, and naval parties, are now (25th May) all out; how long I shall be detained by the circumstances, I cannot know, as it does not depend of me.

To 33 add: That is no more than is fully compensated by the advantages which it gives in the office part of the work, and the keeping in order of the instruments of the coast survey, which is of daily occurrence, in which my task is very much eased by it.

To 34 add: Without the constant attendance to my works, at any hours that can be used for them, my task would be positively inexecutable; this is evidently the state of the establishment, and the works produced.

To 35 add: That extra works and varieties occur in all works, is too well known to expect that every day shall be equal to every other day; my easiest part is the field work.

To 36 add: The field work is more agreeable, in the favorable season, than the office work; they are always anxious to go out as soon as they can.

To 37 and 38 add: These are sufficiently explained as for the fact, but it must be added here, that the speaking disreputably and inimically against the coast survey work in Congress, occasions ignorant men in the

country, who read these things, to lay impediments in the way of the work, and to ill-treat us, which is a great loss to the work, and its economy.

To 39: It is well known that the accidental circumstance of the exhaustion of the old appropriation, and the delay of the new one, have kept all back to the end of May, in 1842, and that I remain even after that. I advanced money to assistants to enable them to go out, only $350; but if the attacks had not been made upon me, as well known, I would have prevented all stoppage, as I did three times in the beginning of the work, but under existing circumstances it was not proper for me to advance my credit as I did in those cases, and also before in London.

To 40, 41, and 42, add: The main triangulation determining large distances with greater accuracy than the secondary triangulation, it serves as element and groundwork for the latter, which, in consequence of the accuracy of these elements, can proceed outside of the limits of the main triangulation for a certain distance, without losing sensibly in accuracy. But this has its determined limits; the main triangulation has always kept near enough to the other parts of the work, not to expose it to any loss of accuracy, detrimental to the use made of the secondary triangulation.

To 43 add: This namely means that, in this place and time, both triangulations must come up together, and then the field of operation is open in all directions.

To 44, 45, 46, 47, 48, and 49: I should desire very much that, by the time the work is in that state, more extensive means might present themselves, appropriated to the exigency of the case that may then be, but to say any thing about it, would be of no avail, and premature.

To 50 and 51 add: It must be remarked upon these articles that, the putting me in jail at Mount Holly by a warrant of Judge Dayton, of Trenton, given upon the oath of a *clergyman* of the name of Brown, who *swore* his damage was over $200, because I had refused to pay, at first presentation, instantly, a bill presented to me by a, so called, Judge Haywood, for $25 damages, because I found it overrated and asked an impartial estimate, to legitimate me to direct the payment to be made, (the accounting officer being absent;) that such a circumstance, I say, I considered as neither *decent* nor agreeable; such acts go to the direct overthrow of the work, the court concern following; it cost both sides useless, but I had to stand the disagreement, and the Treasury Department had to defend the suit, which awarded the *reverend* Mr. Brown with difficulty, as a highest extreme, the $25 claimed, most of the jury voting first for $10, $15, or $20, instead of the hundredth which he had *sworn to*. It was necessary to stand this legal transaction in self-defence—the documents upon it can be exhibited.

At Yards the same impudence is now repeated, damages asked of more than double the value, and impudent letters written upon it, &c.

Such things not only cost money, but have a tendency to give apprehensions upon the safety of our station points, and signals, to the great annoyance of the work.

To 52 add: We have been obliged to make a special agreement with the owner of the land of the station next after Yard, to avoid difficulties if possible, by a contract for the use of the land for three years.

To 53, 54: I have habitually only one of the persons engaged in the work, at lower wages than assistant, to write the angles, not to take an assistant, at higher wages, away from a more important work; in this pecu-

liar instance at Yards, a friend was a great part of the time with me, who was capable to assist me, as I was sick, and in signalizing, to ascertain visibility of distant stations, being acquainted with the country.

To 55, 56: It is very natural that in this, like in every other subject of science, or knowledge, the acquirements and improvements are gradual; they develope themselves as the occasion for them is given, and with a considerable, and proportional consummation of time. So much so, that even in Europe this branch of science is not so much spread, as it is pretended, to be already in this country, where it has never yet been employed at all; for the detached small surveys, made so abundantly, do not come at all in comparison, nor under the principles of science, which is absolutely required for such an extensive work as the coast survey, especially in the form and in the locality of the earth in which it lies.

To 57: These are not the exact words of my answer; I answered, with measured reflection, "*Science* is no secret, but it *requires* a great deal of *study to acquire it.*

To 58: The accusation of secret, started against me, is *most unfounded*, as my assistants will certainly aver.

To 59, 60, 61: To explain nearer these three answers, would require a theoretical and practical treatise upon the subject, which would be too long, and not appropriated here.

To 62: It would be presumptuous in any man, to name a certain determined time, none would undertake it unless he had the accessory *intention to mislead.* (See my answer to question 13, of the resolution of the last Congress session.) Steady assiduity, and well-guided exertions, will bring it forward as fast as the nature of the work, and the localities of the country will admit, and more can neither be expected, *nor obtained*, by no means whatsoever; mathematical principles and nature, cannot be bargained with.

To 63: It is evident, that the length is no determining element of the work, because the nature of the coast, and its indentures, etc., form the determining element, as stated repeatedly.

To 64: This would evidently have to be measured by the principles stated in the preceding answer, and therefore can afford but a very vague scale of comparison; what I have said upon that in my report of last December, gives all the data, that can be given to a man knowing both, the science and the country.

To 65: This is an individual experience of mine, no doubt the determinations, charts, maps, &c., will vary among one another.

To 66, 67: Need no addition.

To 68, 69, 70, 71, 72, 73, 74: These questions go evidently into details of the practical applications of the mathematical principles, to certain localities, which can be discussed only with the map of these localities before the eye.

To 71: I decline no answer upon any question.

To 75: I must add a more detailed answer to that question which asked me: "How I would proceed in the Southern coast, where marshes, woods, &c., presented peculiar impediments?" I answered to it "by mixed astronomical and geodetical observations." This question was followed by that "Is that not more, or less, the case with all the coast survey?" This question showed, that the nature of the scientific principles to be applied, and indicated by my answer, were unknown. I must therefore *explain:* what is called, in mathematical practice, MIXED astronomical and geodetical ob-

servations, it is, when both these elements concur in the *same individual determination;* this is the case in the application of a problem of practical mathematics, which I have applied in Switzerland, and in this country, on Weasel mountain, (to the full knowledge of my assistants,) to obtain preliminarily the junction of my works, of 1817, with those of 1833, in the beginning, when I had not yet a new base line, nor sufficient angles; it was equally successful in both cases.

It consists in "one geodetic line being given in position and length, the latitude of either point being known, the latitude, and the angle which the line subtends from a third point, being observed, together with the azimuth of either end point, to determine the place of observation."

From such a result new connexions are then opened further onwards.

This was what I was beginning to express, when I was stopped, under the denomination of entering into arguments, which Mr. Cushing refused to hear.

That I should expose it from its elementary principles is, what I am sure, the committee cannot intend, because it is a problem which, joining both branches of science, would require long deductions of principles, almost an elementary work, for persons not acquainted with the science and its practical application.

In the triangulation the two kinds of observations, astronomical and geodetical, are *disconnected*, each operation is *separate*, and they are only compared to draw conclusions upon one another, for a new, different result, required to place the survey in general in its proper place upon earth; therefore the astronomical parts are only made at a few properly selected places, and with general views for the work, not for details, like in the other case, so as I have stated in my answer to question 5, article 3, of my report of December 2d, 1841.

To 76: The second base forms as much an indispensable part of a survey of a large extent as the first base. This is a principle in the science well known by all accounts of large surveys.

To 77: (I had added) and corrected. This could, however, not be the case for any great amount, in a well-conducted work, and a well-conditioned series of large triangles.

There are other data and results to be obtained, and considered, in such a completed system of a work, which are well known to be deduced from it by the science, but which to treat here would require an elementary, theoretical, and practical deduction, entirely out of place.

To 78, 79, 80, 81, and 82: These questions could be discussed long, without leading to any actual practical effect. They are treated under the general denomination of the question of limitations asked to be introduced in the work, in the paper already handed in, and here repeated, viz:

Upon the question of limitation of the works for the survey of the coast.

1. The limitation to any determined distance from the coast would require that the mountains, which are indispensably necessary for the station points of the survey, be within that limited distance.

2. This is well known not to be the fact; therefore, also, the limitation not adapted to the nature of the country; thence this limitation would become impossible to be observed, if even decreed.

3. If even smaller elevations were found within these limits, which, it

might be said, fit to substitute instead of the greater ones, it would be improper to use them otherwise than so as they are used now, namely: for secondary triangles and the plane-table operations.

4. These smaller elevations, from their too great proximity to each other, would occasion triangles by far too small to give the accuracy required for the connexion of the work.

5. The multiplication of the triangles would evidently also require a much greater length of time to execute them, because every one of them would require as much time and trouble as one of the large triangles, which might cover six or twelve of these small ones.

6. With this increasing of the operations, the necessity of cutting through woods, &c., increases actually in still greater proportion than the triangles themselves, and these cuttings are one of the great difficulties of the work.

7. Such smaller triangles are even much more tedious to make properly than the large ones; therefore, they consume each more time, and, of necessity, retard the work, by limiting the greater strides which the freedom of the work at present admits. The improper increase of the expenses is self-evident.

8. Upon the limitation of the work only in the *topographical part* the same reasoning applies as to the more extensive operations. The inland bays, rivers, creeks, &c., which are navigable, are all so winding, and very often hid in hardly approachable marshes, that to follow them, which often would be fully impossible, would necessarily take up much more time than to survey them by the general survey of the whole topography of the neighborhood.

9. How far, therefore, this topography shall, can, or must go, it is as impossible as improper to determine beforehand, without the special reference to any given locality, nothing can be said about it in general terms.

10. This reference to any given locality can only be decided by the operator upon the spot and the special superintendent of the work, as has always been done hitherto.

11. The topography has hitherto never yet been carried further than the proper aim, and the principles of the work require; on the contrary, in several instances, an extension of the work has been specially desired.

12. Any idea of limitation and distinction between the different parts of the works would never be understood by the uninformed people with whom the operators in the work must come in daily contact in the field works.

13. Thence would result that any owner of land upon which an operator in the survey would have to go could explain this limitation to his fancy or interest, and attack him, drag him to jail, and otherwise expose him to insult and ill treatment, at his own option, as has been too often the case already.

14. That even this accessory incident causes much loss of time, and forms an actual retardation of the work, is self-evident, as well as its expensiveness.

15. The topographical part appears, by experience, to be that least objected to by the inhabitants, to judge from the manner in which the operators have been received, in comparison with the difficulties that have been laid in the way of the other parts of the work.

16. In general, a limitation to three miles from the coast, as has been talked of, is a virtual abolition of the work itself, as well from the side of the natural as the moral difficulties it would suscitate, and the impossibility

of giving to the work the required accuracy; nor would any other limitation be less injurious.

17. The shore line of a coast is never seen from a ship approaching it; the picture of the elevated land is what presents itself to the sailor; in this he is guided by so much of the topography as can be seen at a reasonable distance at sea, and this lies back in the country at distances which are not determinable but by actual survey; thence the only rule is that which I have followed, and long ago stated, namely: the "topography must go to the ridge of mountains which determine the heads of the coasting rivers or creeks, or their passage through such mountains, what is called in France, technically, '*le versant de la Vallie côtiere*,' or '*le voisant de la cote*.'"

Such it has always been understood and proved.

18. My rule of action, and guide in the work, must be my contract to make the work "*honorable* and *permanently useful, to the nation*:" the way to obtain the aim must be left to me; if I was to be guided by any foreign direction, except mathematical principles, some of my assistants might even rise up against me, refusing to do, what they might think to exceed my powers, and I would either have to dismiss them for such refusal, or the work would become impossible.

19. Hitherto the work has proceeded in harmony, and with all good-willing exertions on the part of every one; if such had not been the liberal action of all in the case, not half the work would be done, which actually is done.

21. The attempt to find causes for change in my arrangement, by the resolution of the last Congress session, and the present committee, has already caused a great damage.

To 84: As I keep a regular journal every day, since 1811, when I left Schenectady for London, for all the time that I am in public employment, I can give exact account of every event of any moment; here follows therefore the extract from these journals, referring to this question. My work in the office has always been the most arduous and laborious task, in the combination of the scientific methods, devising the means, the calculations, and all the manifold parts, of the administration, or direction of the works. Any man of science in this practical line will *see that easily*.

Times of going to the field work, and returning from it each year, thus:

In 1832.

September 25, having received the instruments, I left Washington the 26th of September, at 8 o'clock, A. M., to reconnoitre for the continuance of my works of 1817, towards the east of it; returned to Washington the 31st of January, 1833, in the evening.

1833.

April 5, at 7½, A. M., left Washington for the first beginning of actual primary triangulation; returned to Washington the 3d of January, 1834, in the evening.

1834.

After having finished all the preparations and comparisons for the meas-

urement of the base line, I left the 29th of May, at 9 o'clock, A. M., having made also stations; returned 21st January, 1835, in the evening.

1835.

There being much calculation to be made, and many arrangements, for the organization of the parties, the State of Maryland having offered an arrangement to join the survey of that State with that of the coast survey, I went out only at different intervals to reconnoitre the country in Maryland, and until Washington and the outer bays, accompanied by Mr. J. H. Alexander, of Baltimore, until late in the fall and winter. Details could be given if needed.

1836.

The present office was established. I left 17th August, at 7½ o'clock, A. M., and returned the 8th of January, 1837.

1837.

I left Washington 14th June, at 8¾ o'clock, A. M., and returned at 4½ o'clock, P. M., 5th January, 1838.

1838.

I left Washington July 19, at 8 o'clock, A. M., and returned 24th December, 1838, just at sunset.

1839.

I left Washington the 9th of June, at 7 o'clock, A. M., and returned the 5th of January, 1840, beginning of dark.

1840.

I left Washington the 14th of September, at 8 o'clock, A. M., 1840, and arrived again at Washington the 20th of January, 1841, at 6 o'clock, P. M.

1841.

I left Washington 29th August, at 10 o'clock, A. M., 1841, and returned 22d December, 1841, at night.

This enumeration shows how the office work has increased since the beginning, when the work was starting, and the elements for it were first collected in the field. In the further progressing state of the work, the calculations, as well of myself, as of the assistants, the reduction into maps, making of projections, to take to the field, for the topographical and hydrographical works, their plotting and working out, required as much, and in most cases even more work, from the assistants in the office, than out of doors; so that indeed the going out for the field work is considered as real relief, from the harder works of the office, as well for me, as for the assistants. For what relates to my assistants' *time* of going to the field work, they must be asked themselves.

To 83 till 90, inclusive: There is some miswriting in some of my answers to these questions.

Instructions for sounding outside of Long Island and New Jersey shore, from Block Island until Cape May, out of sight of land, and some interior parts, given to Capt. Gedney, in 1841 :.

1. The soundings are to be extended in the lower part of New Jersey, as far as the Gulf stream, which will be met there, at a distance appropriated to the wants of the approaches to the shore in navigation.

2. The return current of the Gulf Stream will be met before, and perhaps already something of an inner stream, which runs inside of this parallel to the Gulf stream, nearer to the shore, in the more southern parts of the coast, as a result of the contre-current; it may be sensible along the Jersey coast, but along the shore of Long Island none of these will likely be felt.

3. These two inner currents will, in their places, have a tendency to lead the sounding vessels off from their intended courses, so that account must be kept of this circumstance in the sailing and the determination of the points of soundings.

4. There will be found along the Jersey shore, near about the distance where the land ceases to be visible, a sand bank, or beach under water, which, when met with in any place, it is proper to follow in its course, as a special object. It will likely present more or less breadth and interruptions by deep water similar to the inlets of the dry beaches of the shore.

5. As the entrances of the inlets through the dry beaches are of importance, it will be necessary to determine if these two outer and inner inlets correspond, and, in any case, to determine any best course of navigation leading to the inlets of the beaches through these openings or interruption of this outside bar. They are much used by coasting vessels.

6. On the outside of Long Island shore such a bank is not likely to be, in a similar manner as along the Jersey shore, but rather a deepening placed somewhat similarly, but further from the shore, outside of which there will likely be less depth again.

7. In the offings of New York bay, where these two probable dispositions cross one another, great attention will be paid to the irregular changes of the depth and the currents; these latter will change with the time and the different elevations of the tides, therefore also at different times of the year; perhaps some regularity may show itself in it, with the time of the tide, which it will be of interest to ascertain.

8. It would lead to clear up the question of the currents, if the *direction* of the current of the *ebb tide in the offing* was carefully followed in its course, particularly in the times of the highest tides; because, these will always occasion temporary currents in directions, which depend on many circumstances of the winds, and the configuration of the ground under water.

9. In the part of the Jersey shore already passed over, the soundings ought yet to be multiplied in several places by boats, nearer to the shore than the larger vessels can come; this joins with the investigation stated above, of the beach under water or shoal bank, which longes the Jersey shore, and the openings through it. In calm weather, passages are well practicable with boats, which may be sent off from the vessel attending to them from the outside.

10. In the part of the soundings already done and falling in the map of New York, the register map exhibits some omissions, which must be filled

up first; therefore, will be the first work to be attended to this spring, and the results of them be sent into the office as soon as obtained; these are:

A. The low grounds of Communepa, at the west of the light-house of Robin's reef; around Bedlow's and Ellis's islands, they have in the lower part only one line sounded through in a northerly direction, which is not an actual channel, but the steamboats pass through two different channels, over the flat west of the light-house and east of the island, &c.; there are docks at the two islands which are of constant use and even proposed for public works, &c. These flats in general are navigated at high water in different directions by small vessels; it is therefore necessary to make a regular, full, accurate sounding of the whole—the docks, channels, &c.—with boats, directed from the vessel stationed at proper places, and determined from the many triangle points of the neighborhood.

B. The cove, called the Great Kilns, at the southeast side of Staten island, northeast of Princess bay, has an inlet practicable, at high water, for small vessels, which occasions very often that many go in to shelter in it; it must be sounded with boats.

C. The whole shoaler part of the Jersey shore, from South Amboy to the Navesink, and the bay behind Sandy Hook, must be sounded nearer in shore, till to below 2 feet depth, even some inlets of the creeks, the bay and harbor of Keyport, Middletown point, &c. Steamboats and coasting vessels frequent this shore; it is therefore necessary and important to have the detail soundings of it.

D. The eastern part of Gravesend bay must be filled up with soundings in the same way.

E. The inlet of Rockaway and into the Jamacia bay has been omitted to be sounded, as far as it is practicable, towards the interior with small vessels which frequent it very much, a part even admits larger vessels. It will be proper to fill up that deficiency, and to go with a boat round in the interior, to see how the low grounds, which are extensive and with marshy bottom, are constituted.

The same is the case with the neighborhood, Hog Island inlet, and several such places around; nearer notice of them must be taken in the maps; and by the indication of the low soundings, the end of the navigable part may be indicated, in the same manner as that has been done in Great South bay.

F. In all these places it is proper to determine the two lines of high and low water.

G. In all the bay, the currents must yet be observed more particularly.

H. In all soundings the nature of the bottom is of course observed, and, in proper places, introduced in the maps or charts.

11. For the accurate determinations of the places of these different interior soundings, you will have to put up again the signals of the neighborhood, which will be needed as fixed points, to determine the position of the vessels and the boats from them.

12. To determine your position, out of sight of land, you will always take your departure from a point yet in sight of some well-determined stations, and get, by observation upon four or five points, the means of verification by independent data, for the more accurate determination of this starting point.

13. From such points you may then proceed in a regular, uniform course and direction, determining the rate of going of the vessel, and keep-

ing account of the time elapsed since the starting from the point of departure to all the points at which you will take soundings, by which you will be able to make an estimate of the position of such a place, and all the points under way at which soundings have been taken; whenever occasion presents itself, you may verify your work by retracing the route backwards, determining again the point of arrival, within sight of the same, or other convenient, well-determined points on the shore, determining the place of arrival in the same manner as the point of departure has been. By keeping account of these forward and return courses, by both the log and the time of the chronometer, with a first free determined rate of velocity, you may, by this comparison of the two double results, get an insight into the currents, if any, in the directions gone through.

14. This method you may pursue to a certain distance from either the Jersey or the Long Island shore, particularly if no changes occur from lateral currents or other disturbing causes.

15. You may, under favorable circumstances, from any well-determined sounding point, send off boats to make soundings, under the guide of an azimuth compass, in a direction rectangular to the course of the vessel, but this will be admissible only where the depth is not too great. The distances, being measured by the time and velocity of the boat, ascertained as well as possible.

16. In starting from a point south of the Long Island shore, well determined by the problem of three points, in the manner described above, you may be sailing under a determined angle with the meridian, in a steady southerly direction, then you can, by the determination of your latitude at noon, indicate the point of arrival at that time, by which the length of your whole course will be determined, and become comparable with the register of your sailing; by this, also, all the points at which soundings have been taken in the course of the line, and its continuance afternoon, will become determined proportionally, and become comparable.

17. In such a course, and in general, in any case of determination of your position by the noon observations of the sun, you will find it advantageous for the accuracy of the result, as well as most easy, to make use of the method of determining latitude and longitude, simultaneously, by circum-meridian observations, with a reflecting instrument and a chronometer, a method which I have described and used to advantage.

18. *You will make, as much as possible, regular observations on board* ship, to ascertain the rate of your chronometers, and compare them at intervals with the well-determined time of New York, keeping separate account of the going of the chronometers, which, besides that, you will compare together every day. Of the whole, you will keep a regular register, in the manner in which you have the form in one of mine. The chronometers being regulated for mean time, it will also be necessary to get mean time in New York.

19. To verify your compass, you will make a regular comparison of it with any one of the principal lines of the main triangulation of the coast, near your operations, of which the real azimuth will be furnished to you whenever you will inform the office of the coast survey of the line chosen.

20. The base line of the Long Island shore itself may be fitting for that purpose; you may, at the same time there investigate the state of security and preservation of the monument stones, placed at the two ends of the

base, which it is so highly important to preserve undisturbed, and your information upon this subject to the coast survey office is desired.

21. Whenever out of sight of land, you will, at every noon, make the observation indicated by the method above alluded to, keeping a regular account of the results of the observations, both as to latitude and the time of your chronometers; these determinations will form the principal data to compare with the time of New York.

22. For all observations of latitude or time, at sea, you will make use of your best sextant of Troughton, using the largest magnifying powers, and always make series of as many observations as can be conveniently made, suppose five or ten, in the latter case forming two calculations, each of five observations, to take a mean result.

F. R. HASSLER.

WASHINGTON CITY, *May* 1, 1841.

WASHINGTON CITY, *May* 7, 1842.

SIR: You will, with all the officers and crew attached to your party of the brig Washington, proceed, as soon as you can be ready, to sea, to execute the direction given to you in my instruction of May 1, 1841, which you will consider as herewith repeated to you at full length, and execute all the operations to be performed for the soundings out of sight of land, between the longitudes of the east end of Long Island and of Cape Henlopen and the latitudes of the same points, in the manner indicated to you at that time.

You will employ in this work all the means of assistants, and all other means which are at your disposition, exclusively, for all the time during which the season may be favorable to that work, or until to its full completion, that, if possible, it may not become necessary to recur to the same works another season. You will in this work follow the special instructions, and description of methods of observing, &c., which I have given to you in writing, to your instruction of last year.

When you will either have fully executed the task here stated, or the season will no more allow work at such a distance from the coast, as may be required, you will report to me your progress immediately, to receive such instruction about your further works as the state of the work and the circumstances will then dictate.

With best wishes, yours, &c.

F. R. HASSLER.

Com'r TH. R. GEDNEY, *U. S. N.*,
Assistant in the Coast Survey.

It is evident to every man acquainted with the coast and its approaches that the district, described in these instructions, forms the offings of the two ports of New York and the Delaware bay. The brig Washington is considered a vessel well adapted for this work; it is in good order for it.

To 91: The end of my answer should stand thus: according to my special *formulæ* for the work. There are other miswritings in the question and the answer.

To 92 and 93: These answers I consider sufficient, as any detailed discussion could not lead to any useful result; there are slight misunderstandings in the writing, which are of no moment, as for instance in 93, *ascertained* is not my, nor a proper, expression, &c.

To 94 to 98, inclusive: These answers I consider as self-evident, and entirely of the domain of the science, in one respect, and of the decision of the Goverment in another; I have said upon it what was to be said by me, in its proper place, in my report of last December. If the work is not carried on, with all the means that science dictates for its execution, *it is worse than useless, and discreditable.* I consider myself always bound to such a course, as I have hitherto pursued, and have found myself always approved in this view, by those men *best able* to judge, and by those in the *proper stations to decide upon it.*

To 99: So far as is expected from small secondary triangles; but, according to good principles, it must still be *joined* in its middle, by triangles across the country, from the main triangulation inland; this is indispensable mathematical requisite.

To 100: It is well known, by my very first plans of operation for the work, that this was the only true course for the main triangulation.

To 101: It is self-evident to any practical mathematician, and answered in a former question.

To 102, 103, and 104: Are sufficient explained. I may only add now, 25th May, that a third engraver has just arrived from Philadelphia.

To 105: There is evidently an omission of some words in my answer.

To 106: This time, includes in part the time used in the preparatory arrangements.

To 107 and 108: It is *well known* that the finer style of topography is not in practice yet in this country; my duty required, that this part of the execution of the work should be of the best quality, to answer honorably the aim of the work, in its final appearance in the public: therefore I procured, with authorization of the Treasury Department, two men known in Europe already in this line, from the quarter in best renown for the appropriated style of these works, which will guide the style of the work, also with the engravers, to be engaged hereafter.

To 109: The habitual way in common use is very bad. To preserve the accuracy obtained by the work of the survey, the main points, which guide the positions, are brought upon the copper, by the same assistant, who makes the drawing of the map, which secures the accuracy. For the same reason, also, the engraving and the printing must be made in the office itself, where it is done much more economically, under proper inspection, and not dilapidated.

To 120 add: Whenever an interest was manifested for any part of the work, for improvements, or otherwise, the extracts of the work desired, were given under the *authorization* of the Treasury Department, under whose decision all *communications* or *publications* are to be made, *according to* my agreement.

List of the individual maps executed and delivered.

No.	Maps.	By whom made.	Scale.	Date.	Remarks.
1	Harbor of Bridgeport, Ct.	Lt. G. S. Blake	1-10,000	1835	Engraved.
2	Newark bay, N. J.	Lt. Th. R. Gedney	1-10,000	183–	Engraved.
3	Harbor of New Haven, Ct.	Lt. G. S. Blake, and Wm. M. Boyce.	1-10,000	1838	Engraved.
4	Country between the Thames and Niantic, from the sound up to Mohigan creek.	F. H. Gerdes	1-10,000	1840	Treasury Department, for the honorable J. W. Williams.
5	Sandy Hook bar	C. Renard	1-10,000	1841	Treasury Department, light-house, Mr. Pleasonton.
6	Thames river, topography and hydrography.	F. H. Gerdes	1-20,000	1842	Treasury Department, for Senator Huntington.
7	Sandy Hook bar	H. L. Whiting	1-10,000	1842	Topographical bureau.
8	Fisher's Island sound, and the entrance of New London harbor, Ct.	F. H. Gerdes	1-20,000	1842	Treasury Department, for the honorable J. W. Williams.

To 111 and 112: The principles of my action in this respect, are fully exposed already in my printed papers upon the coast survey, quoted before. The reduction, to any other measure, consists only in the addition of a constant logarithm, as for instance, that for the yards, and even for the miles, is given in my printed logarithmic and trigonometric tables. As all the scales of the maps are expressed by their fractional value, the distance upon the maps can be ascertained in any measure whatsoever, and by that means is really given in any measure whatsoever, which is widely different from the *bad method* so many miles to the inch, which has no regular comparable proportion.

The pressing of the questions put to me in the committee, and refusing all explanatory answers, in a subject which cannot be understood without them, must of course always leave some unilluminated spots after the examination is over, I must therefore take the liberty to supply afterwards.

1st. Mr. Aycrigg asked particulars about: why I measured with the metre as unity. I will not delay here by any detailed explanation, but must take the liberty to refer to my report upon the coast survey works of May 17, 1834, section 34, where the subject is fully treated, it stands in page 148 of the first volume of documents upon the survey of the coast, printed by me in 1834, and in the Congressional Documents of that time.

2d. Mr. Cushing said, that the discoveries of dangers in the navigation of the sound had been kept *secret ten years*; this is an *entirely erroneous statement*, the work itself being even not as old as that, the sound was of course worked later; the sounding part was made by Lieutenant Blake, United States navy, assistant in the coast survey; I request that he be asked particularly to clear up this *erroneous* statement.

3d. Upon the publication, or not publication of any thing resulting from the coast survey, *no reproach whatsoever can be applied to me*, because, by my contract with the Government, I am prohibited to communicate any results without order of the Treasury Department. Whenever such orders were given, they were instantly executed, as well known, sometimes even they were provoked by me, and given to public officers. My public accounts showed regularly every year the state of the work, *upon which any call could have been grounded.* I must, in this respect, request again that my answers to questions 5 and 7, of my last report, be considered as inserted here, and also the section 12, of my communication of 23d March last.

4th. The publication is, of course, a consequence of the survey; but only in proper time. Its reduction, as well by calculation as by the mapping, is a work absolutely intermediate between the two, therefore the means given by the appropriation are to be distributed in due proportion between them, *according to the state of the work*, and the means on hand, by the existing appropriation at any special time.

Besides, no publication can be creditably done, unless it presents a work, presenting a systematic whole in itself, be it a map of a harbor, or a certain part of the coast. The origin of the improper, hasty claims, is too well known to me; it would be of too much real damage to give way to it.

5th. I was asked how many hours the assistants worked per day: I answered, as many as the day allows, (*the work cannot be made in office hours.*) This addition, I believe, has been omitted to be written down; in fact, all my assistants, like I, work from interest for the work, and not as

hirelings by the hours, it would be a disgrace to treat the actors in a scientific work with such illiberality.

To 113 and 114 : These answers are self-evident.

To 115 add : As far as known to me, at least in respect to the scientific account of the work, as there is nothing of it in the publication of the English survey.

To 116 and 117 : Sufficiently clear by themselves.

To 118 : The hours of work are immaterial to mention, as they all work with really liberal exertions, for the best advantage and promotion of the work, even with regard to economy.

A well-organized work produces much result, without appearing laborious.

To 119 add: My work in establishing the uniformity of standards, weights, and measures, in this country, with more accuracy (I can safely pretend) than other countries have it, are public documents which speak upon that. My various books printed, upon elementary parts of mathematics, upon astronomy, tables, &c., might be looked at in the Congress Library, and if desired I will show the manuscripts of other works not yet published. However, my situation in early life had caused me to apply to diplomacy and jurisprudence; and I occupied offices of high trust in these branches, to full satisfaction, as my papers may prove, my first entering into public life dating now *over 56 years ago.*

I must be excused to enter here in extraneous details, because I recollect very well Mr. Mallory's question was general, *whether I know something more than only the coast survey.* Without the limitation to mathematical.

To 120 add : But the constant persecution to which the work has been exposed, and especially *now is*, impede its progress very much; there is a damage now incurred by the propositions of the last Congress session, and the present investigations, which have been occasioned by it, of positively upwards of $50,000, in delay of the work, and accessories; besides the discouragement occasioned by it, in all those persons who are engaged in the work, by their seeing their liberal exertions rewarded by *throwing out suspicions* against them, these occasion a still greater damage. The discredit thrown out in the public, occasions impediments with the people in the country, with whom we come in contact, they consider themselves equally authorized to ill-treat us, which makes the work difficult, and increases the expenses beyond reason, to no good purpose, and subject to uncertainty.

F. R. HASSLER.

WASHINGTON CITY, *June* 1, 1842.

TREASURY DEPARTMENT, *June* 9, 1842.

SIR : I have the honor to submit, herewith, the information called for in the resolutions of the select committee of the House of Representatives, on the subject of the coast survey, enclosed in the communication of the honorable Francis Mallory, chairman of said committee, addressed to the President under date of the 12th of March last, copies of which were furnished by the committee to this Department on the 16th ultimo.

The information is contained in the accompanying letters and statements

from the War and Navy Departments, the Second and Fourth Auditors, and the Register of the Treasury, numbered from 1 to 5, both inclusive.

All which is respectfully submitted.

W. FORWARD,
Secretary of the Treasury.

The PRESIDENT *of the United States.*

NAVY DEPARTMENT, *June* 3, 1842.

SIR: In reply to your letter of the 16th ultimo, transmitting "a copy of a communication from the Hon. F. Mallory, chairman of the select committee on the coast survey," and requesting this Department to furnish the information asked for, so far as its files and records would enable it to do so, I have the honor to transmit a copy of a letter from the Fourth Auditor, with a statement showing the names of the officers of the Navy who have been employed on the coast survey, and the amount of pay received by each.

I am, very respectfully, your obedient servant,

A. P. UPSHUR.

Hon. WALTER FORWARD,
Secretary of the Treasury.

TREASURY DEPARTMENT,
Fourth Auditor's Office, May 31, 1842.

SIR: A letter addressed to you by the acting Secretary of the Treasury, on the 16th instant, enclosing a communication from the chairman of a select committee of the House of Representatives to the President of the United States, requesting certain information in regard to the coast survey, having been referred to this office for a report, I have the honor to transmit a tabular statement, "showing the 'navy pay' received by the several officers employed on the said survey, during the respective periods of their engagement on such service," so far as it can be ascertained from the files or records of this office. It is proper for me to observe, however, that, as the purser's accounts for the first quarter of the present year have not all been received, (the law allowing three months after the close of the quarter for rendering them,) it is possible that some payments may have been made, between the 1st of January and the 12th of March last, to the officers employed on the said survey, which are not included in the statement submitted; but, if there be any such, I am satisfied that the amount of them is inconsiderable.

The papers referred to me are herewith returned.

I have the honor to be, &c.

A. O. DAYTON.

Hon. A. P. UPSHUR,
Secretary of the Navy.

List of officers of the navy who have been employed on the coast survey, "between the period of the commencement thereof and the 12th of March, 1842," showing also the amount of navy pay received by each while engaged in the performance of said duty, so far as appears by documents on file in this office.

Names.	Rank.	Amount.
Thomas R. Gedney	Lieut. comm'g and commander	$13,593 20
Geo. S. Blake	Lieutenant commanding	12,421 88
I. T. McLaughlin	Passed midshipman	447 69
Francis Huger	Do	437 40
B. W. Hunter	Do	423 02
A. S. Worth	Do	409 23
T. A. Jenkins	Passed midshipman and lieut.	7,272 20
W. J. H. Robertson	Passed midshipman	281 61
Joshua Humphreys	Midshipman	286 69
John Rodgers	Passed midshipman and lieut.	408 11
Geo. M. Totten	Midshipman	276 23
John L. Ring	Passed midshipman	3,017 08
Levin Handy	Do	3,266 79
Alberto Griffith	Passed midshipman and lieut	3,424 91
B. F. Sands	Do do	7,158 93
A. A. Holcomb	Do do	5,773 71
R. W. Meade	Do do	3,215 11
W. H. Ball	Passed midshipman	3,140 41
D. D. Porter	Passed midshipman and lieut.	5,627 08
F. Clinton	Passed midshipman	2,464 75
J. Sterrett	Do	887 77
Richard Bache	Passed midshipman and lieut.	3,880 90
S. C. Rowan	Do do	4,584 46
R. Wainwright	Do do	1,544 52
Geo. M. Bache	Do do	3,912 98
C. P. Patterson	Do do	3,491 38
C. W. Chauncey	Lieutenant	1,841 71
J. J. Boyle	Do	3,039 08
D. F. Dulaney	Assistant surgeon	455 51
J. K. Mitchell	Lieutenant	2,974 40
W. Chandler	Do	2,960 43
E. G. Parrott	Passed midshipman and lieut.	1,452 76
H. H. Lewis	Passed midshipman	709 21
T. H. Stevens	Midshipman	195 97
Stephen Johnston	Lieutenant	1,402 78
John Mooney	Passed midshipman and lieut.	1,093 13
H. S. Stellwagen	Do do	2,026 01
Henry Moore	Lieutenant	916 54
W. A Bartlett	Passed midshipman	961 86
J. P. McKinstry	Do	302 15
Oliver Todd	Passed midshipman and lieut.	7,935 76
B. J. Morller	Do do	3,718 21
T. A. Budd	Passed midshipman	1,478 88

LIST—Continued.

Names.	Rank.	Amount.
T. A. M. Craven	Passed midshipman	$4,949 69
Z. Holland	Do	482 52
W. Bleecker	Do	266 06
W. Craney	Midshipman	220 81
A. McLane	Do	227 57
H. C. Flagg	Passed midshipman and lieut.	1,877 43
C. W. Morris	Do do	2,913 66
Henry Oaks	Midshipman	263 06
W. E. Newton	Do	251 39
I. I. Almy	Passed midshipman	710 23
W. B. Whiting	Passed midshipman and lieut.	4,301 06
I. F. Mercer	Do do	2,875 99
W. S. Young	Do do	6,050 09
O. H. Perry	Passed midshipman	527 60
W. C. Lambert	Do	682 15
C. C. Barton	Do	448 84
Luther Stoddard	Do	303 79
Francis Lowry	Do	1,217 42
John Hall	Do	227 72
T. M. Brashear	Do	245 76
I. B. Dale	Passed midshipman and lieut.	2,045 97
D. R. Crawford	Passed midshipman	269 60
Ed. Jenkins	Do	589 13
R. C. Cogdell	Do	293 81
S. D. Lavallette	Midshipman	170 06
J. N. Barney	Passed Midshipman	139 39
M. C. Delaney	Surgeon	1,749 02
S. Sharp	Do	3,781 45
T. I. Page	Passed midshipman and lieut.	11,781 07
O. H. Berryman	Passed midshipman	3,218 65
I. A. Dahlgren	Do	3,127 35
F. A. Bacon	Do	43 83
W. May	Midshipman	148 90
F. P. Hoban	Do	132 75
I. C. Graham	Passed midshipman	288 61
C. J. Wyche	Do	500 56
A. L. Case	Do	507 32
		181,942 71

WAR DEPARTMENT, *May* 17, 1842.

SIR: In answer to your letter of the 16th instant, and the several papers, copies of which you enclosed to this Department from the "select committee on the subject of the coast survey," I have to transmit a report of the Colonel of the corps of Topographical Engineers. It is believed that the further inform-

ation embraced in the call must be furnished from the records and files of the Treasury and Navy Departments, and their subordinate bureaus.

The papers transmitted by you are respectfully returned herewith.

Very respectfully, your obedient servant,

J. C. SPENCER.

To the SECRETARY OF THE TREASURY.

NOTE.—The pay accounts of officers of the army are settled by the Second Auditor of the Treasury.

BUREAU OF TOPOGRAPHICAL ENGINEERS,

Washington, May 17, 1842.

SIR: I have the honor to acknowledge your direction to report upon certain queries from the select committee on the coast survey. Of the queries on the paper A, the 4th is the only one applicable to the War Department.

The following is the list of army officers who have been employed in this duty:

Major John J. Abert, corps topographical engineers, in 1816.
Major John J. Abert, corps topographical engineers, in 1817.
Major John J. Abert, corps topographical engineers, in 1818.
Lieutenant W. G. McNeill, of the artillery, in 1818.
Lieutenant J. A. Adams, of the artillery, in 1818.
Lieutenant J. R. Vinton, of the artillery, in 1818.
Captain W. H. Swift, corps topographical engineers, in 1832, 1833, 1836, 1837, 1838, 1839, 1840, 1841, and 1842.

Major Abert and Captain Swift were, while so employed, also the disbursing agents of the Treasury Department.

It is not in my power to state either the "army pay and emoluments" or any "additional pay" which these officers received while on this duty, as the accounts in the case do not pass through this office. The Second Auditor will be able to furnish the information in reference to army pay and emoluments, and the First Auditor that in reference to additional pay.

The queries of the paper B are the following:

1st. Whether a part of the topographical corps of the army can be detached for the purpose of the coast survey.

Answer. This can undoubtedly be done; probably from four to six could be detached during the present season; and more, as the various surveys upon which the corps is now engaged are completed, if other duties are not in the mean time assigned to it.

2d. Whether the expense of the service of the coast survey will probably be reduced by detaching a part of the topographical corps.

Answer. There would certainly be a reduction, to the extent of the civil agents, and the amounts of compensations paid to them, who would have their places supplied by officers of the corps.

3d. Whether the expenses of the survey of the coast will probably be reduced by employing other persons than officers of the army and navy to perform the duties they are now employed to perform in the coast survey.

Answer. This is a question of compensations, supposing qualifications to be equal in each. As officers of the army and navy draw their pay from the army and navy appropriations, it is clear, that, if some of these are em-

ployed in the coast survey, the appropriation for that survey will be relieved to the amount of their pay; and equally clear, that, if these officers are not so employed, but others in their places, these others must derive their compensations from the appropriation for the coast survey, and the appropriation be taxed to that extent.

Very respectfully, sir, your obedient servant,

J. J. ABERT,
Col. Corps Topographical Engineers.

Hon. J. C. SPENCER,
Secretary of War.

TREASURY DEPARTMENT,
Second Auditor's Office, May 23, 1842.

SIR: In obedience to the request contained in your letter of the 18th instant, to be furnished with "the amount of army pay and emoluments, in dollars and cents," allowed to the officers of the topographical engineer corps, mentioned "in Colonel Abert's letter, herewith sent; also, the pay and emoluments of Lieutenants Bomford and Mackay, of the army, who were employed in the coast survey duty in the year 1833," I have the honor to report as follows:

Major John J. Abert was paid for the year 1816 - -	$1,545 20
Major John J. Abert was paid for the year 1817 - -	1,616 40
Major John J. Abert was paid for the year 1818 - -	1,592 40
Lieutenant W. G. McNeill was paid for the year 1818 -	689 20
Lieutenant J. A. Adams was paid for the year 1818 - -	689 20
Lieutenant J. K. Vinton was paid for the year 1818 - -	689 20
Captain W. H. Swift was paid for the year 1832 - -	963 60
Captain W. H. Swift was paid for the year 1833 - -	1,160 16
Captain W. H. Swift was paid for the year 1834 - -	1,067 80
Captain W. H. Swift was paid for the year 1835 - -	947 00
Captain W. H. Swift was paid for the year 1836 - -	948 00
Captain W. H. Swift was paid for the year 1837 - -	947 00
Captain W. H. Swift was paid for the year 1838 - -	1,363 93
Captain W. H. Swift was paid for the year 1839 - -	1,926 80
Captain W. H. Swift was paid for the year 1840 - -	1,916 80
Captain W. H. Swift was paid for the year 1841 - -	1,829 40
And from the 1st January, 1842, to 31st March, 1842, to which time only does he appear to have been paid for this year - - - - - - - -	487 50
Lieutenant Bomford (J. Y.) was paid for the year 1833 -	764 96
Lieutenant Mackay (John) was paid for the year 1833 -	837 90

And return herewith the accompaniments of your letter.

I am, sir, very respectfully, your obedient servant,

W. B. LEWIS.

MCCLINTOCK YOUNG, Esq.,
Acting Secretary of the Treasury.

Captain Swift, by the act of July, 1838, receives the pay and emoluments of a captain of cavalry; previous to which, he received only the pay, &c., of a captain of infantry; and by that act he receives one ration for every five years' service; and since 1838 has, in addition, been in receipt of double rations, as he was also for part of 1838.

A list of all officers of the navy employed in the coast survey; their navy pay during their service in the coast survey; and the additional pay of each in the coast survey, from the year* 1833 *to* 31*st December,* 1841.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1833, 1st quarter	Mid. Henderson	$95 00	
1833, 2d quarter	Lieut. Bell	176 00	
1833, 3d quarter	Mid. Henderson	88 00	
1833, 3d quarter	Lieut. Bell	184 00	
1833, 4th quarter	Lieut. Bell	184 00	
1837, 1st quarter	T. R. Gedney	–	$1,516 00
Do	G. S. Blake	–	1,434 00
Do	Mid. Handy	–	633 00
Do	Sands	–	706 00
Do	Lambert	–	336 00
Do	Budd	–	449 00
Do	Todd	–	558 00
Do	Craven	–	585 00
Do	Flagg	–	47 00
Do	Dahlgren	–	760 00
Do	C. M. Morris	–	330 00
Do	A. S. Worth	–	119 00
Do	Mercer	–	331 00
Do	Bleecker	–	119 00
Do	T. S. Page	–	760 00
Do	Griffith	–	449 00
Do	T. A. Jenkins	–	760 00
Do	A. F. Holcomb	–	304 00
Do	W. H. Ball	–	353 00
Do	R. W. Meade	–	219 00
Do	A. S. Case	–	213 00
Do	D. D. Porter	–	336 00
Do	F. Oakes	–	204 00
1837, 2d quarter	Clinton	–	336 00
Do	Holland	–	216 00
Do	Berryman	65 00	
Do	Handy	61 00	
Do	Humphreys	–	128 00
Do	R. W. Meade	68 00	
Do	T. R. Gedney	156 75	
Do	T. J. Page	372 50	
Do	J. A. Dahlgren	375 00	
Do	T. A. M. Craven	107 70	
Do	F. F. Hagar	85 00	

* For navy pay, see statement of Fourth Auditor, accompanying Secretary of the Navy's report, marked No. 1.

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1837, 2d quarter	B. J. Morller	$91 00	
Do	O. H. Berryman	30 00	
Do	J. McLaughlin	119 00	
Do	B. F. Sands	100 00	
Do	A. Griffith	91 00	
Do	A. A. Holcomb	91 00	
Do	J. L. Ring	91 00	
Do	R. W. Meade	30 00	
Do	W. B. Whiting	101 00	
Do	H. C. Flagg	101 00	
Do	W. H. Ball	91 00	
1837, 3d quarter	Mid. Handy	61 00	
Do	Berryman	92 00	
Do	Newton	—	$194 00
Do	McLane	—	134 00
Do	Meade	62 00	
Do	Holcomb	62 00	
Do	T. A. Jenkins	625 00	
Do	G. S. Blake	313 50	
Do	T. A. M. Craven	100 00	
Do	Mid. Sands	100 00	
Do	O. H. Perry	113 00	
Do	W. S. Young	173 00	
Do	H. C. Flagg	92 00	
Do	O. Todd	211 00	
Do	J. F. Mercer	183 00	
Do	T. A. Budd	129 00	
Do	A. Griffith	92 00	
Do	L. Handy	61 00	
Do	R. W. Meade	30 00	
Do	D. D. Porter	183 00	
Do	W. B. Whiting	92 00	
1837, 4th quarter	T. J. Page	312 50	
Do	J. A. Dahlgren	375 00	
Do	Mid. Clinton	190 00	
Do	Holcomb	61 00	
Do	Porter	31 00	
Do	Ring	136 00	
Do	Berryman	92 00	
Do	Griffith	44 00	
Do	Handy	92 00	
Do	Ball	123 00	
Do	Almy	193 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1837, 4th quarter	Mid. Clinton	$44 00	
Do	Young	51 00	
Do	Meade	30 00	
Do	Budd	46 00	
Do	Perry	45 00	
Do	T. J. Page	312 50	
Do	T. A. Jenkins	312 50	
Do	T. R. Gedney	156 75	
Do	Mid. Morller	184 00	
Do	Sands	100 00	
Do	Whiting	92 00	
Do	Almy	46 00	
Do	Meade	31 00	
Do	Ball	61 00	
Do	Holcomb	61 00	
Do	Meade	31 00	
Do	Mercer	51 00	
Do	Todd	92 00	
1838, 1st quarter	Graham	121 00	
Do	Handy	31 00	
Do	Berryman	31 00	
Do	Holcomb	31 00	
Do	Lieut. G. S. Blake	210 00	
Do	Mid. Porter	92 00	
Do	Handy	28 00	
Do	Berryman	28 00	
Do	Ball	59 00	
Do	Meade	59 00	
Do	Lieut. T. J. Page	102 58	
Do	T. R. Gedney	175 00	
Do	F. A. Jenkins	312 50	
Do	T. A. M. Craven	200 00	
Do	Mid. Sands	119 00	
Do	Whiting	90 00	
Do	Holcomb	59 00	
Do	Handy	31 00	
Do	Ball	31 00	
Do	Berryman	31 00	
1838, 2d quarter	Robertson	125 00	
Do	Todd	90 00	
Do	Berryman	30 00	
Do	Clinton	117 00	
Do	Craney	142 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1838, 2d quarter	Mid. Handy	$30 00	
Do	Meade	61 00	
Do	Porter	89 00	
Do	Ring	30 00	
Do	Flagg	46 00	
Do	Morller	90 00	
Do	Barton	44 00	
Do	Berryman	31 00	
Do	Handy	31 00	
Do	Almy	100 00	
Do	J. A. Dahlgren	1,067 30	
Do	T. J. Page	125 00	
Do	F. A. Jenkins	312 50	
Do	Mid. Sands	100 00	
Do	Lieut. T. R. Gedney	156 75	
Do	G. S. Blake	259 50	
Do	Mid. Patterson	97 00	
Do	Todd	91 00	
Do	Berryman	30 00	
Do	Ball	91 00	
Do	Wainwright	97 00	
Do	Holcomb	91 00	
Do	Meade	61 00	
Do	Mercer	111 00	
Do	Lieut. Sterrett	68 00	
Do	Mid. T. A. Budd	111 00	
Do	Barton	30 00	
Do	Whiting	91 00	
Do	Perry	135 00	
Do	Young	107 00	
1838, 3d quarter	Budd	17 00	
Do	Perry	17 00	
Do	M. G. Delaney, surgeon	97 00	
Do	Mid. Bacon	34 00	
Do	Handy	61 00	
Do	Stoddart	34 00	
Do	Barton	31 00	
Do	Meade	31 00	
Do	Rowan	127 00	
Do	Sterrett	31 00	
Do	Bache	127 00	
Do	M. G. Delaney	31 00	
Do	Griffith	120 00	
Do	M. G. Delaney	31 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1838, 3d quarter -	Mid. Sterrett - -	$31 00	
Do -	Meade - -	31 00	
Do -	Wainwright - -	62 00	
Do -	Patterson - -	62 00	
Do -	Whiting - -	62 00	
Do -	Flagg - -	136 00	
Do -	Stoddart - -	31 00	
Do -	Lowry - -	39 00	
Do -	Brashear - -	38 00	
Do -	Barton - -	31 00	
Do -	Hall - -	39 00	
Do -	Ring - -	123 00	
Do -	Berryman - -	62 00	
Do -	Handy - -	31 00	
Do -	Hunter - -	–	$190 00
Do -	Sands - -	100 00	
Do -	T. J. Page - -	125 00	
Do -	T. R. Gedney - -	156 75	
Do -	T. A. Jenkins - -	312 50	
Do -	T. A. M. Craven - -	200 00	
Do -	M. L. Delaney, surgeon -	30 00	
Do -	Mid. Meade - -	30 00	
Do -	Sterrett - -	30 00	
Do -	Todd - -	92 00	
Do -	Young - -	92 00	
Do -	Ball - -	61 00	
Do -	Handy - -	30 00	
Do -	Barton - -	30 00	
Do -	Hall - -	30 00	
Do -	Lowry - -	30 00	
Do -	Whiting - -	30 00	
1838, 4th quarter	M. L. Delaney - -	31 00	
Do -	Mid. Meade - -	31 00	
Do -	Holcomb - -	123 00	
Do -	Rowan - -	92 00	
Do -	Handy - -	31 00	
Do -	Patterson - -	61 00	
Do -	Whiting - -	31 00	
Do -	Barton - -	31 00	
Do -	Clinton - -	184 00	
Do -	Berryman - -	61 00	
Do -	Griffith - -	92 00	
Do -	Porter - -	184 00	
Do -	Sterrett - -	31 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1838, 4th quarter	Mid. Bache	$92 00	
Do	Sands	33 33	
Do	Wainwright	61 00	
Do	Ring	61 00	
Do	Ball	31 00	
Do	Barton	12 00	
Do	Flagg	73 00	
Do	Young	43 00	
Do	Stoddart	73 00	
Do	Mercer	123 00	
Do	Hall	43 00	
Do	Lowry	43 00	
Do	Brashear	73 00	
Do	Meade	13 00	
Do	Clinton	13 00	
Do	Lieut. G. S. Bache	261 25	
Do	Mid. Berryman	30 00	
Do	Wyche	—	$225 00
Do	T. J. Page	125 00	
Do	T. R. Gedney	166 15	
Do	T. A. Jenkins	312 50	
Do	B. F. Sands	66 66	
Do	Mid. Handy	61 00	
Do	Holcomb	61 00	
Do	Ring	61 00	
Do	Porter	61 00	
Do	Patterson	61 00	
Do	Bache	61 00	
Do	Wainwright	61 00	
Do	Berryman	31 00	
Do	Ball	61 00	
Do	Morller	275 00	
Do	Todd	92 00	
Do	Whiting	61 00	
1839, 1st quarter	T. A. M. Craven	100 00	
Do	Mid. Griffith	12 00	
Do	Rowan	61 00	
Do	Mercer	92 00	
Do	Handy	31 00	
Do	Whiting	31 00	
Do	Ring	31 00	
Do	Berryman	31 00	
Do	Porter	31 00	
Do	Whiting	28 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1839, 1st quarter	Mid. Rowan	$59 00	
Do	Wainwright	59 00	
Do	Berryman	28 00	
Do	Handy	28 00	
Do	Patterson	59 00	
Do	Clinton	79 00	
Do	Holcomb	59 00	
Do	Ring	28 00	
Do	Bache	59 00	
Do	T. J. Page	125 00	
Do	T. A. Jenkins	312 50	
Do	B. F. Sands	100 00	
Do	G. S. Blake, lieut. com.	209 00	
Do	Mid. Handy	31 00	
Do	Porter	59 00	
Do	Patterson	31 00	
Do	Ball	90 00	
Do	Berryman	31 00	
Do	Morller	90 00	
Do	Ring	31 00	
Do	Holcomb	31 00	
Do	Clinton	31 00	
1839, 2d quarter	Whiting	61 00	
Do	Handy	30 00	
Do	Ring	30 00	
Do	Chauncey	32 00	
Do	Berryman	30 00	
Do	Wainwright	61 00	
Do	Holcomb	30 00	
Do	Bache	61 00	
Do	Clinton	30 00	
Do	Ball	30 00	
Do	Patterson	30 00	
Do	T. A. M. Craven	100 00	
Do	Mid. Meade	63 00	
Do	Ring	31 00	
Do	Patterson	31 00	
Do	Berryman	31 00	
Do	Ball	31 00	
Do	Wainwright	31 00	
Do	Rodgers	—	$183 00
Do	T. J. Page	125 00	
Do	Lieut. T. R. Gedney	156 75	
Do	T. A. Jenkins	312 50	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1839, 2d quarter -	T. A. M. Craven - -	$187 50	
Do -	Mid. Ring - -	30 00	
Do -	Griffith - -	83 00	
Do -	Wainwright - -	30 00	
Do -	Berryman - -	30 00	
Do -	Young - -	104 00	
Do -	Lowry - -	104 00	
1839, 3d quarter -	Sharpe - -	31 00	
Do -	Ring - -	62 00	
Do -	Berryman - -	31 00	
Do -	Wainwright - -	31 00	
Do -	Whiting - -	62 00	
Do -	Rowan - -	92 00	
Do -	Meade - -	92 00	
Do -	Holcomb - -	33 00	
Do -	Ball -	31 00	
Do -	Sands - -	187 50	
Do -	Patterson - -	30 00	
Do -	Ball - -	30 00	
Do -	Whiting - -	60 00	
Do -	Mercer - -	150 00	
Do -	Lieut. Todd - -	212 00	
Do -	G. M. Bache -	78 00	
Do -	Mid. Porter - -	122 00	
Do -	Bache - -	92 00	
Do -	Clinton - -	92 00	
Do -	Lieut. Chauncey - -	92 00	
Do -	Mid. Ball - -	31 00	
Do -	Patterson - -	31 00	
Do -	Wainwright - -	31 00	
Do -	Holcomb - -	92 00	
Do -	Berryman - -	31 00	
Do -	S. Sharpe, surgeon - -	124 00	
Do -	B. F. Sands - -	187 50	
Do -	T. J. Page - -	125 00	
Do -	T. A. Jenkins - -	312 50	
Do -	Lieut. T. R. Gedney -	156 75	
Do -	T. A. M. Craven -	187 50	
Do -	Young - -	92 00	
Do -	Griffith - -	92 00	
Do -	Chauncey - -	61 00	
Do -	Bache - -	61 00	
Do -	Mid. Patterson - -	61 00	
Do -	Whiting - -	30 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1839, 3d quarter	Mid. Holcomb	$30 00	
Do	Porter	61 00	
1839, 4th quarter	Berryman	30 00	
Do	McKinstry	152 00	
Do	Morller	183 00	
Do	Lieut. G. S. Blake	365 75	
Do	Mid. S. C. Rowan	153 00	
Do	Lieut. Bache	31 00	
Do	Mid. Bache	92 00	
Do	Porter	31 00	
Do	Lieut. Meade	61 00	
Do	Mid. Wainwright	61 00	
Do	Lieut. Griffith	31 00	
Do	Mid. Ball	61 00	
Do	Whiting	31 00	
Do	Mercer	123 00	
Do	Lowry	31 00	
Do	Holcomb	31 00	
Do	Lieut. Chauncey	37 00	
Do	Mid. Ring	67 00	
Do	Lieut. Meade	6 00	
Do	Surgeon Sharpe	67 00	
Do	Mid. Clinton	98 00	
Do	Porter	38 00	
Do	Lieut. Bache	30 00	
Do	Todd	122 00	
Do	Lieut. T. R. Gedney	156 75	
Do	T J. Page	125 00	
Do	T. A. Jenkins	312 50	
Do	T. A. M. Craven	187 50	
Do	Mid. Sands	187 50	
Do	Lieut. Young	92 00	
Do	A. A. Holcomb	30 00	
Do	Mid. Morller	92 00	
Do	S. C. Rowan	61 00	
Do	Wainwright	61 00	
Do	Bache	61 00	
Do	Porter	61 00	
Do	A. A. Holcomb	31 00	
Do	Mid. Ball	61 00	
Do	Lieut. Bache	31 00	
Do	Mid. Patterson	92 00	
1840, 1st quarter	Lieut. G. S. Blake	156 75	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1840, 1st quarter	Mid. Sands - -	$62 50	
Do -	Holcomb - -	31 00	
Do -	Patterson - -	31 00	
Do -	Berryman - -	123 00	
Do -	Todd - -	62 00	
Do -	Sands - -	62 50	
Do -	Rowan - -	60 00	
Do -	Ball - -	60 00	
Do -	Berryman - -	29 00	
Do -	Holcomb - -	29 00	
Do -	Morller - -	81 00	
Do -	Mercer - -	144 00	
Do -	T. R. Gedney - -	184 15	
Do -	T. J. Page - - -	125 00	
Do -	T. A. M. Craven - -	187 50	
Do -	Mid. Sands - -	62 50	
Do -	Young - -	91 00	
Do -	Porter - -	60 00	
Do -	Lieut. G. M. Bache -	91 00	
Do -	A. L. Holcomb - -	31 00	
Do -	T. A. Jenkins - -	79 79	
1840, 2d quarter	Mid. Patterson - -	60 00	
Do -	Wainwright - -	13 00	
Do -	Ball - -	44 00	
Do -	Lieut. T. R. Gedney -	58 25	—
Do -	G. S. Blake -	156 75	
Do -	Mid. Berryman - -	30 00	
Do -	Rowan - -	92 00	
Do -	Wainwright - -	91 00	
Do -	Whiting - -	61 00	
Do -	Young - -	61 00	
Do -	Lowry - -	71 00	
Do -	Flagg - -	71 00	
Do -	Patterson - -	61 00	
Do -	Berryman - -	31 00	
Do -	Holcomb - -	61 00	
Do -	Chandler - -	52 00	
Do -	Mitchell - -	52 00	
Do -	Boyle - -	52 00	
Do -	Moor - -	52 00	
Do -	Porter - -	61 00	
Do -	Lieut. G. M. Bache -	61 00	
Do -	S. Sharp, surgeon - -	52 00	
Do -	Lieut. T. R. Gedney -	104 50	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1840, 2d quarter	T. A. Jenkins - -	$125 00	
Do -	T. A. M. Craven - -	187 50	
Do -	Mid. Berryman - -	30 00	
Do -	Lieut. Stellwagen - -	82 00	
Do -	Mid. Holcomb - -	30 00	
Do -	Dulaney - -	82 00	
Do -	Porter - -	30 00	
Do -	S. Sharpe, surgeon - -	30 00	
Do -	Mid. Whiting - -	30 00	
Do -	T. J. Page - - -	125 00	
1840, 3d quarter -	D. F. Dulaney - -	31 00	
Do -	Mid. Berryman - -	31 00	
Do -	Lieut. Stellwagen - -	31 00	
Do -	Mid. D. D. Porter - -	31 00	
Do -	Lieut. Chandler - -	61 00	
Do -	Mid. Patterson - -	61 00	
Do -	Lieut. Mitchell - -	61 00	
Do -	G. M. Bache -	61 00	
Do -	H. H. Holcomb - -	31 00	
Do -	Lieut. Moore - -	61 00	
Do -	Young - -	61 00	
Do -	Mid. Whiting - -	31 00	
Do -	Lieut. Boyd - -	61 00	
Do -	Mid. Lowry - -	92 00	
Do -	Mid. Whiting - -	31 00	
Do -	Surgeon Sharpe - -	62 00	
Do -	Lieut. Chauncey - -	144 00	
Do -	G. M. Bache - -	31 00	
Do -	Mid. Berryman - -	31 00	
Do -	T. R. Gedney - -	156 75	
Do -	T. J. Page - - -	125 00	
Do -	T. A. M. Craven - -	187 50	
Do -	T. A. Jenkins - -	125 00	
Do -	D. D. Porter - -	61 00	
Do -	A. A. Holcomb - -	61 00	
Do -	D. F. Dulaney - -	61 00	
Do -	Mid. Patterson - -	61 00	
Do -	Surgeon Sharpe - -	30 00	
Do -	Mid. Whiting - -	30 00	
1840, 4th quarter	Lieut. G. S. Blake - -	261 25	
Do -	Mid. R. Bache - -	183 00	
Do -	C. W. Morris - -	133 00	
Do -	Lieut. W. Chandler -	92 00	
Do -	G. M. Bache - -	61 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1840, 4th quarter	Lieut. Patterson	$31 00	
Do	J. K. Mitchell	92 00	
Do	Lieut. Todd	274 00	
Do	Mid. Porter	31 00	
Do	D. F. Dulaney	31 00	
Do	A. A. Holcomb	31 00	
Do	F. Lowry	65 00	
Do	J. B. Dale	90 00	
Do	W. B. Whiting	29 00	
Do	H. S. Stellwagen	97 00	
Do	J. J. Boyle	98 00	
Do	H. C. Flagg	158 00	
Do	S. Sharpe, surgeon	40 00	
Do	O. H. Berryman	72 00	
Do	H. Moor	103 00	
Do	C. W. Chauncey	77 00	
Do	Mid. D. D. Porter	61 00	
Do	Lieut. G. M. Bache	61 00	
Do	Mid. R. Bache	92 00	
Do	Lieut. Young	153 00	
Do	T. J. Page	125 00	
Do	Mid. C. W. Morris	77 00	
1841, 1st quarter	T. A. M. Craven	187 50	
Do	Lieut. A. W. C. Chandler	61 00	
Do	J. K. Mitchell	61 00	
Do	G. S. Blake	209 00	
Do	Mid. C. W. Morris	31 00	
Do	Dale	89 00	
Do	A. A. Holcomb	92 00	
Do	D. D. Porter	31 00	
Do	J. K. Mitchell	31 00	
Do	Lieut. T. R. Gedney	282 53	
Do	Mid. R. Bache	59 00	
Do	Lieut. W. S. Young	59 00	
Do	Mid. C. W. Patterson	120 00	
Do	D. D. Porter	28 00	
Do	Lieut. Todd	120 00	
Do	Mid. W. B. Whiting	27 00	
Do	A. A. Holcomb	26 00	
Do	T. A. M. Craven	187 50	
Do	T. J. Page	125 00	
Do	T. A. Jenkins	125 00	
Do	C. W. Morris	59 00	
Do	S. C. Rowan	304 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1841, 1st quarter	Lieut. G. S. Blake	$90 00	
Do	Mid. C. M. Patterson	31 00	
Do	W. B. Whiting	31 00	
Do	Lieut. W. Chandler	90 00	
Do	Mid. D. D. Porter	31 00	
Do	Lieut. J. K. Mitchell	59 00	
1841, 2d quarter	R. Bache	31 00	
Do	A. A. Holcomb	122 00	
Do	Mid. Crawford	120 00	
Do	Lieut. W. S. Young	61 00	
Do	Mid. Patterson	91 00	
Do	Lieut. J. B. Dale	150 00	
Do	Mid. E. Jenkins	187 00	
Do	T. A. M. Craven	187 50	
Do	T. J. Page	125 00	
Do	T. A. Jenkins	25 00	
Do	W. B. Whiting	91 00	
Do	Lieut. T. R. Gedney	221 16	
Do	C. W. Morris	91 00	
1841, 3d quarter	G. M. Bache	30 00	
Do	D. D. Porter	30 00	
Do	J. K. Mitchell	30 00	
Do	S. Sharpe, surgeon	75 00	
Do	W. Chandler	91 00	
Do	E. G. Parrott	75 00	
Do	H. S. Stellwagen	75 00	
Do	J. K. Mitchell	61 00	
Do	G. M. Bache	61 00	
Do	Thos. H. Stevens	75 00	
Do	O. Todd	122 00	
Do	D. D. Porter	61 00	
Do	R. Bache	91 00	
Do	W. A. Bartlett	75 00	
Do	H. A. Holcomb	31 00	
Do	H. H. Lewis	106 00	
Do	A. A. Holcomb	31 00	
Do	D. D. Porter	62 00	
Do	D. R. Crawford	26 00	
Do	C. P. Patterson	92 00	
Do	A. A. Holcomb	30 00	
Do	C. W. Morris	92 00	
Do	R. Bache	92 00	
Do	W. B. Whiting	92 00	
Do	J. B. Dale	92 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1841, 3d quarter	E. Jenkins - - -	$92 00	
Do -	J. Mooney - - -	1[illegible]5 00	
Do -	S. Johnson - - -	1[illegible]3 00	
Do -	S. Sharpe, surgeon - -	92 00	
Do -	W. S. Young - -	153 00	
Do -	O. Todd - - -	92 00	
Do -	W. A. Bartlett - -	92 00	
Do -	W. Chandler - -	92 00	
Do -	R. C. Cogdell - -	37 00	
Do -	Thos. H. Stevens - -	92 00	
Do -	T. R. Gedney - -	156 75	
Do -	G. S. Blake - - -	418 00	
Do -	T. J. Page - - -	125 00	
Do -	T. A. Jenkins - -	125 00	
1841, 4th quarter	T. A. M. Craven - -	143 82	
Do -	E. G. Parrott - -	92 00	
Do -	H. J. Stellwagen - -	92 00	
Do -	G. M. Bache - -	92 00	
Do -	J. K. Mitchell - -	92 00	
Do -	W. Bartlett - - -	31 00	
Do -	A. A. Holcomb - -	31 00	
Do -	C. P. Patterson - -	31 00	
Do -	S. Sharpe, surgeon - -	31 00	
Do -	R. C. Cogdell - -	39 00	
Do -	S D. Lavalette - -	76 00	
Do -	E. Jenkins - - -	39 00	
Do -	A. A. Holcomb - -	30 00	
Do -	S. Sharpe, surgeon - -	30 00	
Do -	C. P. Patterson - -	30 00	
Do -	W. Bartlett - - -	30 00	
Do -	G. S. Blake - - -	156 75	
Do -	R. Bache - - -	92 00	
Do -	G. M. Bache - -	92 00	
Do -	S. Johnson - - -	92 00	
Do -	W. S. Stellwagen - -	92 00	
Do -	D. D. Porter - - -	92 00	
Do -	D. D. Porter - - -	30 00	
Do -	C. P. Patterson - -	31 00	
Do -	A. A. Holcomb - -	31 00	
Do -	H. H. Lewis - - -	61 00	
Do -	H. H. Lewis - - -	92 00	
Do -	E. G. Parrott - -	92 00	
Do -	J. K. Mitchell - -	92 00	
Do -	C. W. Morris - -	92 00	

LIST—Continued.

Year and quarter.	Name and rank.	Compensation.	
		Additional.	Arrearages.
1841, 4th quarter	J. B. Dale	$92 00	
Do	S. Sharpe, surgeon	31 00	
Do	O. Todd	92 00	
Do	W. S. Young	92 00	
Do	W. Chandler	92 00	
Do	T. A. Jenkins	125 00	

T. L. SMITH, *Register.*

TREASURY DEPARTMENT,
Register's Office, June 9, 1842.

A list of all persons, other than officers of the navy and army, employed in the coast survey, from its commencement to the 31st December, 1841, the order or orders under which they were employed, and the amount of compensation, regular and extra, paid to each.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1811 to 1818	F. R. Hassler	$29,310 94		
1832	F. R. Hassler	1,125 00		
1833	F. R. Hassler	4,500 00		
1833, 2d qr.	R. J. Livingston	144 34		
Do	J. Ferguson	325 59		
1833, 3d qr.	J. Ferguson	512 00		
Do	J. R. Livingston	171 06		
Do	E. Blunt	477 16		
1833, 4th qr.	E. Blunt	512 25		
Do	J. Ferguson	512 25	$125 00	
Do	R. J. Livingston	171 06		
1836, 1st qr.	Charles Renard	356 65		
Do	Hugo L. Dickins	95 58	84 30	
Do	F. R. Hassler	1,125 00		
Do	E. Blunt	509 45		
Do	Chas. Renard	351 81		
Do	J. Ferguson	506 02	125 00	
Do	H. L. Dickins	185 87		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1836, 2d qr. -	H. L. Dickins -	$281 44		
Do -	C. M. Eakin -	842 85	$84 30	
Do -	F. R. Hassler -	1,125 00		
Do -	Jas. Ferguson -	509 45	124 31	
Do -	Edm. Blunt -	509 45	90 16	
1836, 3d qr. -	H. L. Dickins -	286 98		
Do -	W. Wurdeman -	239 62		
Do -	Tho. McDonnell -	115 30		
Do -	Sam. Hein - -	433 00		
Do -	F. R. Hassler -	1,125 00		
Do -	F. Gerdes - -	138 38		
Do -	C. M. Eakin -	532 56		
Do -	E. Blunt - -	515 05	125 68	
Do -	C. Renard - -	355 68		
Do -	James Ferguson -	515 04	125 68	
1836, 4th qr. -	H. L. Dickins -	283 66		
Do -	C. M. Eakin -	426 06	106 51	
Do -	F. R. Hassler -	1,125 00		
Do -	James Ferguson -	515 04	125 68	
Do -	Edm. Blunt -	512 25	125 00	
Do -	C. M. Eakin -	-	195 83	
Do -	Sam. Hein - -	215 04		
Do -	F. H. Gerdes -	188 53		
Do -	C. Renard - -	355 68		
Do -	W. Wurdeman -	219 11		
Do -	Thos. McDonell -	173 96		
1837, 1st qr. -	H. L. Dickins -	279 11		
Do -	F. R. Hassler -	1,125 00	-	$6,494 52
Do -	James Ferguson -	505 23	123 28	
Do -	C. M. Eakin -	522 43		
Do -	C. Renard - -	348 19		
Do -	Wm. Wurdeman -	251 42		
Do -	S. Hein - -	247 42		
Do -	Thos. McDonnell -	201 42		
Do -	F. H. Gerdes -	150 00		
1837, 2d qr. -	John Farley -	500 00		
Do -	Sam. Hein - -	200 00		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. Boyce - -	395 60		
Do -	T. W. Werner -	375 00		
Do -	F. H. Gerdes -	375 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1837, 2d qr.	H. L. Dickins -	$375 00		
Do -	Thos. McDonnell	150 00		
Do -	C. Preuss - -	125 00		
Do -	T. P. Dornenburg -	164 04		
Do -	W. Wurdeman -	252 50		
Do -	W. Jacobi - -	65 00		
Do -	H. Paulson - -	65 00		
1837, 3d qr.	Thos. McDonnell -	177 67		
Do -	Sam'l Hein - -	222 75		
Do -	F. W. Werner -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	Edm'd Blunt -	695 65		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	C. Preuss - -	375 00		
Do -	J. P. Dornenburg -	200 00		
Do -	W. Wurdeman -	252 57		
Do -	W. Jacobi - -	197 50		
Do -	W. Hill - -	100 00		
1837, 4th qr.	W. Hill - -	10 00		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	H. L. Dickins -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	T. W. Werner -	375 00		
Do -	C. Preuss - -	378 50		
Do -	T. P. Dornenburg -	200 00		
Do -	S. Hein - -	231 36		
Do -	Thomas McDonnell -	168 62		
Do -	W. Wurdeman -	208 00		
Do -	W. Jacobi - -	195 00		
1837, 3d and 4th qrs.	John Farley - -	1,000 00		
1838, 1st qr.	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1838, 1st qr.	C. M. Eakin -	$750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	T. W. Werner -	375 00		
Do -	C. Preuss - -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	T. P. Dornenburg -	200 00		
Do -	Sam'l Hein - -	251 43		
Do -	W. Wurdeman -	251 42		
Do -	Wm. Jacobi -	195 00		
Do -	Tho. McDonnell -	201 43		
Do -	John Farley -	500 00		
1838, 2d qr.	Thos. McDonnell -	202 00		
Do -	W. Werner - -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	H. L. Dickins -	375 00		
Do -	C. Preuss - -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	T. P. Dornenburg -	200 00		
Do -	S. Hein - -	252 00		
Do -	W. Wurdeman -	245 14		
Do -	Wm. Jacobi -	195 00		
Do -	John Farley -	500 00		
1838, 3d qr.	Chs. Preuss - -	62 50		
Do -	T. W. Werner -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. Eakin - -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	478 26		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	T. P. Dornenburg -	200 00		
Do -	Sam'l Hein - -	222 86		
Do -	W. Wurdeman -	230 28		
Do -	W. Jacobi - -	195 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1838, 3d qr.	Tho. McDonnell -	$182 80		
Do -	John Farley -	500 00		
1838, 4th qr.	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	H. L. Dickins -	391 50		
Do -	T. W. Werner -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	S. Hein - -	226 73		
Do -	Thos. McDonnell -	184 33		
Do -	W. Wurdeman -	217 71		
Do -	T. P. Dornenburg -	200 00		
Do -	W. Jacobi - -	197 50		
Do -	John Farley -	500 00		
1839, 1st qr.	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	C. Renard - -	750 00		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	T. P. Dornenburg -	252 00		
Do -	S. Hein - -	251 43		
Do -	W. Wurdeman -	251 43		
Do -	Tho. McDonnell -	201 43		
Do -	W. Jacobi - -	192 50		
Do -	T. W. Werner -	375 00		
Do -	John Farley -	500 00		
1839, 2d qr.	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	J. P. Dornenburg -	250 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1839, 2d qr.	T. W. Werner -	$375 00		
Do -	S. Hein - -	290 00		
Do -	Tho. McDonnell -	191 72		
Do -	Wm. Jacobi -	195 00		
Do -	W. Wurdeman -	244 00		
Do -	John Farley - -	500 00		
1839, 3d qr. -	Tho. McDonnell -	184 66		
Do -	S. Hein - -	280 89		
Do -	T. W. Werner -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	J. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	T. P. Dornenburg -	250 00		
Do -	W. Jacobi - -	197 50		
Do -	W. Wurdeman -	217 14		
Do -	J. J. S. Hassler -	500 00		
Do -	John Farley -	500 00		
1839, 4th qr.	H. L. Dickins, 3d qr.	375 00		
Do -	H. L. Dickins -	125 00		
Do -	H. L. Dickins -	125 00		
Do -	S. Hein - -	270 80		
Do -	Tho. McDonnell -	192 85		
Do -	W. Wurdeman -	252 57		
Do -	W. Jacobi - -	197 50		
Do -	F. R. Hassler -	1,500 00		
Do -	Jas. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	John Farley -	500 00		
1840, 1st qr.	H. L. Dickins -	125 00		
Do -	H. L. Dickins -	125 00		
Do -	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		

LIST—Continued.

Y earnd quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1840, 1st qr.	H. L. Dickins -	$125 00		
Do -	T. W. Werner -	375 00		
Do -	Thomas McDonnell	202 00		
Do -	S. Hein - -	302 00		
Do -	W. Wurdeman -	252 00		
Do -	William Jacobi -	195 00		
Do -	John Farley -	500 00		
1840, 2d qr.	Thomas McDonnell	202 00		
Do -	T. W. Werner -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	J. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	J. J. S. Hassler -	500 00		
Do -	S. Hein - -	302 00		
Do -	W. Wurdeman -	252 00		
Do -	W. Jacobi - -	195 00		
Do -	John Farley - -	500 00		
1840, 3d qr.	H. L. Dickins -	375 00		
Do -	Thomas McDonnell -	193 00		
Do -	T. W. Werner -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	John Farley -	500 00		
Do -	Samuel Hein -	293 43		
Do -	W. Wurdeman -	252 57		
Do -	W. Jacobi - -	197 50		
Do -	L. Muller - -	168 00		
1840, 4th qr.	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	C. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	John Farley -	500 00		
Do -	W. M. Boyce -	500 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1840, 4th qr.	J. J. S. Hassler -	$500 00		
Do -	T. W. Werner -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	H. L. Dickins -	375 00		
Do -	S. Hein - -	282 47		
Do -	W. Wurdeman -	250 86		
Do -	W. Jacobi - -	197 50		
Do -	L. Muller - -	150 37		
1841, 1st qr.	Thomas McDonnell -	184 87		
Do -	S. Hein - -	288 86		
Do -	L. Muller - -	248 40		
Do -	W. Jacobi - -	192 50		
Do -	W. Werdeman -	251 43		
Do -	Thomas McDonnell -	201 43		
Do -	F. H. Gerdes -	375 00		
Do -	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	H. L. Dickins -	375 00		
Do -	C. Renard - -	750 00		
Do -	John Farley -	500 00		
1841, 2d qr.	L. Muller - -	199 98		
Do -	W. Jacobi - -	195 00		
Do -	W. Werdeman -	249 14		
Do -	Samuel Hein -	302 00		
Do	F. R. Hassler -	1,500 00		
Do -	James Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	F. H. Gerdes -	375 00		
Do -	T.W.Werner, 1 & 2 qr.	750 00		
Do -	John Farley -	500 00		
1841, 3d qr.	H. L. Dickins, 2d qr.	375 00		
Do -	J. J. S. Hassler -	166 66		
Do -	L. Muller - -	66 66		
Do -	F. R. Hassler -	1,500 00		
Do -	J. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		

LIST—Continued.

Year and quarter.	Names of the persons.	Compensation paid.		
		Regular.	Extra.	Arrearages.
1841, 3d qr.	C. M. Eakin -	$750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	John Farley -	500 00		
Do -	H. L. Dickins -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	T. W. Werner -	375 00		
Do -	S. Hein - -	282 69		
Do -	W. Wurdeman -	252 57		
Do -	Thomas McDonnell -	187 96		
Do -	J. J. S. Hassler -	166 66		
Do -	L. Muller - -	66 66		
1841, 4th qr.	W. Jacobi - -	197 50		
Do -	L. Muller - -	66 66		
Do -	S. Siebert, engraver -	300 00		
Do -	T. A. Rolle, do -	216 66		
Do -	L. Muller, - -	66 66		
Do -	W. Wurdeman -	252 57		
Do -	W. Jacobi - -	197 50		
Do -	F. R. Hassler -	1,500 00		
Do -	J. Ferguson -	1,000 00		
Do -	E. Blunt - -	1,000 00		
Do -	C. M. Eakin -	750 00		
Do -	C. Renard - -	750 00		
Do -	W. M. Boyce -	500 00		
Do -	T. W. Werner -	375 00		
Do -	F. H. Gerdes -	375 00		
Do -	S. Hein - -	277 14		
Do -	Thomas McDonnell -	198 34		
Do -	H. L. Dickins -	375 00		
Do -	S. Siebert, engraver -	150 00		
Do -	T. Rolle - -	108 34		
Do -	John Farley -	500 00		
Do -	J. J. S. Hassler -	500 00		
Do -	L. Muller - -	66 66		

T. L. SMITH, *Register.*

TREASURY DEPARTMENT,
Register's Office, June 9, 1842.

A list of all officers of the army employed in the coast survey; their army pay and emoluments, in dollars and cents, whilst so employed; and the additional pay of each for service in the coast survey, from 1816 *to the* 31*st December*, 1841.

Year.	Name and rank.	Army pay.	Additional pay.	Total.
1816	Major J. J. Abert - -	$1,545 20	$357 20	$1,902 40
1817	Major J. J. Abert - -	1,616 40	912 50	2,528 90
1818	Major J. J. Abert - -	1,592 40	327 50	1,919 90
1818	Lieutenant W. G. McNeill -	689 20	156 25	845 45
1818	Lieutenant J. A. Adams -	689 20	183 75	872 95
1818	Lieutenant J. R. Vinton -	689 20	253 75	942 95
1832	Lieutenant M. D. Mackay -	–	76 25	76 25
1832	Captain W. H. Swift -	963 60	–	963 60
1833	Lieutenant John Mackay -	837 90	–	873 90
1833	Lieutenant J. V. Bomford -	764 96	267 00	1,031 96
1833	Captain W. H. Swift -	1,160 16	929 47	2,089 63
1833	Lieutenant A. D. Mackay -	–	7 50	7 50
1834	Captain W. H. Swift -	1,067 80	–	1,067 80
1835	Captain W. H. Swift -	947 00	–	947 00
1836	Captain W. H. Swift -	948 00	* 292 80	1,240 80
1837	Captain W. H. Swift -	947 00	*4,648 13	5,595 13
1838	Captain W. H. Swift -	1,363 93	*2,830 67	4,194 60
1839	Captain W. H. Swift -	1,926 80	*2,868 52	4,795 32
1840	Captain W. H. Swift -	1,916 80	*2,148 42	4,065 22
1841	Captain W. H. Swift -	1,829 40	*1,919 27	3,748 67

* Includes his commission on disbursements.

T. L. SMITH, *Register.*

TREASURY DEPARTMENT,
Register's Office, June 9, 1842.

TREASURY DEPARTMENT, *June* 20, 1842.

SIR: I have the honor to transmit the following communication, in answer to the inquiries made in your letter of the 31st ultimo, in behalf of the special committee "on the coast survey."

First. Respecting "the contract between the Government and F. R. Hassler, superintendent of coast survey," of which a copy is asked by the committee, I beg leave respectfully to refer to the accompanying papers, (marked A, B, C, and D,) as containing all the information in possession of the Department, in reference to the engagement of the services and the terms on which Mr. Hassler undertook to perform the work, in the year 1816, and on its revival in 1832.

Second. In reference to the inquiry, "under what authority was Mr. F. R. Hassler employed to make a set of measures for the United States?" I would respectfully refer the committee to the copy of a communication, herewith sent, from Mr. Secretary Ingham, under date of the 30th of April, 1831, (marked C,) by which it appears he was employed by the Treasury Department, with the sanction of the President, to superintend the manufacture of weights and measures for all the custom-houses of the United States.

Third. In regard to the inquiry, "when was the work commenced, and how much has been expended, yearly, from its commencement up to the present time, specifying the sums, to whom paid, and for what purpose?" it is to be remarked, in answer to the first branch of this inquiry, that on the 29th of May, 1830, the Senate of the United States adopted a resolution directing the Secretary of the Treasury "to cause a comparison to be made of the standards of weight and measure now used at the principal custom-houses in the United States, and report to the Senate at the next session of Congress." To comply with the requirements of this resolution, it appears Mr. Secretary Ingham deemed it expedient to engage the services of Mr. Hassler to make the necessary comparisons, as shown by the accompanying copy of his letter to that gentleman, dated 12th June, 1830, (marked B,) and inviting him to come on to Washington to perform that duty. To institute the comparisons mentioned, it became necessary to require the collectors of the principal ports to forward their standards to Washington, which occasioned some unavoidable delay in the commencement of the work. The proper tests and comparisons were accordingly made by Mr. Hassler, and the determined results were submitted to the Senate, in reports from the Department, under dates of the 3d of March, 1831, and 20th June, 1832, which will be found in Senate documents, 2d session of 21st Congress, 2d volume, document 74, and Executive documents, 1st session 22d Congress, volume 6, document 299.

As the results of these comparisons exhibited serious discrepancies between the standards used at the respective ports, the Department gave directions to Mr. Hassler to superintend, in this city, the manufacture of standard weights and measures for all the custom-houses. These directions were given in April, 1831, but, as many arrangements had to be made before the work of fabricating these standards could be properly entered upon, such as the collection of materials and the preparation of requisite machinery, some time elapsed before it went into complete operation. There is no data in the Department by which the precise time when the work was commenced can be fixed.

In reply to so much of the second branch of the inquiry under considera-

tion as relates to the amount "expended yearly, from its commencement," I beg leave to refer to the statement prepared by the Register of the Treasury, and transmitted to the committee on the 15th instant, in compliance with the request of Mr. Aycrigg, a member of the committee.

Fourth. As to the inquiry, "from what source or sources have the funds thus used been derived?" I have to state that the funds have been derived from the accruing revenue, under the authority believed to be given in the 21st section of the general collection act of the 2d of March, 1799, requiring surveyors of the customs, from time to time, and particularly on the first Mondays in January and July, in each year, to examine and try the weights, measures, and other instruments, used in ascertaining the duties on imports, with standards, "to be provided by each collector, at the public expense, for that purpose." The construction given by the Department to this provision of law seems to have been sanctioned by a special committee of the House of Representatives, of which the Hon. Horace Binney, of Pennsylvania, was chairman, as shown by their report, No. 132, vol. 1, second session of the 23d Congress, which closes with the following resolution, which was adopted by the House:

"*Resolved*, That it is highly expedient that the Treasury Department should complete, with as little delay as practicable, the fabrication of standards of weights and measures, for the supply of the different custom-houses of the United States, upon the principles set forth in the reports of the Secretary of the Treasury to the Senate on the 3d of March, 1831, and 20th June, 1832."

Both Houses of Congress subsequently sanctioned the source from which the expenditures were made, by a joint resolution of the 14th June, 1836, directing the Secretary of the Treasury to finish a complete set of all the weights and measures adopted as standards, for the respective States; and by the 7th section of the act "for the support of the military academy," &c., passed the 7th July, 1838, the Secretary of the Treasury is directed to cause to be made, under the superintendence of Mr. Hassler, one standard balance for each State, and, when completed, to be delivered to the respective Governors, for the use of each of the States.

Fifth. In regard to the inquiry, "how many complete sets of weights and measures have been delivered to the Treasury Department, and how have they been disposed of?" I beg leave, in answer, to refer the committee to the statement herewith sent, (marked D,) by which it will be found that two hundred and seven sets of large weights, forty-four sets of ounce weights, and forty-one yard measures, have been delivered by Mr. Hassler to the Department; that, of the former, there have been distributed to custom-houses and States, &c., one hundred and nineteen, of the second twenty-three, and of the latter thirty-four.

Sixth. In respect to the inquiry, "when is it probable the work will be finished?" I would remark, that the Department is not possessed of such information as to enable it to fix any precise time when the work will be finished; but, as it is informed that the capacity measures, and the balance of the ounce weights and yards, have been fabricated, and are now undergoing their final comparison, it is not supposed that much time will elapse before their final completion. It is understood that the balances designed for the States are also in a state of forwardness. It is deemed proper to observe, in conclusion, that it is not contemplated to furnish the respective

custom-houses with balances or ounce weights, they being designed for the respective States alone.

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

W. FORWARD,
Secretary of the Treasury.

Hon. F. MALLORY,
Chairman of Select Committee on Coast Survey.

WASHINGTON, *July* 12, 1816.

SIR: Herewith I have the honor to deliver the more detailed articles of the agreement between the Treasury Department and myself, relative to the survey of the coast, as desired by the letter of the Secretary of the Treasury, under the 5th instant.

You will judge if I have expressed myself clearly upon the subjects under consideration, or not, and dispose, in consequence, as you find most proper.

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

F. R. HASSLER.

——— JONES, Esq.,
Treasury Department, Washington City.

Articles of engagement between the Treasury Department of the United States and F. R. Hassler, relative to the survey of the coast of the United States.

A. Mr. Hassler engages to bestow all his time, labor, and attention, to the work of the survey; as well to make, himself, the principal part of the general large triangulation, and the consequent calculations, as to superintend and direct the establishment of the observatories, and the officers of engineers, or naval officers, who will be engaged under his orders, in the detail parts of the work, and give them proper instructions to that effect, according to the plan proposed by him, under the 15th May, 1816.

B. He will, to that purpose, have the use of such instruments and books of the collection he has procured, or which are yet to be procured, for the use in this work, as he may find necessary for his objects, and give directions relative to those which are to be used by the officers under his direction.

C. He will be provided from the corps of engineers, on his application to the general of said corps, with the following assistance to his own works, or such part of the same as he may deem necessary, according to circumstances, viz:

1. Two officers of engineers, topographical or others.
2. Some cadets of said corps, in number according to the circumstances.
3. Twelve men of said corps, for the most part artificers, with corporal or sergeant.
4. One large baggage wagon, with four horses, or two smaller ones, as he may require, with the necessary drivers to them.
5. Two saddle horses.

6. Tents for the accommodation of himself, the above-mentioned officers, cadets, and men, and the shelter of the instruments.

7. The necessary field utensils, as well for the personal accommodation of the company as for the works occurring, not comprehending Mr. Hassler's private equipment.

D. Under Mr. Hassler's orders, the officer first in rank accompanying him will have the chief command of the above military assistance, and act as treasurer upon the funds, which will be given to said officer to defray all the expenses of a public nature occurring or ordered by Mr. Hassler; and said officer will render account upon these funds to the Treasury Department.

E. The following are to be considered expenses of a public nature, viz:

1. The keeping in order and securing from injury of the instruments belonging to the Government, their stands and boxes, and the fitting them up for use.

2. Such additions to the collection of instruments and books as may be found necessary by Mr. Hassler in the progress of the work, as well to complete the collection from time to time as to furnish a sufficient number of them for the use of the detail surveyors.

3. The construction of the signals and signal lamps, and their attendance and protection

4. The preparations of the stations, for the convenience of observations, and the securing of them for future utility.

5. The transport of the instruments and the baggage of the company.

6. All expenses consequent or relating to the keeping in order and maintenance of the military assistance stated in article E.

7. All expenses for the establishment of the permanent or temporary observatories, to be erected according to Mr. Hassler's plans.

8. The printing of blank formulas of journals and calculations, for the detail surveyors, if such are found advantageous, as it is probable.

F. Mr. Hassler will receive, as compensation for his personal work in the survey, his superintendence and direction of the whole, and all his personal expenses consequent thereof, the sum of five thousand dollars annually, to be paid quarterly, on his drafts upon the Treasury Department, or otherwise.

G. It is understood that the work shall not be carried on in the form of a bureau or office; but that Mr. Hassler himself, as well as the officers under his direction, shall execute such work as devolves upon them, or are ordered to them in the field, by defraying their own personal expenses, and at home in their private quarters. Therefore, no accounts will be admitted upon room hire, fire wood, stationery, or smaller drawing implements, not provided by the collection of the Government. The above-mentioned compensation is to be considered compensating all his personal expenses, in his absence from home, in the work of the survey, and the items here mentioned, required for his personal use in this work, exclusive only of the expenses stated as of a public nature in article E.

H. The appointments to be made in future, to officers undertaking separate parts of the work, will be fixed so as to comprehend the same articles, and to follow the same principles.

I. If, therefore, Mr. Hassler shall at any time require officers to work under his direction in his quarters, it will be at his option, and entirely a

matter of his private arrangement; otherwise, every officer is to be understood to execute his house work in his own quarters.

K. From these regulations are excepted:

1. All expenditures relating to the use of vessels or shipping, for soundings and the nautical part of the survey, for which proper arrangements will be made in time by the Treasury Department, upon propositions to this effect.

2. The clear executed copies of the maps and charts, either general or special, which will be required by the proper authorities, or prepared for publishing; for which proper draughtsmen will be appointed, and paid according to separate arrangements, to be made with men who may have applied to such works with particular success.

3. All expenses and consequences of engraving, printing, publishing, or executing such number of copies of the maps or charts as may be required for this purpose, or desired by the Government, or the officers to whom it may belong.

F. R. HASSLER.

WASHINGTON, *July* 12, 1816.

TREASURY DEPARTMENT, *August* 3, 1816.

SIR: The correspondence and documents relative to your being employed as superintendent of the survey of the coast, under the act of Congress respecting that object, have been submitted to the President, and your services are engaged, on the following terms:

1. The whole of your time, labor, talents, and attention, shall be given to the work, as well in relation to the superintendence of the duties to be performed by military or naval officers and assistants, or by draughtsmen and engineers, as in relation to the parts of the work which are to be executed by yourself.

2. You will be provided with competent assistance of officers and men, from the corps of engineers and from the navy, with tents and field equipage, with baggage wagons and horses; and you will have the free use of the public instruments and books, for the purposes of the survey.

3. The party of officers, men, and assistants, accompanying you, will be ordered to conform to your instructions; and all the incidental expenses of the survey, which are of a public nature, will be defrayed by the Government; but your own personal expenses are to be defrayed by you, whether you are employed at home or abroad.

4. Funds will be placed, from time to time, upon your requisition, in the hands of the chief officer accompanying you, to be disbursed, upon your order, in the payment of the expenses of a public nature, and to be accounted for by him at the Treasury once at least in every three months.

5. You will receive, in full for all your services, a compensation at the rate of $3,000 per annum, and for your personal expenses an allowance at the rate of $2,000 per annum, to commence on the 18th day of June, 1816, and to be paid quarterly at the Treasury, upon your drafts.

6. You will make frequent reports of your progress to this Department, and deposite here all the surveys, drafts, notes, charts, maps, journals, and documents, in any wise belonging to the survey of the coast; and you will return the public instruments and books to such place as shall be directed, when they are no longer required for the business of the survey.

7. If at any time it should be necessary to explain the nature and extent of your employment and engagement, your communications to this Department, and particularly the articles submitted by you on the 12th July, 1816, will be resorted to.

It only remains to repeat the President's solicitude for a successful and speedy execution of the great national work which is thus confided to you, and to assure you of the esteem with which I am, sir, your most obedient servant,

A. J. DALLAS.

Mr. F. R. HASSLER,
[*To the care of Robert Patterson, Esq., Director of the Mint, Phila.*]

Copy certified conformable to the original.

F. R. HASSLER.

Upon the articles of agreement between the Treasury Department of the United States and F. R. Hassler, relative to the survey of the coast of the United States.

1. Mr. Hassler engages to undertake the direction of the survey of the coast of the United States, according to the law to that effect of 1807, and the act to put the same in activity, passed in 1832, as well by performing such of the principal parts of the same as will require his own personal work, as by directing and superintending the work of such officers of the army and navy, and also civil engineers, as will be appointed, upon his recommendation, in the other parts, and the detail surveys, the determination of soundings, and such like.

2. He will, for that purpose, have the use and disposition, for himself or his assistants, of the instruments and all other necessary implements, books, &c., that have been procured in time for that purpose, and such others as will be procured successively for the same use.

3. He will also be provided with the proper means of safe conveyance of these instruments and other objects, either by land or by water, according to the arrangements which he will make at proper times for that purpose.

4. He will receive the assistance of such officers, cadets, midshipmen, or other men of the military or naval service, as will be appointed upon his request, and who will be provided with all their necessary field equipments, &c.

5. All the assistants and men, military, naval, or civil, that will be appointed for this service, will be ordered to conform to his instructions and directions, and, in case of their refusal, he will have the liberty to order them to report for other services, or dismiss them.

6. He will have the sole and free disposition of the carriages or other means of conveyance, and other objects or implements appertaining to the equipments for this work.

7. He will be provided with tents for the instruments and for the accommodation of himself and his assistants, with the necessary tools for preparing stations, placing signals, and the other necessary works for the encampment on the stations, and mending implements, &c., that might be in

need of it, the necessary means for signals, and for the preservation of the stations of the survey.

8. One of the assistants will act as accountant for all public expenses made upon the orders of Mr. Hassler, and will receive from the appropriations made for the survey such sums, at different times, as shall be agreed upon. He will account for them, at stated times, to the Treasury Department, for which service he will receive a compensation.

9. All drawing, plotting, execution of maps, or such like, will be done by the assistants, upon Mr. Hassler's orders, either in their private quarters or in an office, as may be judged best adapted to the case; the office expenses will be paid by the accounting officer, on public account.

10. All the stationery needed in the work, as well for Mr. Hassler as for any of the assistants, will be provided by the accounting officer, at public expense, in the field or at home.

11. Officers or engineers, detailed out by Mr. Hassler for separate works, of detail parts or others, will conform to the instructions which they will receive from him upon their work; they will be furnished with such instruments, implements, and assistance, as he will direct; and their expenses of a public nature will be accounted with the accountant above stated. They will report to Mr. Hassler, as he will direct; for such works they will receive adequate compensation.

12. Mr. Hassler will receive, for compensation of his services, $3,000 per annum, and in lieu of his private personal expenses $2,000 per annum, to be paid together quarterly, upon his draft, bill, or otherwise, unless, in the progress of the work, he should be obliged to make voyages at greater distances, when an allowance, by the way of mileage, will be determined.

13. Mr. Hassler will be provided with an ostensible public paper, stating his employment, and the nature and object of the same, to support him in his actions and transactions in any part of the country he may have to go for the purpose of his work, to serve equally for his assistants and the persons employed under him.

F. R. HASSLER.

WASHINGTON CITY, *August* 6, 1832.

Instruments, implements, and assistance required.

1st. These cannot be very essentially different from what they were in 1817. In the present state of the instruments and their accessories, it will be best to give them under detailed inventory, as stated in its place, to the disposition of the chief of the work, to take the best advantage of them that they will afford, to have them put in as good order as possible, and to allow him to replace the missing accessories as best he can.

2d. The carriage made purposely for the transportation of the principal instruments was sold, but is yet on hand, and can be made serviceable until a new one may be constructed, which would most likely delay too long at present. For the other parts of the transportation it will be easy to get a Jersey wagon, as has been used before.

3d. Horses and harness it will be necessary to purchase—the first strong and sure; the second simple, but strong. The mode of transportation of the instruments by a proper carriage, made of a size exactly to serve as a box

for them, and upon springs and thorough-braces, has been found more secure and economical for this country than the transportation by hand. It admits, therefore, also, to reduce the number of laboring hands for the work of the triangulation.

4th. The whole party in the work must be supplied with the necessary tents for their encampment in the field, and other necessary field equipments, besides axes, pickaxes, spades, and other tools, required for the placing of signals, preparing stations, and keeping every thing in good order. (I have even always such tools with me as are proper for keeping the instruments in good order, and repairing lighter accidental damages.)

5th. It must be observed, that the proper provision and arrangement of the accessories, and even the ease of an observer, are essential elements of accurate observation, as well as attentive and intelligent assistants; both favor the unimpeded and proper progress of the work, and are therefore essentially economical. A defective state of these parts is very detrimental.

6th. It is expected that none of the chronometers will be in a serviceable state; that defect may be supplied by the loan of a second-pendulum clock at West Point, (of Troughton's arrangement,) made expressly for transportation, which is not expected to be in use there; even a circular instrument of Troughton's, which is there, most likely in the same predicament, might be borrowed with advantage for the secondary triangles mentioned in the proper place.

7th. The selection of the assistants, in officers or other able men, must of course belong to the chief of the work, who will recommend them, and they will receive their appointments from the Department, but, if necessary, removed upon the proposition of the chief of the work. For the present first beginning, to execute the part stated for the immediate work, three such persons will only be required, whom I wish to name, besides what accidental help I shall have to call my son in for, on account of his acquaintance with the former work.

8th. The number of laboring men will vary at different times. When the base lines are measured, fifteen to twenty will be required for the simple triangulations, particularly that proposed at present in completion and extension of the triangulation made in 1817. Six or seven may be sufficient, besides the drivers for the carriages and what may be needed for detail triangulations, if they are undertaken simultaneously.

9th. The best manner of getting this part of the assistance in laboring men is to take them from the military, where they may be easily spared from some garrison or other. Their habit and regulation of discipline, and their being placed under the order of an officer, introduces much easier the necessary regularity, and they stand for their conduct under proper regulation.

10th. The pay and maintenance, in every respect, of the officers and men taken from the army and navy, is in all cases to be provided for and paid by the army corps to which they belong, or the navy in general, according to the regulations in which they otherwise stand; so, also, they will receive all their equipments. They must, in general, be considered as coming to this service in the same manner as to any other in their line to which they might be ordered.

F. R. HASSLER.

WASHINGTON CITY, *August* 6, 1832

TREASURY DEPARTMENT, *August* 9, 1832.

SIR: With the President's approbation, you have been appointed to make, under the superintendence of this Department, the survey of the coast of the United States, directed by the acts of the 10th February, 1817, and 10th July, 1832.

The act last mentioned having authorized the employment of other persons as well as those in the land and naval service, such assistants, of either description, as may be necessary in the work, will be provided at your request.

Funds will be placed, from time to time, upon your requisition, in the hands of one of your assistants, to be disbursed for such expenses of a public nature as may be properly chargeable to the appropriation for the survey of the coast, and he will render his accounts, approved by you, quarterly, to the First Auditor.

Those expenses of the persons in the military and naval service employed in the survey, which are chargeable to military and naval appropriations, will be defrayed by the officers of the respective Departments, and accounted for under the direction of those Departments.

You will receive, in full for all your services, a compensation at the rate of $3,000 per annum, and, for all your personal expenses, an allowance at the rate of $1,500 per annum, payable quarterly, to commence on the 2d of August, 1832, you having been employed since that time in the necessary arrangements of the instruments and other preparatory works. It is to be understood, however, that you will still continue your services in the construction of weights and measures for the custom-houses, as far as may be compatible with your duties in the coast survey, without any other compensation than what is allowed for the coast survey.

In all other respects than those indicated by this letter, the terms and nature of your employment will be the same as were fixed by the letter addressed to you by this Department on the 3d of August, 1816.

The plan of operations and methods formerly adopted by you in the coast survey having been approved of, you will recommence and continue the work in conformity with them, including such modifications as are suggested in your report of the 6th instant.

I am, respectfully, your obedient servant,

LOUIS McLANE,
Secretary of the Treasury.

F. R. HASSLER, Esq.

WASHINGTON CITY, *August* 12, 1832.

MOST HONORED SIR: I have the honor to acknowledge the receipt of your favor of the 9th instant, by which you are pleased, with the authorization of the President, to give into my charge and direction the important national work of the survey of the coast of the United States, with a compensation of $3,000 annually for my services, and an annual allowance of $1,500 for my personal expenses, to begin from the 2d instant.

I am too well aware of the great importance of the work, its exigencies and nature, and the magnitude of the task, not to appreciate duly the value of the confidence you place in me by this trust. I shall call up all my exertions to prove these feelings, by conducting the work in a manner as

honorable as permanently useful to the country; for which it presents so valuable means, that I feel highly honored by the occasion thus given to me to contribute my exertions toward such an aim.

The diminution of the allowance for my personal expenses, from what they had been rated at in my first appointment in 1816, is not such that within the limits of such estimations, made beforehand, its effects could be distinctly foreseen; I could only say, that while I was in activity in this work in 1817, my annual expenses in my absence from home amounted to about $2,000. What effect the now somewhat changed prices of things may have in this respect is of course impossible to foretell; therefore this is so much less an objection with me, as in any case I am certain it is not the intention of the Government to put me to pecuniary loss, and that, therefore, in case it should be found appropriate, this part may easily be modified to the exigency of unforeseen circumstances.

I shall also attend to the standarding of weights and measures, in which I have hitherto been engaged. I have taken such arrangements as will enable my assistant in it, Mr. Schmid, to prepare the works to the last stage of their adjustment, which I shall then make myself next winter, after my return from this year's field work in the survey. His acquaintance with the subject, and his practice in that part during his presence in all my former operations, render him fully capable to the task; and his work will abridge mine so as to bring the necessity of my personal attendance within such limits of time as will be compatible with my work in the survey.

With thanks for the honor of your confidence, I remain, with perfect respect and esteem, most honored sir, your most obedient servant,

F. R. HASSLER.

Hon. LOUIS MCLANE,
Secretary of the Treasury of the United States.

INVESTIGATION

UPON THE

SURVEY OF THE COAST

OF THE

UNITED STATES,

AND THE

CONSTRUCTION OF STANDARDS

OF

WEIGHT AND MEASURE,

BY A

SELECT COMMITTEE OF CONGRESS,

IN 1842.

PUBLISHED BY F. R. HASSLER.

1843.

United States Job Printing Office, Ledger Building, Phila.

WASHINGTON, JUNE 26, 1841.

Hon. CALEB CUSHING, Member of Congress.

SIR,—The many mistakes which are in your statements in Congress, relating to the Survey of the Coast of the United States, committed to my charge, occasion me to take the liberty to request of you, that you will please to visit the office, in the last house, right hand side of New Jersey Avenue upon Capitol Hill, as it must be disagreeable to you to labor under so many misapprehensions, or side influences, by which besides you might occasion irreparable mischief before the so desirable investigation has proved them as unfounded as they are.

For the investigation which you provoke, I thank you very much.

I enclose here, also, some of the last reports which may have escaped your notice. The previous documents are too voluminous and unfortunately much of a polemic nature, occasioned by similar unfounded attacks, which were overcome in 1836. A previous circumstance in 1818, similar to your call, which was successful, destroyed the work then, after only about one year's existence, caused the nation an expense of about half a million, for which not a map of the size of a hand is producible in the Navy Department, where the accounts testify to my statement. At that time, it was the naval chaplain, Felsh, who occasioned the damage, and the bill passed Congress without any inquiry, committee, or other discussion, and it was not until 1832, (not 1831) that the law for the renewal of the work could be passed, even with unfavorable limitations, the work beginning again 1833, notwithstanding the notice given by the then Secretary of the Navy, now Senator Southard, dates already in 1828.

Please to consider nothing of all this as personal to me, it is the good of the public, and your own credit, alone which I consult in addressing you; as for me, personally, I can only gain from that side by any investigation.

I have the honor to be, &c.

(Signed) F. R. HASSLER.

On motion of Mr. MALLORY,

Ordered, That the letter from the Secretary of the Treasury, laid before the House on the 3d January, transmitting a report of F. R. Hassler, Superintendent of the Coast Survey, showing the progress made in that work, and the report from the Secretary of the Treasury, laid before the House on the 31st January, 1842, in relation to the expenditures on account of the Survey of the Coast, be referred to a select committee. Mr. Mallory, Mr. Wise, Mr. Cushing, Mr. Ayerigg, and Mr. Holmes were appointed said committee.

Saturday, February 19, 1842.

Thursday, March 17, 1842.

Present, Mr. MALLORY, Mr. WISE, Mr. HOLMES, Mr. AYCRIGG.

Mr. Hassler appeared before the Committee, agreeably to the request of the Chairman, made by order of the Committee at former meeting.

EXAMINATION OF F. R. HASSLER.

1. Question by Mr. Mallory. Have you deviated in any way from the original plan adopted in 1807?

Answer. Not in the least.

2. Question by the same. Is not the work now conducted on a more extended plan than was originally intended, and does it not embrace objects not originally contemplated by the Government?

Answer. Not in the least.

3. Question by same. Is it intended that the present Coast Survey shall furnish the necessary data for the measurement of an arc of the meridian, or a parallel of latitude?

Answer. No.

4. Question by same. Is there any necessary connection between such measurement, and a hydrographic Survey of the Coast?

Answer. No.

5. Question by same. Could an arc of the meridian or parallel of latitude be measured with more facility, expedition and economy, if disconnected from all other objects?

Answer. Yes.

6. Question by Mr. Ayerigg. You refer in your Report (Document No. 28,) to a number of volumes in which the work is contained; is the work in those volumes reduced?

Answer. They are reduced.

7. Question by Mr. Mallory. Where are these papers kept?

Answer. In my office.

8. Question by same. Are they safe from fire?

Answer. Yes.

9. Question by same. Are there any duplicates of these papers?

Answer. Some; of the greater part.

10. Question by same. Of what paper are these duplicates?

Answer. Of all, except the last year's work.

11. Question by Mr. Ayerigg. Is the Government in possession of any of the data, or are they in your possession?

Answer. They are in the office—a house rented by the Treasury Department, and under the care of persons in the employment of Government.

12. Question by Mr. Mallory. Who do you mean, when you say, "persons in the employment of Government?"

Answer. Myself and my assistants.

13. Question by same. Suppose the house should be burnt and papers destroyed, would not Government sustain great loss?

Answer. Yes; but I conceive the house completely safe, proper measures being taken to guard against fire. The houses have been slated with this view.

14. Question by same. Have any other maps or charts been published besides those of New Haven, Newark and Bridgeport?

Answer. No other.

The hour of 12 having arrived, the Committee adjourned to meet on this day week.

Additions to the first examination of F. R. Hassler.

To questions 3, 4, and 5. Here is omitted what I said to Mr. Mallory upon the measurement of an arc of meridian, or such like, namely: I will do it, if you want. Upon which he retired smiling.

Questions 6, 7, 8, 9, 10, 11, 12, and 13, show evidently the desire to take the *results of the field works* immediately out of my hands, which would expose them to spoliation, as I know would be the case. I answered therefore simply, but could not otherwise but be displeased with the (for me evident) tendency of the questions. Besides, it must be observed, that such measures could lead to nothing but positive disappointment.

Question 14. This answer must be corrected by the list of maps handed in afterwards.

COAST SURVEY OF THE UNITED STATES.

1. In the last discussion upon the appropriations, it has pleased Mr. Aycrigg, and one more of the members of a committee of five representatives in Congress, to throw out the broad cast accusation, that I was mentally and physically incompetent to that task which I have now performed for ten years, with full approbation and even praise, on the part of the men of science of Europe, and of this country.

2. This statement was made not only without producing any proof, but also in full contradiction to abundant facts, and without producing the report which the committee is bound to make to Congress with the documents in support; namely, the examination of myself and assistants upon the Coast Survey, and my report asked by the very member upon my works for the establishment of uniform standards of weights and measures for the United States.

3. As it is impossible that an assembly of the representatives of a whole nation should possibly be guided by mere empty words without any proof, it appears not necessary to go into an actual refutation of an assertion, the nullity of which can be well dismissed, and will be proved by Congress calling for the examinations, &c., quoted under 2d. So much the rather, as luckily my well known state of mental and physical capacity cannot possibly depend upon the decision of a committee of Congress, and are now in full good state, as they have been observed by the gentlemen who have favored the Coast Survey Office with their visit.

4. I will, therefore, limit myself here to two statements made under the denomination of facts, but which are related in a manner completely different from what they actually are.

5. The wrong scale upon a map of Newark Bay, by Lieut. Com. Gedney. This fact stands thus:

6. When Lieut. Gedney was sounding Newark Bay, he communicated uncautiously, without any communication with me, and against the regular order of the work, a chart of his soundings, to some persons pressing him for it. When informed of it, I had to

call him to the regular order of the work, that nothing should be delivered unknown to me, and without orders previously obtained from the Treasury Department; this to get caused some delay, while local contending interests in Newark were impatient. This Mr. Aycrigg reproached to me, in the committee, that he had so long to ask for it. When the whole summer's work was brought in the bureau, Lieut. Gedney had a map made as desired, and more extensive, under his direction, wherein the fraction of the scale was mistaken, which map *was never exhibited to me until at the time of the committee*, when he complained to me *that such a great crime was made to him out of an accidental miswriting* of a fraction by one of his subaltern officers. I believe he then told me that the error was corrected; I properly remonstrated with him that this accusation was the reward for his hurrying a work with unreasonable impatience, and without any communication with me. Mr. Aycrigg, who takes up this subject as an accusation against me, is *completely aware of every particular*, as Lieut. Gedney explained it all to himself, he can therefore not be otherwise but perfectly aware that he does me a wilful injustice.

7. Mr. Aycrigg accuses me of having made, in a pamphlet of 200 pages, 400 errors, which I myself corrected. I had no idea that I should have to reveal to the public the errors of some learned men, by being forced into self-defence by a misapplication of the fact against the actual statement made on the face of it. I do it reluctantly, but as the full proof can be administered, I must give it as follows.

8. When the Coast Survey broke up in 1818, and after my return from the Northern Boundary Survey, I gave in 1820, under the title, "*Papers upon various subjects relating to the Survey of the Coast of the United States*," to the Philosophical Society of Philadelphia, the descriptions of the instruments, the method of operating and observing, which I had partly used, partly proposed to use, in that work. Old Dr. Patterson, then its president, the gentleman the most acquainted with the work and its various first plans, &c., proposed it as a great national work, and upon the report of a committee, it was the 30th March following, ordered to be printed. But the Philosophical Society being short of funds, the execution of the printing was delayed so long, that in 1822 the Philosophical Society of New York, where I then was, desiring to see a work, which they considered so honorable for the country, published, asked the manuscript from Philadelphia, but was refused it—see the opinion

of Professor Renwick of New York, in the Syllabus of his Lectures upon natural philosophy.

9. All at once, without the slightest notice given to me from Philadelphia, the volume of the Philosophical Society's Transactions, containing these papers, appeared in 1825; but with the sense in science so terribly distorted that I complained of it, and asked for my original manuscript, which I had requested to be preserved; and then found that Professor Patterson, now Director of the Mint in Philadelphia, and Mr. Nulty, a good theoretical mathematician, both members of the Philosophical Society, who had never been in, nor seen, or studied any particular part of mathematics bearing upon a work of that nature, had undertaken to correct (as they called it,) the language of my papers. Now, it is well known, that it is impossible for a man knowing nothing of a subject to write upon it with propriety of expression; thence, the most absurd errors crept into the printing. I was obliged, in self-defence, to print immediately corrections which rendered the mistakes less absurd, though they do not bring the expressions back to my original manuscript.

All the men of science acquainted with the subject of these papers acknowledge my language in manuscript proper, but not the one introduced in lieu of it in the printing, and all the subjects of the papers were highly approved, in German, French, and English publications equally.

10. The complaint against my language is new and is affected, merely arising from want of acquaintance with the subject. Already in 1806, people of good society in Philadelphia considered my language as very appropriate in expression. Mr. Jefferson called it very clear, one of the best public editors of this country declared it very precise and perspicuous. In England, and by Englishmen, it was always approved as expressing subjects very well, though it was not of the common street character. I was in that compared with an eminent lawyer of London, and I got at different times acknowledgments of a good and very clear expressive style of English. But I am not alone in having observed that in this country the English language actually varies from the English of England, and from one State to the other. As I wrote books in New York and in Virginia, I have had sufficient experience to see some of my expressions approved in the Southern States, and condemned in the Northern. But always the main difficulty was the unac-

quaintance with the subject upon which I wrote, and not the language in itself.

11. If there should be any part of the accusation of errors of print tried to refer to my Logarithmic and Trigonometric tables, published stereotype in New York, I must state as follows—they were in the first appearance considered as containing far less errors than commonly occur in first editions of such works. They were instantly all corrected, and an edition of 1000 was made for Admiral Krusenstern, chief of the Russian Naval Academy, as most appropriate, (who not long ago offered me to be recommended to the Emperor for a decoration.)

They were sufficiently approved in England, so that immediately an edition was published there, quoting its origin from me.

12. I have written a number of other books, which were well approved in Europe, and in this country, by the men acquainted with the science to which they relate; I rely upon that public, which is the only one that can be acknowledged competent, for the ultimate decision of the case.

F. R. HASSLER.

Philadelphia, 23*d Dec.* 1842.

QUESTIONS AND ANSWERS.

Q. 1. Have any maps been prepared and completed so as to be ready for publication, other than the three published? And if so, what?

Ans. 1. A complete map of New York Harbor is engraving. 2. A partial map of the entrance of New York has been prepared and delivered to the Fifth Auditor for the Lighthouse Bureau. 3. One for the Thames River in Connecticut nearly ready for delivery, to an order of the Secretary. 4. One for the Topographical Bureau for the site of fortification of the entrance of New York harbor at Sandy Hook. 5. One of the north shore of Long Island Sound at New London, called for by the Secretary of the Treasury.

The four last named were prepared for the offices.

[Add. By my contract with the Government I am obliged to deliver nothing of the work, but to the Government or its order, with whom my contract is made. It is therefore through that medium that all publications, and whatever may have reference to them, are to be ordered, which are to be executed by me in this respect.]

Q. 2. Is either of the eight maps above named, so far correct and complete in itself as to be of any utility in and for the localities to which it applies?

Ans. To be sure. Each is complete and of use in itself.

[Add. But they must for that purpose, at the time of their application for publication or otherwise, be reduced to the scale which their application will require; like that is always the case, no map being published so as it is surveyed.]

Q. 3. Are these all on the same scale or otherwise?

Ans. They are not all on the same scale, but some larger and some smaller, according to the purpose for which they were respectively intended.

[Add. It is evident in principle that the maps of harbors must be, as well surveyed, as published, upon a much larger scale, than those of a mere running coast.]

Q. 4. Is there any objection to the publication of definite and successive parts of the work as they may be completed, such as the map of New York now in the engraver's hands?

ANS. No; not in the least, as soon as the engraving is finished.

[Add. It is necessary on the part of the government to take proper measures to give with the publication guarantee to the public for the authenticity of all that is published. (See answer to question 5, in my report of December, 1841.)]

Q. 5. Is it necessary to complete the survey of Delaware Bay before it can be practicable to publish a chart of Long Island Sound?

ANS. No.

[Add. But the publication of the Delaware is of much more pressing importance.]

Q. 6. Is there any objection to the publication of the work connected with the maps, as they are published?

ANS. No; it is proper to publish the data on which the chart is constructed, in order to verify its correctness, and as a guide for the use of it.

[Add. But this cannot be done until a full system of main triangulation between two base-lines is completed.]

Q. 7. Has the work of mensuration and triangulation connected with the maps of Bridgeport, New Haven and Newark, been published with them?

ANS. No.

[Add. Because this was not a requisite in the case, the points used were all only detail points; what may be proper to be quoted of mathematical data belongs to the general account of the work.]

Q. 8. Has any part of the mensuration of the survey, and of other scientific elements of the work, been published?

ANS. No.

[Add. My papers upon various subjects relating to the survey of the coast of the United States, in the Philosophical Transactions of Philadelphia, second volume, new series, 1825, which are in duplicate in the Library of Congress, give full account of these parts; what may become necessary to add after the present work, *has to await its proper time.*]

Remark.—The word mensuration is in all these articles used entirely against its sense in the science.

Q. 9. Has any systematically full part of the work between two base-lines and two astronomical stations been completed as yet

ANS. No; the locality of the coast hitherto surveyed has not permitted it.

[Add. Nor is it proper to be done but at an appropriated distance from the first base-line, and astronomical station, of some amount proportionate to the work which is to be grounded upon it.]

Q. 10. Where is your furthest eastwardly astronomical station on the coast?

Ans. Mount Carmel near New Haven.

Q. 11. Where is your next astronomical station proceeding southwestwardly?

Ans. Tashua near Bridgeport.

Q. 12. Where your next?

Ans. West Hills on Long Island.

[Add. There also a Solar Eclipse was observed.]

Q. 13. Where the next?

Ans. Buttermilk Hill, near Tarrytown, New York.

[Add. to 10, 11, 12, 13. These stations were not exclusively astronomical stations; the astronomical observations were intended more for preliminary determinations at the beginning to guide the work, and to take advantage of the presence of the assistants, who were all present, to introduce them, and to exercise them in this kind of observations. The main aim of these stations was the determination of main triangular points.]

Q. 14. Any others?

Ans. Yes. Weazel Mountain near Patterson, N. J., and some southwest of that.

[Add. Upon that station of Weazel Mountain, all the means for astronomical determinations and azimuths were united, and a regular system of those observations executed with its appropriated combinations, upon peculiar methods, which I made and prescribed, and which succeeded to satisfaction. The isolated observations of the preceding stations were of course reduced to this, by way of comparison.]

Q. 15. How many base-lines have been measured in the Survey?

Ans. Two in 1817 and one in 1834.

[Add. Those of 1817 were measured only preliminarily with the chain, still the verification proved very satisfactory, as the triangle results and the measurement differed less than 8 inches in about 5 miles. The base-line of 1834 was measured with the microscopic apparatus, and exactly as described in the papers of the Philosophical Transactions of 1825, quoted above.]

Q. 16. Between what points is the base-line, measured in 1834?

Ans. On the beach at Fire Island light-house, L. I., and the line measured is eight and three quarter miles in length, measuring eastwardly from the light-house.

[Add. From a point southeast of the light-house, towards the sea, upon the sand along the sea eastward. The points are marked by square hewn red sand-stone, of near 4 feet length, fixed solid in the ground. See my 3d Report of May 8, 1835.]

Q. 17. Where are the base-lines of 1817?

ANS. One in English Neighborhood, N. J., and the other at Gravesend Beach, L. I.

[Add. The end points of these are marked by hollow cones of stoneware.]

Q. 18. Has any use been made of the two last named base-lines in the work of the Survey?

ANS. Yes: for the beginning in 1833.

[Add. It was, of course, proper to take advantage of this element on hand, to start the work more rapidly in 1833, by using determinations grounded upon these bases, so much the rather as they had proved exact. The use made of them in 1817, appears in the schedula of the triangulation, which I handed into the Treasury Department in 1818.]

Q. 19. What objection is there to publishing the details and mathematical elements of the work as completed from Point Judith to New York Harbor?

ANS. The main triangulation has not been completed so far as Point Judith, but only the secondary. The main triangulation has been completed only between Friar's Head, opposite New Haven, and Mount Carmel in Connecticut, eastwardly, and Mount Holly, N. J., and Yard's, (Newton township, near Philadelphia,) southwestwardly. The secondary triangulation has been completed from Point Judith to Cape Henlopen on the Coast, and from New York across to the head of the Chesapeake.

[Add. The remark to 6, applies here most forcibly, and upon a larger scale. Such an account is to be given only when two bases are joined; I did it on a small scale in 1818, because I had, by way of precaution, measured two bases near each other, (see the reasons in my printed papers above quoted.) Now, in the renewed work, this must be done only when another large base-line is measured, by the same means and methods, as that on Fire Island Beach has been, and at a distance from that in proper proportion with the extent to which the Survey shall reach.*]

Q. 20. What reason is there for concealing from the public the elements of the work between Friar's Head and Mount Holly?

ANS. None.

[Add. to 20, 21, 22. For concealing. But it would be of no use whatsoever to any one, except copyists, who would, by abusing the public property in the work, degrade it, it would be, therefore, an expense not only useless but very detrimental; it will, besides, all appear in the account referred to in the addition to 19; in fact it would

* There is a *lapsus calami* in the statement of my answer.

be highly improper to do it before the publication of the more extensive system, of which it shall form a part in proper time. (There is, however, no concealment about it.)]

Q. 21. Has it been published?

Ans. No—it is not proper.

Q. 22. Why is it not proper?

Ans. Because, it will introduce imitations of the work to the detriment of its validity.*

Q. 23. Imitations by whom?

Ans. By common chart sellers or others.

[Add. It is the duty of the government to let no parceling out if possible, under penalty of seeing the government's own work ultimately discredited; such a desire cannot be fairly entertained.]

Q. 24. How is the Survey injured by individuals publishing charts, copied from those of the Survey?

Ans. Because the maps would not be official.

[Add. This quality of being official is absolutely required to give confidence to the public, therefore security to the navigation, (see question 5, in my Report of December last.)]

Q. 25. Would not the publication of the data with the maps, enable scientific men to judge of the accuracy of the work?

Ans. Of course.

[Add. When the account of the modes and of the means to their execution will be joined to them; which can be done only after a certain full system between two main bases can be presented to the public.]

Q. 26. Would not the withholding the data until the completion of the Survey enable the operator to force results?

Ans. No—in the manner in which the work is carried on it cannot be.

[Add. Unless flagrant falsification, which men of science would discover immediately in the account rendered of the work; but in the maps alone there lies no such verification; therefore, also, they are not admitted as any proof of the work, notwithstanding that in common habit, *in the offices here*, this is not regarded, nor any account of the mode of operating is asked.

Q. 27. Can scientific men judge of the accuracy of the work, unless the mathematical elements of it be published?

Ans. No.

[Add. Just, therefore, the hasty publication of an unfinished work has no value.]

* There seems to be an error in copying.

Q. 28. Have the mathematical elements of the charts of Bridgeport, New Haven and Newark, been published?

ANS. No.—That will come into the general account.

[Add. Like stated upon question 7, which is in fact the same.]

Q. 29. When do you propose to publish such a general account?

ANS. So soon as I shall have reached the verification base on the Chesapeake.

[Add. Where I expect to find a proper locality to measure one, probably upon what is called the Eastern-shore.]

Q. 30. When do you expect to reach that point?

ANS. In a few years.

[Add. Unless circumstances should decide to accelerate still more, on the ground of finding better locality, therefore larger triangles, which would be more advantageous to join northerly from there the points now reached from the north.]

Q. 31. When do you expect to complete the Delaware?

ANS. If I can get out in season, by the end of the year.

Q. 32. What prevents your getting out in season?

ANS. The want of money—nearly all the appropriation having been expended.

[Add. to 31, 32. The secondary, plane-table, and naval parties are now (25th May,) all out; how long I shall be detained *by the circumstances*, I cannot know, as it does not depend on me.]

Q. 33. Does the work on the Weights and Measures occupy any of your time, which might be appropriated to the Survey?

ANS. No.—It does not take any of my time.

[Add. That is, no more than is fully compensated by the advantages which it gives in the office part of the work, and the keeping in order of the instruments of the Coast Survey, which is of daily occurrence, in which my task is very much eased by it.]

Q. 34. How much of your time is wanted personally to the coast survey?

ANS. All the time, except the inspection and reporting on the Weights and Measures.

[Add. Without the constant attendance to my works, at any hours that can be used for them, my task would be positively inexecutable. This is evident by the state of the establishment and the works produced.]

Q. 35. How much time does it take to inspect and report upon the Weights and Measures?

ANS. About half an hour in the morning and half an hour in the afternoon of the day—but not of each day. This is only while I am in the office. I am generally in the field from the middle of May

to that of December. Sometimes I am in the field to the end of December.

[Add. That extra works and varieties occur in all works is too well known, to expect that every day shall be equal to every other day. My easiest part is the field work.]

Q. 36. At what time in the spring do the different corps start on their duties?

Ans. Generally in April, remaining until the middle or end of November.

[Add. The field work is more agreeable, in the favorable season, *than the office work; they are always anxious to get out as soon* as they can.]

Q. 37. Did you lose part of a year last year, and if so, why?

Ans. I lost the aim of last year's work, in order to answer the resolution of the House of Representatives on the Coast Survey, of January 24th, 1841, and by the fever which seized me in October.

Q. 38. At what time did you take the field last year, and how much of your time did the resolution occupy?

Ans. I did not take the field until the middle of September. The resolution occupied me three or four weeks. I was also detained to make a report on Weights and Measures.

[Add. 37, 38. These are sufficiently explained as for the fact, but it must be added here, that the speaking disreputably and inimically against the Coast Survey work in Congress, occasions ignorant men in the country, who read these things, to lay impediments in the way of the work, and to ill treat us, which is a great loss to the work and its economy.]

Q. 39. Is the work in the office now in such a state of forwardness as not to interfere with the commencement of the field work this year, so soon as the season will permit the work to go out?

Ans. Not in the least.

[Add. Namely, *interfere*. It is well known that the accidental circumstance of the exhaustion of the old appropriation, and the delay of the new one, have kept all back to the end of May, in 1842, and that I remained even after that. I advanced money to assistants to enable them to go out, only $350; but if the attacks had not been made upon me, as well known, I would have prevented all stoppage, as I did three times in the beginning of the work; but, under existing circumstances, it was not proper for me to advance my credit, as I did in those cases, and also before in London.]

Q. 40. Why is not the main triangulation up with the secondary?

Ans. On account of the difficulties of finding suitable elevations on both sides of the Delaware.

Q. 41. Who conducts the main triangulation?

ANS. I, myself, according to positive stipulations.

Q. 42. Why is not the main triangulation carried as far eastward as the secondary?

ANS. Because it was not needed.

[Add. to 40, 41, 42. The main triangulation determining large distances with greater accuracy than the secondary triangulation, it serves as element and ground-work for the latter, which, in consequence of the accuracy of these elements, can proceed outside of the limits of the main triangulation for a certain distance, without losing sensibly in accuracy, but this has its determined limits; the main triangulation has always kept near enough to the other part of the work, not to expose it to any loss of accuracy, detrimental to the use made of the secondary triangulation.]

Q. 43. When will it be needed?

ANS. So soon as the junction is made with the base-line on the Chesapeake.

[Add. This namely means, that in this place and time, both triangulations must come up together, and then the field of operation is open in all directions.]

Q. 44. When that junction is made, do you propose to suspend the work south, and go back east, or to have two parties?

ANS. When the junction is made, while the secondary triangulation goes on south, I shall continue the primary triangulation east.

Q. 45. Cannot the main triangulation be carried on, except under your immediate personal supervision?

ANS. Not in the present state of things.

Q. 46. Why not?

ANS. Because there is nobody to do it, and the circumstances are contrary.

Q. 47. Is there nobody else attached to the Survey who can do it?

ANS. Not now.

Q. 48. What are the contrary circumstances spoken of?

ANS. Want of money; that is of a larger appropriation.

Q. 49. Must the main triangulation be suspended eastward, until you can take it up personally?

ANS. In the present state of things, yes.

[Add. to 44 to 49, inclusive. I should desire very much, that by the time the work is in that state, more extensive means might present themselves appropriated to the exigency of the case that may then be; but to say any thing about it would be of no avail, and premature.]

Q. 50. In what portion of the field work have you been personally employed the last year?

Ans. At Yard's, behind Philadelphia.

Q. 51. Where the year before?

Ans. Willowgrove and Mount Holly.

[Add. to 50, 51. It must be remarked upon these articles, that the putting me in jail at Mount Holly, by a warrant of Judge Dayton, of Trenton, given upon the oath of a *clergyman* of the name of Brown, who swore his damage was over $200, because I had refused to pay at first presentation, instantly, a bill presented to me by a so-called Judge Haywood, for $25 damages, because I found it overrated, and asked an impartial estimate to legitimate me to direct the payment to be made, (the accounting officer being absent,) that such a circumstance, I say, I considered as neither *decent* nor agreeable; such acts go to the direct overthrow of the work; the court concern following it cost both sides useless, but I had to stand the disagreement, and the Treasury Department had to defend the suit, which awarded the *reverend* Mr. Brown, with difficulty, as a highest extreme the $25 claimed, most of the jury voting first for 10, 15, or $20, instead of the hundreds which he had *sworn to*. It was necessary to stand this legal transaction in self-defence; the documents upon it can be exhibited.

At Yard's, the same impudence is now repeated; damages asked of more than double the value, and impudent letters written upon it, &c. Such things not only cost money, but have a tendency to give apprehensions upon the safety of our station points and signals, to the great annoyance of the work.]

Q. 52. Where do you propose to employ yourself on the field work the present year?

Ans. South of Yard's and of Mount Holly, on both sides of the Delaware.

We have been obliged to make a special agreement with the owner of the land of the station next after Yard's, to avoid difficulties, if possible, by a contract for the use of the land for three years.

Q. 53. What is the precise duty or part of the work performed by you at Yard's, and at Mount Holly?

Ans. Measuring the angles of the main triangulation.

Q. 54. How many assistants were there in the party in which you operated last year?

Ans. None.—I did the work alone. That is, I did the mathematical work alone.

[Add. to 53, 54. I have habitually only one of the persons engag-

ed in the work at lower wages than an assistant, to write the angles, not to take an assistant at higher wages away from a more important work. In this peculiar instance at Yard's, a friend was a great part of the time with me, who was capable to assist me, as I was sick, and in signalizing to ascertain visibility of distant stations, being acquainted with the country.]

Q. 55. Is there any person in the Coast Survey, competent to take charge of, and continue the work, if you should cease to do it?]

Ans. Not as yet.

Q. 56. Do you mean to be understood, that without your personal superintendence the work must cease, and that no man can take it up, continue and complete it?

Ans. Not honorably.

Add. to 55, 56. It is very natural that in this, like in every other subject of science, or knowledge, the acquirements and improvements are gradual, they develop themselves as the occasion for them is given, and with a considerable and proportional consumption of time. So much so, that even in Europe this branch of science is not so much spread, as it is pretended to be already in this country, where it has never yet been employed at all; for the detached small surveys, made so abundantly, do not come at all in comparison, nor under the principles of science, which is absolutely required for such an extensive work as the Coast Survey, especially in the form and in the locality of the earth in which it lies.]

Q. 57. Is there any profound secret in the measuration of triangles, and the making of astronomical observations known to you alone of all mankind?

Ans. Science is a public thing, but it requires study to be perfect in it.

[Add. These are not the exact words of my answer. I answered, with measured reflection, "*Science* is no secret, but it requires a great deal *of study to acquire it.*"]

Q. 58. Is there any person in the Survey who is pursuing such a line of observation and study, as to be in the way of learning to measure triangles, and take observations hereafter in your stead?

Ans. I give them all instruction which they will accept.

[Add. The accusation of secret, started against me, is *most unfounded*, as my assistants will certainly aver.]

Q. 59. Does no one in the survey but you measure triangles or take observations?

Ans. Every one of the principal assistants takes the secondary triangles.

Q. 60. What difference is there in the mathematical elements of primary and of secondary triangles?

ANS. The larger triangles require more attention to the figure of the earth, and to the mathematical elements arising from it.

Q. 61. Does geodesy apply to the main triangulation and not to the secondary?

ANS. More especially, but not exclusively.

[Add. to 59, 60, 61. To explain nearer these three answers would require a theoretical and practical treatise upon the subject, which would be too long, and not appropriate here.]

Q. 62. How long will it take to finish the work along the whole coast of the United States, going on at the rate of time and appropriation heretofore used?

ANS. That nobody can say, in either one way or another.

[Add. It would be presumptuous in any man to name a certain determined time, none would undertake it unless he had the accessory *intention to mislead.* (See my answer to question 13 of the resolution of the last Congress session.) Steady assiduity, and well guided exertions, will bring it forward, as fast as the nature of the work and the localities of the country will admit, and more can neither be expected *nor obtained*, by no means whatsoever; mathematical principles and nature cannot be bargained with.]

Q. 63. What is the whole extent of the general coast from Passamaquoddy to the Sabine, not including rivers?

ANS. I cannot tell.

[Add. It is evident that the length is no determining element of the work, because the nature of the coast and its indentures, &c. form the determining element, as stated repeatedly.]

Q. 64. What proportion of the entire coast of the United States has thus far been surveyed?

ANS. I cannot say.

[Add. This would evidently have to be measured by the principles stated in the preceding answer, and therefore can afford but a very vague scale of comparison; what I have said upon that in my report of last December, gives the data that can be given to a man knowing both the science and the country.]

Q. 65. You have said that the latitude and longitude of Cape Hatteras was erroneous in the charts: How did you ascertain it?

ANS. By having attempted to make a union of the northern and southern maps, which join at that place, in 1828.

[Add. This is an individual experience of mine; no doubt the determinations, charts, maps, &c. will vary among one another.]

Q. 66. How long before the survey will reach Cape Hatteras?

ANS. It is impossible to say; it is too vague a guess.

Q. 67. Have you any personal knowledge of the localities of the Southern Coast?

ANS. I have never been any further south than Norfolk.

Q. 68. You have said that it was difficult to find suitable elevations on both sides of the Delaware; which cause prevented the main triangulation from keeping up with the secondary? (No. 40.) How do you propose to obviate similar difficulties on the flat coasts of the South?

ANS. By care and assiduity, and by the methods used on the Jersey sea-coast.

Q. 69. Is that work on the Jersey sea-coast a primary or a secondary triangulation?

ANS. It is a secondary triangulation.

Q. 70. What is the peculiarity of the methods used on the Jersey sea-coast where there is a deficiency of actual elevations?

ANS. By adapting the triangulations to any locality which may be found favorable.

Q. 71. You did not specify any of the means you propose to recur to at the South in the absence of actual elevations: Do you decline to state what they are?

ANS. No.

[Add. I decline no answer upon any questions.

Q. 72. What are they?

ANS. By mixed astronomical and geodetical observations.

Q. 73. Why were not such means used to overcome the impediments to the completion of the main triangulation on the Delaware?

ANS. Because they would not apply with propriety. There are better means.

Q. 74. What are those better means?

ANS. By meeting those localities by triangulations from the south side of the locality.

[Add. to 68, 69, 70, 71, 72, 73, 74. These questions go evidently into details of the practical application of the mathematical principles to certain localities, which can be discussed only with the map of these localities before the eye.]

Q. 75. You say that the peculiar methods by which you propose to overcome the difficulties on the southern coast are mixed astronomical and geodetical operations. Are not such the general means used everywhere in the survey?

ANS. The means of both are different in the two cases.

N. B. Here is to be inserted the separate paper, which I handed in for further explanation.

Q. 76. What is the object of the second base-line?

ANS. The verification of the whole work, which is the system of all such works.

[Add. The second base forms as much an indispensable part of a survey of large extent as the first base; this is a principle in the science, well known by all accounts of large surveys.]

Q. 77. If the object is to verify the survey, and suppose it does not agree, what is the consequence?

Ans. That the error, if any, is to be investigated.

[Add. I had added and corrected. This could, however, not be the case for any great amount in a well conducted work, and a well conditioned series of large triangles. There are other data and results to be obtained and considered in such a completed system of a work, which are well known to be deduced from it by the science, but which to treat here would require an elementary theoretical and practical deduction entirely out of place.

Q. 78. It is stated in one of your reports that the survey extends over 11,000 square miles: Is that mapped?

Ans. Yes, to be sure.

Q. 79. What benefits result to navigation by having all the details of the topography of the country?

Ans. There is no more topography in the maps than what is necessary for that object.

Q. 80. Cannot a portion of the topography be dispensed with without detriment to the object of a knowledge of the coast for navigation?

Ans. Not to that extent to which it is carried now. I could not dispense with any of the topography as it is now done.

Q. 81. Do not the hydrographical parties have to wait for those engaged on the topography?

Ans. They cannot go six inches without it; but they do not wait: the topographical part has always been ahead.

Q. 82. What distance from the coast have you carried the soundings?

Ans. Until they were out of sight of land; I mean the points given to them as guide; those points are made to be seen as far as possible. We elevated signals thirty feet or more.

[Add. to 78, 79, 80, 81, 82. These questions could be discussed long without leading to any actual practical effect. They are treated under the general denomination of the question of "Limitation," asked to be introduced in the work, in the paper already handed in.]

Q. 82. The Committee wish you to state the time each year since the recommencement of the work in 1832, at which you have taken the field, and also the time each party has commenced its work. Also the whole number of months occupied by yourself in working the main triangulation.

ANS. [Add. As I keep a regular journal every day, since 1811, when I left Schenectady for London, for all the time that I am in public employment, I can give exact account of every event of any moment; here follows therefore the *extract from the journals* referring to this question. My work in the office has always been the most arduous and laborious task, as well in the combination of the scientific methods, devising the means, the calculations, and all the manifold parts of the administration or direction of the work. Any man of science in this practical line will see that easily.]

Q. 83. You have sounded from Point Judith to Egg Harbor, along the coast. Have those soundings been extended as far out as you intend?

ANS. They are complete for the detailed maps, but they have not been carried out so far as I intend.

Q. 84. How much farther do you intend to carry the soundings?

ANS. To the Gulf Stream.

Q. 85. What will be the probable time required to extend the soundings, with the same force now employed, so far as you intend?

ANS. As this kind of work is to be done by astronomical observations, it depends entirely on the weather.

Q. 86. Where are the astronomical observations to be made?

ANS. Of course on board the ship, or sounding vessel, according to special instructions given to Lieut. Gedney last summer.

Q. 87. (By Mr. Wise.) For the present, is it necessary in order to carry the survey South, to extend the soundings to the Gulf Stream? And ultimately will the survey of the coast not be complete without extending the soundings to the Gulf Stream?

ANS. No, to the first clause of the question. As to the second clause, I answer, that the survey is in that respect ad libitum.

Q. 88. (By Mr. Wise.) By your answer to the second clause, am I to understand you as saying that the Government may carry the Survey as far out in the ocean as it chooses, but that the survey as far as it goes wherever it stops will be completed?

ANS. Yes.

Q. 89. (By Mr. Mallory.) Do you propose this or the next year to carry on these Gulf Stream soundings, by employing any of your present force?

ANS. Whenever any fit vessel is disposable, without otherwise impeding the work.

Q. 90. (By Mr. Mallory.) Is it probable that any such vessel will be disposable for that purpose during this or the next year?

ANS. It is likely, but it depends on the weather.

[Add. to 91. There is some miswriting to some of my answers to these questions.

Here I insert, as explanation, my instructions given to Captain Gedney, in 1841 and 1842.

It is evident to every man acquainted with the Coast and its approaches, that the district described in these instructions, forms the offings of the two ports of New York and the Delaware Bay; the brig Washington is considered a vessel well adapted for this work: she is in good order for it.

Q. 91 Of how many points in the United States have the latitudes and longitudes been ascertained and verified in the course of the Survey?

Ans. The calculation of the triangles in my work, gives in ultimate result the latitude and longitude of each point of the triangles, primary and secondary, according to my special form of the work.

N. B. The end of my answer should stand thus: "According to my special *formula for* the work." There are other miswritings in the question and answer.

Q. 92. Of the points of latitude and longitude thus determined, how many have been made public?

Ans. None; because it is not yet the proper time.

Q. 93. Have you determined the latitude and longitude of any points on the Coast? and if any, how many and what?

Ans. I have ascertained the latitude and longitude of points on the Coast as well as inland, according as the triangle points fell.

[*Add.* These answers I consider sufficient, as any detail discussions could not lead to any useful result. There are slight misunderstandings in the writing, which are of no moment, as for instance, in 93, *ascertained* is not my, nor a proper, expression.

Q. 94. Why have not the important points on the Coast thus determined, been made public?

Ans. The time of the publication is, when the general account of the triangulation is given, before which it will be of no use.

Q. 95. Did the French, in the triangulation of their country, use mixed geodetical and astronomical observations?

Ans. Not in the form in which I have stated in the first part of my written explanation.

Q. 96. Do you regard the Survey as a great scientific enterprize, embracing delicate problems of geodetic research, beyond what is necessary to an accurate but rapid Survey of the Coast for nautical purposes?

Ans. There is not a single movement in all I do, which is not necessary for the honorable and faithful execution of the work.

Q. 97. (By Mr. Mallory.) Is it intended as the basis of a topographical, military, and statistical Survey of the whole United States?

Ans. That is the government's business, and not mine.

Q. 98. Is the Survey conducted now with a view to any such ultimate purpose?

Ans. That is not given in my charge by the government, therefore I do nothing with it.

[Add. to 94 to 98. These answers I consider as self-evident, and entirely of the domain of the science in one respect, and of the decision of the government in another. I have said upon it what was to be said by me, in its proper place in my Report of last December. If the work is not carried on with all the means that science dictates for its execution, it is *worse than useless and discreditable.* I considered myself always bound to such a course as I have hitherto pursued, and have found myself always approved in this view, by the men *best able to judge,* and by those *in the proper stations to decide upon it.*]

Q. 99. Was not the secondary triangulation along the Jersey shore, found to be sufficiently accurate?

Ans. Yes.

[Add. So far as is expected from small secondary triangles. But, according to good principles, it must still be *joined* in its middle, by triangles across the country from the main triangulation inland; this is an indispensable mathematical requisite.]

Q. 100. Was not the main triangulation through New Jersey made with a view to the topographical Survey of that State?

Ans. No.

[Add. It is well known, by my very first plans of operation for the work, that this was the only true course for the main triangulation.]

Q. 101. Cannot the Survey of the bays and rivers be postponed, without injury to the general work, till the Survey of the Coast proper is completed?

Ans. It is impossible, because no accuracy could be got for the Coast.

[Add. It is self-evident to any practical mathematician, and answered in a former question.]

Q. 102. How many plates are now in the hands of the engravers?

Ans. Of actual copperplates, two.

Q. 103. Do they contain the whole map you are now getting ready for publication?

Ans. No: the Map of New York Harbor will cover eight such plates.

Q. 104. Why are not more preparing for publication?

Ans. They are in work; in a few days we can cut off a few more.

[Add. to 102—104. Are sufficiently explained. I may only add

now, 25th May, that a third engraver has just arrived from Philadelphia.]

Q. 105. How many engravers have you in employ?

Ans. Two; I would have if I had the money.

[Add. There is evidently an omission of some words in the statement of my answer.]

Q. 106. How long have those two been employed; and at what salary?

Ans. Since last January or December; one at $1800, and the other at $1300 per annum.

[Add. This time includes in part the time used in the preparatory arrangements.]

Q. 107. Where did you procure the copper for the above engraving, and where the engravers?

Ans. The copperplates now used were procured from Keim, in Philadelphia. The engravers from Hamburg, because they were the best, and best recommended.

Q. 108. Cannot American engravers put on copper all map engraving which has been put on paper?

Ans. No.

[Add. It is *well known* that the finer style of topography is not in practice yet in this country; my duty required that this part of the execution of the work should be of best quality, to answer honorably the aim of the work in its final appearance in the public; therefore, I procured, with authorization of the Treasury Department, two men known in Europe already in this line, from the quarter in best renown for the appropriated style of those works, which will guide the style of the work also with the engravers to be engaged hereafter.]

Q. 109. What is the ordinary amount of error in transferring from paper to copper?

Ans. In the way in which I do it, there shall be none.

[Add. The habitual way in common use is very bad. To preserve the accuracy obtained by the work of the Survey, the main points, which guide the positions, are brought upon the copper by the same assistant who makes the drawing of the map, which secures the accuracy. For the same reason, also, the engraving and the printing must be made in the office itself, where it is done much more economically, under proper inspection, and not dilapidated.]

Q. 110. Have the grossest errors in the position of places, stated in one of your reports to have been ascertained by you during the Survey, been pointed out by you for public information?

ANS. They have not yet been made public, but will be when the works relating to these places are published.

[Add. Whenever an interest was manifested for any part of the work, for improvements or otherwise, the extracts of the works desired were given, under the authorization of the Treasury Department, under whose decision all *communications* or publications are to be made *according to my agreement.*]

Q. 111. Are the measures in the Survey taken in French metres? If so, why?

ANS. Yes; because it is the only absolute standard; but the results are given in yards and metres both.

Q. 112. In what parts of yards?

ANS. In decimal parts only.

[Add. The principles of my action, in this respect, are fully exposed already in my printed papers upon the Coast Survey, quoted before. The reduction to any other measure consists only in the addition of a constant logarithm; as for instance, that for the yards, and even for the miles, is given in my printed logarithmic and trigonometric tables. As all the scales of the maps are expressed by their fractional value, the distances upon the maps can be ascertained in any measure whatsoever, and by that means are really given in any measure whatsoever, which is widely different from the *bad method*, so many miles to the inch, which has no regular comparable proportion.

Q. 113. What reason is there why all the *data* must remain in your office?

ANS. Because they are in daily use there.

Q. 114. Have you any reason to believe that the Surveys made by Captains Gedney, Wilks and Glynn, are not sufficiently accurate for the purpose of navigation?

ANS. I know nothing in regard to them.

[Add. to 113, 114. These answers are sufficient.]

Q. 115. Did the British officers survey the North Sea after the same manner that you are now surveying the Coast of the United States?

ANS. I am entirely unacquainted with what they did: there is nothing of it published.

[Add. As far as known to me, at least, in respect to the scientific account of the work; as there is nothing of it in the publication of the English survey.]

Q. 116. You stated in your printed Report, that you had accomplished now in a shorter time, and at less expense, more than had

been done in any other work of a similar kind. With what works do you make this comparison?

Ans. The English general Survey of England, Ireland and Scotland; the French survey of the inland and coast of France.

Q. 117. How many hours per day do your subordinate parties work in the field in favorable weather?

Ans. As many as possible.

Q. 118. Are there any data to ascertain how many hours?

Ans. They keep an account and will answer as to this.

[Add. The hours of work are immaterial to mention, as they all work with really liberal exertions for the best advantage and promotion of the work, even with regard to economy. A well organized work produces much result, without appearing laborious.]

Q. 119. Does this Survey employ the whole extent of your mathematical knowledge?

Ans. No.

[Add. My work in establishing the uniformity of Standards of Weights and Measures in this country, with more accuracy (I can safely pretend,) than other countries have it, are public documents which speak upon that. My various books printed upon the elementary parts of mathematics, upon astronomy, tables, &c., might be looked at in the Congress Library, and if desired, I will show the manuscripts of other works not yet published. However my situation in early life had caused me to apply to diplomacy and jurisprudence, and I occupied offices of high trust in these branches to full satisfaction, as my papers may prove, my first entering into public life dating now *over fifty-six years ago*, I must be excused to enter here in extraneous details, because I recollect very well, Mr. Mallory's question was general, *whether I knew something more than only the Coast Survey*, without the limitation to mathematical.]

Q. 120. Do you think, that under the most favorable circumstances, and with continuance of a yearly appropriation of $100,000, the Survey of the Coast can be completed in twenty years?

Ans. Perhaps. The progress is slower at first; and the means increase as the work proceeds.

[Add. But the constant persecution to which the work has been exposed, and especially *now is*, impedes its progress very much; there is a damage now incurred by the propositions of the last Congress session, and the present investigations, which have been occasioned by it, of positively upwards of $50,000 in delay of the work and accessories; besides, the discouragement occasioned by it in all those persons, who are engaged in the work, by their seeing

their liberal exertions rewarded by *throwing out suspicions* against them; these occasion a still greater damage.]

The discredit thrown out in the public, uncautiously, occasions impediments with the people in the country, with whom we come in contact; they consider themselves equally authorized to ill-treat us, which makes the work difficult, and increases the expenses beyond reason to no good purpose, and subjects to uncertainty.

HOUSE OF REPRESENTATIVES,
COMMITTEE-ROOM OF COMMERCE,
MARCH 12, 1842.

SIR,—I am directed by the Select Committee on the Coast Survey, to request you to hold yourself in readiness to attend a summons from the Committee for the purpose of explaining the condition of that work.

They will meet this morning in the Committee-room of Commerce, at 10, A. M., and may have occasion for your presence, if so, they will send a message.

Respectfully, your obedt. servt.,

(Signed) F. MALLORY, Chairman.

To F. R. HASSLER,
Supt. Coast Survey, Capitol Hill.

HOUSE OF REPRESENTATIVES,
COMMITTEE-ROOM OF COMMERCE,
MARCH 17, 1842.

SIR,—The Select Committee on the Coast Survey are now in session, and request your attendance this morning.

Respecttully, your obdt. servt.,

(Signed) F. MALLORY, Chairman.

F. R HASSLER, Esq.
Washington City.

WASHINGTON CITY, MARCH 31, 1842.

To the Honorable FRANCIS MALLORY, Chairman of the Committee of Investigation upon the Survey of the Coast.

GENTLEMEN—Allow me to take the liberty to request, that you allow me, in any form you may find proper, to get a full authentic copy of all the interrogatories, questions and answers, which have been the result of my examination.

If you will allow it, I might then yet add separately explanations, or further information, which in the haste of the process of proceedings may have remained unclear.

I have the honor to be, respectfully,
Gentlemen, your obedient servant,
F. R. HASSLER.

(COPY.)

SIR,—The Committee on the Coast Survey have requested Mr. St. E. Stone, to examine the manuscript Maps of the Harbor of New York, now in your office.

(Signed) F. MALLORY, Chairman.

F. R. HASSLER, ESQ.,
Supt. Coast Survey.

House of Representatives, May 30, 1842.

Honorable FRANCIS MALLORY, Chairman of the Committee on the Coast Survey.

SIR,—The unprovoked *insult* offered to me by sending the engraver Stone to me, to inspect the work of the Coast Survey in the Map of New York, is too much as well for the powers of the Committee, as for the feelings of an honest man.

You know, that the maps of the Coast Survey cannot be engraved, but in the office under my own inspection. You know that the map in question, is already cut up in plates, two of which are under the engraver's hands, nearly finished, two others just beginning, for two more the drawing is nearly finished, and two more are half finished drawings.

You know, that the engraver, Stone, is in no way qualified to do such work, nor that I could be made responsible for any of his doings.

Thence you cannot otherwise but conclude, that the measure you begin upon is destructive to the work; therefore, to the exertions and expenses hitherto incurred, directly opposite to the aim professed by the Committee to favor the Coast Survey work.

No man can expect that I, who am answerable for the work, could be compelled to give the final execution in the hands of a man in whom I have not the slightest reason to have any confidence whatever.

I consider the sending of Stone, *to inspect my work, as he said first*, as unmerited insult, and am certain that every member of the Committee, placed in my situation, would consider it so.

With respect and good wishes,
Your obedient servant,
(Signed) F. R. HASSLER.

WASHINGTON CITY, 30th May, 1842.

WASHINGTON CITY, 3d JUNE, 1842.

Honorable ISAAC E. HOLMES, Member of the Committee upon the Coast Survey.

SIR,—Mr. Mallory having communicated to me the questions addressed to me in the Committee, with my hasty answers at the time, according to the agreement, in order that I might add to my answers the explanations and extensions which they require, I have made the proper additions and remarks, and added to them some papers (copies,) which I had given into the Committee at some time intermediate, with nearer particulars in some instances.

Mr. Mallory, Chairman of the Committee, being now absent for a fortnight, as he said, I take the liberty herewith to address to you the paper resulting from these additions, for the use of the Committee, most likely best to circulate among the members to cause as little delay as I can in the labors of the Committee to a final close, which would be desirable to enable me to go to the field work, time enough for my plans or projects of this season.

I suppose Mr. Stone will have made his report upon his *examination* of the manuscript map of New York, for which he has been sent to me, in the name of the Committee. Mr. Mallory has also informed me, that I should not leave here, because the Committee would call me up in examination upon the works of the Weights and Measures. I, therefore, am now waiting, and, like always, in readiness to answer also upon this part of my works.

I have the honor to be, with perfect respect and esteem, Sir,
Your obt. servt.,
(Signed) F. R. HASSLER.

HOUSE OF REPRESENTATIVES, JULY 15, 1842.

SIR,—I am directed by the Committee on the Coast Survey, to inform you, that your attendance before the Committee will not again be required,

Respectfully, yours,
(Signed) F. MALLORY, Chairman.

To Mr. F. R. HASSLER,
Sup't. Coast Survey.

ADDITIONAL PAPERS HANDED IN TO THE COMMITTEE.

I.

MAPS DELIVERED.	DRAWN BY.	SCALE.	DATE OF DELIVERY.
1 Harbor of Bridgeport, Ct.	Lt. G. S. Blake,	$\frac{1}{10000}$	1835, engraved.
2 Newark Bay, N. J.	Lt. T. R. Gedney,	$\frac{1}{10000}$	18 , engraved.
3 Harbor of New Haven, Ct.	Lt. G. S. Blake & Wm. M. Boyce,	$\frac{1}{10000}$	1838, engraved.
4 Country between the Thames and Niantik, from the Sound up to Mohigan, Ct.	F. H. Gerdes,	$\frac{1}{10000}$	1840, Treas. Dep. for Hon. T. W. Willams.
5 Sandy Hook Bar,	C. Renard,	$\frac{1}{10000}$	1841, Treas. Dep. for (Mr. Pleasanton.)
6 Thames River, topography and Hydrography,	F. H. Gerdes,	$\frac{1}{20000}$	1842, Treas. Dep. for Senator Huntingdon
7 Sandy Hook Bar,	H. L. Whiting,	$\frac{1}{10000}$	1842, Topograp. Bureau.
8 Fisher's Second Sound and the Entry of New London Harbor, Ct.	F. H. Gerdes,	$\frac{1}{20000}$	1842, Treas. Dep. for Hon. T. W. Williams

II.

Times of my going to the field work, and returning from it, each year.

In 1832.

September 25th, having received the instruments, I left Washington the 26th September, at 8 o'clock, A. M. to reconnoitre for the continuance of my works of 1817, towards the east of it. Returned to Washington the 31st January, 1833, in the evening.

1833.

April 5th, at half past 7 o'clock, A. M., left Washington for the first beginning of actual primary triangulation; returned to Washington on the 3d January, 1834, in the evening.

1834.

After having finished all the preparations, and comparisons for the measurement of the base-line, I left the 29th May, at 9 o'clock, A. M., having made also stations; returned 25th January, 1835, in the evening.

1835.

There being much calculation to be made, and many arrangements for the organization of the parties, the State of Maryland having offered an arrangement to join the survey of that State with that of the Coast Survey, I went out only at different intervals to reconnoitre the country in Maryland and until Washington, and the outer bays, accompanied by Mr. J. H. Alexander, of Baltimore, until late in the fall and winter. Details could be given if needed.

1836.

The present office was established. I left 17th August, at half past 7 o'clock, A. M., and returned the 8th January, 1837.

1837.

I left Washington 4th June, at 8¾ A. M., and returned at half past 4, P. M., 5th January, 1838.

1838.

I left Washington July 19th, at 8 o'clock, A. M., and returned 24th December, 1838, just at sunset.

1839.

I left Washington the 9th June, at 7 o'clock, A. M., and returned the 5th January, 1840, beginning of dark.

1840.

I left Washington the 14th September, at 8 o'clock, A. M., and arrived again at Washington the 20th January, 1841, at 6 o'clock, P. M.

1841.

I left Washington at 10 o'clock, A. M., 29th August, and returned 22d December, 1841, at night.

This enumeration shows how the office work has increased since the beginning, when the work was starting, and the elements for it were first to be collected in the field. In the further progressing state of the work, the calculations as well of myself as of the assistants, the reduction into maps, making of projections to take to the field for the topographical and hydrographical works, their plotting and working out, required as much, and in most cases even more work from the assistants in the office than out of doors. So that indeed the going out for the field work, is considered as real relief from the harder works of the office, as well for me as for the assistants. For what relates to my assistants' *time* of going to the field work, they must be asked themselves.

Signed, F. R. HASSLER.

Washington City, 30th March, 1842.

III.

I must add a more detailed answer to that question which asked me, "How I would proceed in the Southern Coast, where marshes, woods, &c., presented peculiar impediments?" I answered to it, "By mixed astronomical and geodetical observations." This question was followed by that, "Is that not more or less the case with all the Coast Survey?"

This question showed that the nature of the scientific principles to be applied, and indicated by my answer, were unknown. I must, therefore, *explain;* what is called in mathematical practice MIXED astronomical and geodetical observations, is, when both these elements concur in *the same individual determination;* this is the case in the application of a problem of practical mathematics, which I have applied in Swiserland, and in this country on Buttermilk Hill (to the full knowledge of my assistants,) to obtain the junctions of my works of 1817, with those of 1833, in the beginning, when I had not yet a new base-line, nor sufficient angles; it was equally successful in both cases.

It consists in—one geodetic line being given in position and length, the latitude of either point being known, the latitude and the angle which the line subtends from a third point being observed, together with the azimuth of either end point, to determine the place of observation.

From such a result, new connections are then opened further onwards.

This was what I was beginning to express, when I was stopped, under the denomination of entering into arguments, which Mr. Cushing *refused* to hear.

That I should expose it from its elementary principles, is what I am sure the committee cannot intend, because it is a problem, which joining both branches of science, would require long deductions of principles, almost an elementary work for persons not acquainted with the science.

In the triangulation the two kinds of observations, astronomical and geodetical, are *disconnected;* each operation is *separate,* and they are only compared to draw conclusions upon one another, for a new, different result, required to place the Survey in general to its proper place upon earth; therefore, the astronomical parts are only made at a few, properly selected places, and with general views for the work, not for details like in the other case, so as I have stated in my answer to question 5, article 3, of my Report of December 2d, 1841.

Washington City, March 30th, 1842.

(Signed) F. R. HASSLER.

IV.

WASHINGTON CITY, MARCH 31, 1842.

Hon. FRANCIS MALLORY, Member of the Committee of Investigation of the Coast Survey.

SIR,—The pressing of the questions put to me in the Committee, must of course always leave some unilluminated spots after the examination is over; I must, therefore, take the liberty to supply always afterwards.

1. Mr. Ayerigg asked particulars about: why I measured with the metre as unity! I will not delay you by any detailed explanation, but must take the liberty to refer you to my report upon the Coast Survey works of May 17th, 1834, §34, where the subject is fully treated; it stands in page 148, of the 1st vol. of Documents upon the Survey of the Coast, printed by me in 1834.

2. Mr. Cushing said, that the discoveries of dangers in the navigation of the Sound had been kept secret *ten years*, this is an entirely erroneous statement, the work itself being even not as old as that; the Sound was, of course, worked later; the sounding part was made by Lieut. Blake, U. S. Navy, assistant in the Coast Survey; I request that he be asked particularly to clear up this erroneous statement.

3. Upon the publication, or not publication, of any thing resulting from the Coast Survey, *no reproach whatsoever can be applied to me*, because by my contract with the Government, I am prohibited to communicate any results, without order of the Treasury Department. Whenever such orders were given, they were instantly executed, as well known, sometimes even they were provoked by me, and given to public offices. My public accounts showed regularly every year the state of the work, upon which any call could have been grounded. I must, in this respect request again, that my answers to questions 5 and 7 of my last report be considered as inserted here; and also the §12, of my communication of 23d March last.

4. The publication is of course a consequence of the Survey and its reduction, as well by calculation, as to the mapping is a work absolutely intermediate between the two, therefore, the means given by the appropriation are to be distributed in due proportion between them, according to the state of the work, and the means on hand by the existing appropriation at any special time.

5. I was asked, how many hours the assistants worked per day. I answered, "as many as the day allows;" (*the work cannot be made in office hours,*) this addition, I believe, has been omitted to be written down, in fact, all my assistants, like me, work from interest for the work, and not as hirelings by the hour.

6. When I get the copy of the examination, I may see more that I can explain to a better understanding of my answers, which may appear to be required.

(Signed) F. R. HASSLER.

V.

Upon the Question of Limitation of the Works for the Survey of the Coast.

1. The limitation to any determined distance from the Coast, would require that the mountains, which are indispensably necessary for the station-points of the Survey, be within that limited distance.

2. This is well known not to be the fact, therefore also, the limitation not adapted to the nature of the country, thence, this limitation would become impossible to be observed, if even decreed.

3. If even smaller elevations were found within these limits, which it might be said fit to substitute, instead of the greater ones, it would be improper to use them, otherwise than so as they are

used now, namely, for secondary triangles, and the plane-table operations.

4. These smaller elevations, from their too great proximity to each other, would occasion triangles by far too small, to give the accuracy required for the connections of the work.

5. The multiplication of the triangles would evidently also require a much greater length of time, to execute them, because every one of them would require as much time, and trouble, as one of the large triangles, which might cover 6 or 12 of these small ones.

6. With this increasing of the operations, the necessity of cutting through woods, &c., increases actually in still greater proportion than the triangles themselves, and these cuttings are one of the great difficulties of the work.

7. Such smaller triangles are even much more tedious to make properly, than the large ones, therefore, they consume each more time, and of necessity retard the work, by limiting the greater strides which the freedom of the work at present admits. The improper increase of the expenses is self-evident.

8. Upon the limitation of the work only in the *topographical part*, the same reasoning applies, as to the more extensive operations; the inland bays, rivers, creeks, &c., which are navigable, are all so winding, and very often hid in hardly approachable marshes, that to follow them, which often would be fully impossible, would necessarily take up much more time than to survey them, by the general survey of the whole topograghy of the neighborhood.

9. How far, therefore, this topography shall, can, or must go, it is as impossible as improper, to determine beforehand; without the special reference to any given locality, nothing can be said about it in general terms.

10. This reference to any given locality, can only be decided by the operator upon the spot, and the special superintendent of the work, as has always been done hitherto.

11. The topography has hitherto never yet been carried farther than the proper aim, and the principles of the work, require; on the contrary, in several instances, an extension of the work has been specially desired.

12. Any idea of limitation and distinction, between the different parts of the works, would never be understood by the uninformed people, with whom the operators in the work must come in daily contact in the field works.

13. Thence would result that any owner of land, upon which an operator in the Survey would have to go, could explain this li-

mitation to his fancy, or interest, and attack him, drag him to jail, and otherwise expose him to insult, and ill-treatment, at his own option, as has been too often the case already.

14. That even this accessory incident causes much loss of time, and forms an actual retardation of the work, is self-evident, as well as its expensiveness.

15. The topographical part appears by experience, to be that least objected to, by the inhabitants, to judge from the manner in which the operators have been received, in comparison with the difficulties that have been laid in the way of the other parts of the work.

16. In general, a limitation to three miles from the Coast, as has been talked of, is a virtual abolition of the work itself, as well from the side of the natural, as the moral, difficulties it would suscitate, and the impossibility of giving to the work the required accuracy; nor would any other limitation be less injurious.

17. The shore line of a coast is never seen from a ship approaching it; the picture of the elevated land, is what presents itself to the sailor; in this he is guided by so much of the topography, as can be seen at a reasonable distance at sea, and this lies back in the country at distances, which are not determinable but by actual survey, thence the only rule is, that which I have followed, and long ago stated, namely, the "topography must go to the ridge of mountains which determine the heads of the coasting rivers, or creeks, or their passage through such mountains, what is called in France, technically, *le versent de la Vallée côtiere*," or, "*le versant de la Cote.*" Such it has always been understood and approved.

18. My rule of action and guide in the work, must be my contract to make the work "*honorably and permanently useful, to the nation.*" The way to obtain the aim must be left to me; if I was to be guided by any foreign direction, except mathematical principles, some of my assistants might even rise up against me, refusing to do what they might think to exceed my powers, and I would either have to dismiss them for such refusal, or the work would become impossible.

19. Hitherto the work has proceeded in harmony, and with all good willing exertions on the part of every one; if such had not been the liberal action of all in the case, not half the work would be done, which actually is done.

20. The attempts to find causes for change in my arrangement, by the resolution of the last Congress session, and the present Committee, have already caused a great damage.

UPON CHRONOMETRIC OPERATIONS.

1. The name of Chronometic Survey is a complete misnomer, chronometers *cannot survey.*

The determination of any point on earth by chronometric, or any other operation, requiring the knowledge of the time, requires three different determinations. 1st. The latitude. 2d. The time. 3d. Some phenomena by which the time becomes comparable with that of another place; or in absence of an actual phenomenon a given quantity, or proportion, by which the time of the place can be referred to that of another place. (N. B. When I was Professor at the Military Academy, West Point, 1807—1809, I made a full deduction of this subject by which I instructed some cadets in it.)

2. Chronometers determine only the time of a place, and to do that requires astronomical observations, generally made with inferior reflecting instruments.

The longitude, any how deduced, needs determination of latitude, to determine a point by their intersection. All the results, whatever, depend on the measurement of the altitude of celestial observations at sea, which are subject to unavoidable errors of several minutes.

3. The determination by chronometers must be very frequently repeated, if any even approximate result shall be obtained, for one single point; therefore, these results remain, what may be called, swimming, for many years, or in fact, rather are never exactly determined, while on a Coast the most minute and fully certain determinations are indispensable.

4. The distance that might be concluded from such determinations, would have to be calculated from astronomical elements reduced to the earth's surface, which cannot be done with any thing like an accuracy that can be indicated in any of the linear measures, so as to ground upon it an *actual survey* of the form of the Coast, road, or any thing like what the survey requires to determine, suppose a shoal, rock, or any other individual point of interest.

5. It is well known, that we speak of the time of Washington, Philadelphia, or such, without distinguishing which part of these places the time shall apply to; the chronometers, perfectioned as

they pretend to be, and referred to the necessary observations, which makes indication comparable with the actual time at the place, *cannot show* any distinction between these different parts, by any possibility whatever.

6. How many vessels have there *room to wreck* within, suppose, the precincts of Washington, Philadelphia, or any such city? thence, an instrument which cannot distinguish such distances, is positively no surveying instrument, besides, it determines no linear distances, while the rocks, shoals, or other dangers that may make a shipwreck, are generally small, and, therefore, their determination must be very accurate. These determinations must be guided by accurate survey upon the shore, where alone a survey is possible. Chronometers and sextant are for that entirely unavailable.

7. In my answers to question 15, of my last Report, I have in few words discarded all these ideas, they would not deserve more attention than there, with any man intimate with the scientific principles implied in the case.

8. To make any chronometric determination between points on land, it would be necessary to have a well determined and active astronomical observatory near the sea shore, (a condition which does not exist in this country,) where the time is at any instant determined within the decimal of a second; from this, chronometers, the rates of which are determined there with the minutest accuracy, would have to go off to any point that is to be determined, and return back to it in the shortest time possible, as for long times they cannot be trusted. Chronometers indicate only a time, or rather a place in their revolution, which must, by observation of celestial bodies, be referred to what is called the time of the place; (for which generally reflecting instruments are used by free hand.)

9. The latitude of that point of observation must be exactly known, and observations of time made there, and calculated, all to the greatest minuteness, and during several days, for each single result, of which a great number must be collected before it is allowable to call them a determination.

10. The repeated voyages which this operation requires, consume of course a great length of time, and proportionate large expenses, to produce at last only a very vague approximation, as this is well known in the science.

11. Every such determination is dependent as to the *chronometer*, of three circumstances of its rate, besides all the chances of the accuracy of the observations, which are very bad, and well known; the first rate, at the observatory, can be determined for the time it is there. It is more difficult, but still to a certain degree, possible,

to determine the rate at the station to be determined. But, the third rate which the chronometer may have had during the traveling, is positively undeterminable, and a mere chance; as it is well known that all chronometers alter their rate between being quiet and traveling, by the number of repetitions only a mean between all these evil chances is obtainable, and never any certainty.

12. Between such a collection of uncertain, disconnected points, it is directly impossible to survey details, which however are evidently the most important part of the work, far less to determine the place of any soundings.

13. On board ship horizontal angles can never be measured with the accuracy required to determine other points from them; they can only serve to determine *the momentaneous position of a vessel*, when taking an individual sounding, and no further. A vessel ever so well at anchor, even with three anchors, presents always the lens on an inverted pendulum, oscillating from the points where the anchors touch the ground; it cannot avoid considerable play.

Vertical angles between the horizon and a celestial body, are the only observations admissible on board ships, referring to a point upon the earth; that these are subject to several minutes' uncertainty by the variation of the refraction, and other such causes, is too well known to allow any man of information to put them in any way in comparison with observations on the land.

Lunar distances need not be quoted, they are the same on board ships, and on land, only requiring more skill in the first case. But also, no man whatsoever would think, nor has ever thought, of applying them to *surveying* in either case.

14. By the above it is evident, and experience has often proved it, that the absolute error between two near points, is subject to be as great as that upon any large distance; this again makes it the less applicable for any use in actual surveying, nor has it ever been pretended to determine small distances on earth by the measure of the time.

15. The geographical position of the Coast of the United States, is eminently contrary to any chronometric determinations, and in general any determination from astronomical data, the chronometer is within certain limits but an uncertain tool, the whole dependence must be upon the observations, which are subject to miles of error, by no means admissible in an actual survey. The greatest part of the coast follows, with great varieties of indentations, or variations, so near the same meridian for considerable distances, that the chances of the chronometer's failings are greater than the actual difference of the longitude of the points to be determined.

16. Thus (see in the map,) 1st. From east end of Long Island, the many indentures of the New England Coast, are almost all in the case. 2d. From New York and Sandy Hook, south through Jersey, &c., till to about Cape Hatteras, the gradual and tolerable regular line is again so nearly in the same meridian, that the observations with chronometers could not fail to give indentures which do not exist. 3d. From Charleston to the Florida Capes, the same thing is the case as in No. 2. 4th. Long Island laying more east and west, could get better distances to determine by chronometers between a few points, but nothing would be obtained by it for all its bays, and important points of shipping and navigation, (this part of the work is now done.) 5th. The same is, but far less favorably, the case between Cape Hatteras and Charleston.

Supposing such parts to be intended to be fillod up, with the necessary details, between two chronometric points, this becomes entirely impossible, from the want of accuracy of that very base determined by sextant and chronometer, with their chances of inaccuracy.

17. Chronometers and reflecting instruments render good services at sea, where all other means fail, but within such limits only as are there required, as the highest 6 to 10 miles, which is sufficient at sea, where from the mast of a common vessel, a horizon of 10 to 12 miles diameter is discernible. This chance is entirely inadmissible in a Survey of a Coast, where the details of position of land, shoals, dangers, &c., are the most essential, and which can never be determined at all by chronometers and similar means.

18. It is, therefore, evident that the Survey must be performed upon the land, because there is no possibility to determine distances upon water, in any way admissible with the aim of the Coast Survey. How far land inwards this Survey must go, even for the most simple requisites of the gross navigation outside, is determined by the make of the land, it is not admissible to designate or limit their extent.

The seaman never sees the shore line when he approaches land, he always sees only the farther distant elevations, by which he reconnoitres himself, thence the views added always to the charts, which show him the vertical appearances. When he comes so far as to see the actual shore line, he is lost. He will find himself thrown upon it, before he is aware of it.

19. There is no compounding with mathematical principles, when they shall be applied to a determined practical aim, any deviation from them leads inevitably to a complete failure. So, if it is the question of determining distances and positions, lines and angles

only can determine them, and these must be employed from the simple chain and compass operations to the highest branches of astronomy. The Coast Survey must ground all its operations upon them, and in such a manner as to obtain the highest possible degree of accuracy; if there is a deficiency of accuracy in one of the essential parts, it would increase to a complete distortion of the country in the sequel of the work, if suffered to continue to exist. Without these primary requisites of the methods used, the proper success of the Survey of the Coast is positively impossible.

20. All plans grounding upon chronometers for surveying, are fallacious, and by any attempt towards them, an immense expense would be incurred before even any work could be done, and never any standing results are obtainable; that is strictly mathematically proveable.

At the renewal, 1832, under these very naval plans, the very author of them told me of such a number of steamboats to put into activity for it, as the purchase and equipping with instruments and other effects, would have far exceeded the amount of money, that has been spent as yet in the Coast Survey, and its outfit with instruments and all, under my direction; for which results are exhibited permanently useful, and honorable to the country, as my contract enjoins to me, and a stock of property is acquired of high value and utility for the future; while by the plans, which it appears an idea started up to revive, certainly not four points of the Coast could have been determined with due reliance for the aim of the work. Sufficient proofs have been administered by other works, which are kept out of sight, to attempt to mislead always equally, and to mar the success of a work, which can succeed only by science, divested of all private interest.

21. The boasting up of chronometers by their makers, must not be taken as a true guide, a light reflection reduces the flourish to its proper level. A chronometer maker for instance, brags of one of his chronometers having had the price, or preference among a number of others; this chronometer bears the No. 867, or such like, number, the government of England bought it, thence clearly it cannot be considered as a recommendation for any other person *to buy any of the others*, as, 1st. The choice can now be only among those which were not able to compete. 2d. The high number of the successful one, indicates of itself a very unfavorable chance in the purchase. In England, it is even considered, that one third of the chronometers made, are good for nothing at all, and the full success a mere chance.

22. The determination of the longitude of Madeira by means of

chronometers, made by Dr. Tiarks, is often attempted to be held up for the accuracy of such like determinations; the following true remarks will set this claim to rest.

1st. The only communication between London and Madeira was by water, and the determination implied no line of coast whatever; it reduced itself to knowing the difference of *time* at two *places*, or cities, in the manner quoted above; the minuteness required between two near places on either coast was no consideration.

2d. Of twenty-eight chronometers which Dr. Tiarks had, only three proved so near as to be admissible in the result; the other gave no admissible approach. The last, or rather as Dr. Tiarks wrote to me, only one fully admissible, the Admiralty bought; the others, I suppose, will not be found recommendable for the aim of the Coast Survey, which requires so much minuteness.

23. Details and accounts to the same effect and result might be multiplied up to the present time, but it would be altogether superfluous, the accounts of the very best chronometers, and the highest authorities upon the subject, may be taken from the Astronomical Journal (Astronomishe Nachrichten) of Mr. Shumacher of Altona, all which will fully support even the minutest parts of the above statements.

24. Upon the real principles that science dictates for such works as the Coast Survey, the introduction of the announcement of the new map of France (here joined,) treats shortly from the most authentic sources. The difference between the two works, is no other, than the greater difficulty of the Coast Survey, on account of the coasting land being accessible only from one side.

25. When in 1818 my agency in the Coast Survey was destroyed, by influences over which the veil may remain, the Navy Department undertook it by partitioning off the Coast, and establishing works of which for several years appeared in the newspapers the notice, "The Coast Survey goes on gloriously," until pressed too hard, the truth made itself vent, by its own elasticity, and the expense of many hundred thousand dollars, woke up attention. The annual report of the Navy Department of 1828, giving account of this branch of the service, stated in final conclusion: "Nor can such Surveys be made without the aid of the means contemplated by the act of 10th February, 1807, to provide for surveying the Coast of the United States," which was proposed to be renewed again. But it lasted until 1832, before its passage could be obtained again in Congress. The particulars of the epoch from 1818 to 1828, remain as yet private to the Navy Department, without any public report, or maps.

26. The proposition of the Navy Department of 1828, was accompanied by a report, which is printed in the Congressional Documents of the time, made by Commodore Rodgers, (then yet in good health,) grounded in principle upon my previous plans, adopted already in 1807, and approved by the men of science in Europe, in their reviews of my papers upon the Coast Survey, printed in the Philosophical Transactions of Philadelphia, of 1825.

27. When it was evident in 1832, that the law renewing that of 1807, would pass, it appears that the naval officers prepared these reports, which are now asked for; but the President had proposed to me, to take up the work again, and my plans and propositions were renewed long before I had any knowledge of them. It is remarkable in them, that the same Commodore Rodgers, who had written the reports of 1828, at that time recommended, as chief of the Navy Commissioners still, these same plans, especially for their exclusive quality of being executable by the navy alone, without any reference to their scientific qualifications, and adaptedness to the work in view, and its aim; and in despite of the many strikingly evident impossibilities which they contain.

F. R. HASSLER.

Survey Station, Pine Hill, Gloucester County, N. J., November 29, 1842.

WASHINGTON CITY, MARCH 23, 1842.

Honorable FRANCIS MALLORY, Chairman of the Select Committee of Investigation of the Coast Survey.

SIR,—Among the questions put to me in the Committee's meeting, there was one, at least, which appeared much insisted upon, and by circumstances was rather discussed than answered.

It seemed to put in doubt the propriety of the journals, and other works of the Coast Survey, to remain in the Coast Survey office, and requesting them to be delivered to the Treasury *Department* for safety. I will here supply more distinct answers.

1. This office, here, is one of the offices of the Treasury Department, exactly as much as any of the rooms in the Treasury Building itself.

2. The extension of the Treasury Department works has rendered necessary a number of other offices out of the yet unfinished Treasury Building proper; so is this office.

3. The foreign Standards of Weights and Measures have just now been transported from the Treasury Building to this office, for their more proper and more appropriate safe keeping.

4. There are three houses adjoining each other, rented by the Department, two at the expense of the Coast Survey, and one at the expense of the Weight and Measure works; and the foundry establishment, besides, is across the street.

5. The total of the buildings adapted themselves so peculiarly to the use of both works, that no building in this city could, in any way, equal the conveniences they afford by their present distribution.

6. Various arrangements have been made, at public expense, as well as the expense of the owner, to adapt them the better. One story was elevated to procure drawing-rooms superior to any I know of; for better security the roofs have been slated, and, in general, every arrangement made for convenience and security.

7. In every one of the three buildings, which connect all through with one another, two persons at least sleep; these are assistants, clerk, workmen, and I myself, so that the buildings are well watched all night.

8. The maps and many other valuable objects are placed so that even in the extreme case of fire, they would be saved with the greatest ease.

9. The whole of the Coast Survey work must, in all cases, and at all times, be of the easiest access, nay, present, during the whole time that the work is going on, still more so than in any other office such may be required.

10. In requiring place in the Treasury Building only to deposit the foreign standards, which had been expunged from the State Department to the Patent Office, where they were exposed to damage, I could not get a well appropriated place for want of room.

11. The lower vaults of the Treasury Building, where I got a place to deposit the Weight and Measure Standards, packed up, and not yet sent off, could not but with difficulty be got, and such an one would not do, because of their not being sufficiently dry and aired for paper; the maps especially would be utterly destroyed.

12. To displace the works from the office would be laying great impediment in the way of the work, and expose the parts deposited to *dilapidation and abuse*.

13. Every time that a certain systematically full part of the work, between two base lines, and two astronomical stations, will be executed, a full report will be made, and it is hoped published by Congress, which will rest that part forever, and then the Documents of that part may be placed in some specially selected place of deposit, as original record; but until that time they *must remain* in the office in which they originate.

14. It would be the most effective mode of clearing up any subject whatsoever, that may be desired, and come in question, if the Committee would be so kind as to come over to the office, which is so near the Capitol, and visit all the parts of the work, as they are in activity, and constantly in evidence for every visiter.

(Signed) F. R. HASSLER.

ELEMENTARY REMARKS.

1. The second in time, which is the unit of the kind of quantity which the chronometers indicate, is 15 seconds in the arc, in the rotation of the earth, which measures the time. One second in the arc of a great circle on the earth's surface, is 98 or 100 feet English, therefore one second in time would, and at the equator does, subtend about 1500 feet; this diminishes with the increase of the latitude, in the ratio of the cosine of the latitude; in the mean latitude of the coast of the United States this is about from 72 to 86 feet for each second in the arc, and the error arising from one second in time would be 15 times that: namely, from 1080 to 1300 feet. Such determinations are therefore rather less accurate than the distances obtained by observing the difference of velocity between light and sound.

2. This exhibits the chance of error in distance to which *one single* second of the chronometer subjects in longitude. But the time of a chronometer, in relation to the actual time at its place on earth, depends on observations of altitudes of the sun, if observed at sea with a reflecting instrument, for which generally only sextants are used; this altitude is subject to an error of from 3 to 5 minutes, or miles, independently of the errors of the instrument and observation, from the mere uncertainty of the refraction, and similar causes, which therefore multiplies by so much the uncertainty of the observation by which the chronometric determination of time is affected, independently of the vacillating rate of the chronometer itself.

3. But the best chronometers even do not assure the accuracy of one second in time; the deviation of the chronometer over this, forms therefore the factor by which all these errors are *multiplied;* that they are too great already without this multiplication, is evident enough. How any man in the least acquainted with the exigency of the conscientious execution of the Coast Survey, and the elementary principles given by the science, could hesitate an instant between the choice of such means as chronometers, &c., and those which exact and well known principles of mathematics lay so directly before us, by trigonometry, is incomprehensible. Who will ever trust the map of a coast grounded upon so vague determinations?

4. The above discussion of the accuracy possibly obtainable in the longitude of a point by chronometers, refers only to the one line of the determination required to locate any point of the survey, by which a point of sounding or any other locality is determined. To complete its determination it is necessary to determine the distance of the parallel from the equator, by its intersection with the circle perpendicular to it, namely, the circle of latitude, or the meridian of the place; which in itself is already, as stated, the element indispensable to locate the point in the parallel to which these errors refer; this is determined as above stated, by observations of altitudes of celestial bodies, the uncertainty of which at sea is by no means overrated when, as above set down, at 3 or 5 miles, that is 3 or 5 times 60 seconds, each in that case, of 98 or 100 feet in length, or from 1800 to 3000 feet.

5. Taking now the chances of error of the best chronometers, which are rated by late experiences to at least 3 seconds in time, in the mean latitude of the United States, to suppose 80 feet per second in the arc, the product of this 15 times or 1200 feet for each second, which gives 3600 feet chance of error, we have a quadrilateral resulting of 3600 feet in one direction, and from 3 to 5 miles in the other, within which the point to be determined is uncertain, under the most favorable circumstances; any closer accuracy is a hazard not to be in any way calculated upoa.

6. These calculations and considerations bring the determinations by reflecting instruments and chronometers, to what I have stated in my other paper, to be yet within the visible horizon of a ship at sea, that is a diameter of between 20 and 30 miles; thence comes the conclusion, that chronometers are good seaman's tools, where this accuracy is sufficient, as in a discovery voyage, where never more than a tolerable approximation is expected, and in other similar cases; but they are unable to give any determinations admissible in the determination and delineation of the coast, on account of their want of the accuracy required in that case.

7. The idea of determining the head lands and principal points of the coast, by observations requiring chronometers, as an instrument to determine a place upon earth, and principally for the Coast Survey, and then introduce between them the details, by *separate geodetical* surveys, is positively impossible; for when the first determinations, upon which the others *must* by principles be grounded or relied upon, are so uncertain as the chronometric determinations evidently are, the details can impossibly be made to fit between, and making them separate works, to be tried to fit between these uncertain points, would require either to destroy the accuracy of the geodetic

works, or to be obliged to repeat the whole of both operations, to ascertain where the errors lie, and attempt to correct the results, which it is impossible to do by the first operations, with decided accuracy; thence everlasting repetitions must follow and always yet leave *uncertainty*. I stated, in my other paper, the unvoidable uncertainty of the chronometers, derived between points on land by the undeterminable rate of them during any moving of them.

8. Perhaps it may be yet attempted to quote from my own plan of operations of 1807, that I spoke myself about chronometric determinations. But it must be observed: that at that epoch the intention of the government upon what the Survey of the Coast should be, was just to be ascertained, therefore it was proper for me to state what I did state, to ascertain these very intentions, by the choice which the President would make of the means proposed. The President, Jefferson, being a man of science, selecting the real scientific course, the mode of executing the work was for once and all decided, by invariable mathematical principles; all arrangements were made, the proper expenses have been incurred, an amount of property appropriated to these aims is on hand, amounting to upwards of $120,000, as I stated in my report, in answer to the questions raised in Congress last year.

9. The satisfaction of that late President, upon the principles and their application, which I explained and exhibited in the Transactions of the Philosophical Society of Philadelphia, printed in 1825, can be seen in the letter of Ex-President Jefferson, of 3d December, 1825, to me, in the first volume of the Documents of the Coast Survey, printed in 1834, page 49 and sequel.

F. R. HASSLER.

Pine Hill, 6th December, 1842.

N. B. These two last papers are an extension of the one given in to the committee, which appeared required for a better understanding of the subject.

TRANSLATION.

New Topographical Map of France, adapted to all the public services, and combined with the operations of the Cadaster.

The project of the operation to which the attention of the chambers, and the public, is herewith called, has been submitted to the examination of a committee of fourteen members, presented by the ministers of the interior, of war, of the navy, and of the finances; and the first dispositions agreed upon by this committee, have already been honored with the approbation of His Majesty.

An undertaking presented under such happy auspices, might be dispensed with, quoting other suffrages; as, however, this undertaking belongs to the exact sciences, we shall here begin by presenting an abstract of the opinion of the Marquis of Laplace, upon the project of the law relating to the finances, for the service of the year 1817. The striking coincidence which will be observed between the general views of this illustrious mathematician, and the whole of the plan here proposed, no doubt, will make, that no man will view the expenses as useless, that are necessary to put it in execution, particularly when considering that rigorously made calculations show, that the publication of the work would produce several millions over and above the expenses.

Extract of the Opinion of Marquis of Laplace.

(Chamber of Peers, Session 1816, Friday, 21st March, 1817.)

"To survey with accuracy the map of a kingdom, there is but one method, which unfortunately has not been followed in the operations of the Cadaster. It consists in forming two great lines perpendicular to one another, the one north and south, the other east and west. The whole space or country to be surveyed is covered by a net of great triangles, that are attached to these lines. Subdividing afterwards these large triangles by secondary ones, the work is brought down into the details of the communities, townships, &c. Thus the partial surveys are restricted in their deviations by the triangles, that circumscribe them, the faults of the surveyors are discovered and corrected. By this is obtained a system of operations,

good in its details, and perfect in its union. France has for the execution of such a system all the means that may be desired: the men of science the most able to direct it, a very well informed corps of geographical engineers, who have already made what exists the best in this kind of work, and to which officers of artillery and engineers can be joined. The Cadaster offers them the most favorable occasion to exercise themselves in these operations, which they shall execute in time of war.

"In this manner Prussia continues upon the other side of the Rhine the topographical works of our engineers; it cannot follow better models.

"Already one of the fundamental lines of which I have spoken traverses France from Dunkerque to Perpignan. A perpendicular directed from Strassbourg to Brest is begun; the first of these lines traced with the utmost accuracy has been extended over the Pyrenees, till to the Island of Formentara in the Mediterranean sea. By the favors of the liberal cares of the minister of the interior for the progress of the sciences, this line will be extended to the north till to Yarmouth. Colonel Madge, who surveys the map of England and Scotland, upon the plan that I have quoted, with equal zeal and ability, will unite with the Frenchmen of science in protracting jointly our meridian. The extent of this system comprehends an arc of about one seventh of the distance between the Equator and the Pole. The latitudes of its extreme points have been observed, and those of several intermediate points, and the length of the second pendulum corresponding to these points, has been measured, which gives a great deal of light upon the figure of the earth, and the inequalities of its degrees and of the gravity.

"I wish the ministers may please to take into consideration the plan that I propose. It is possible to adapt to it the part of the Cadaster already done, and to execute the same without delay in the operation, and without increase of expenses. Perhaps even the great number of geographical engineers, which our present state of peace allows to employ in this work, to which it is painful to see them strangers, would render its execution more prompt and less expensive.

"But a commission, appointed by government, to give it light upon this subject, would take the proper necessary informations for its decisions. It would examine how far the reproaches of negligence and incapacity, made to various agents of the Cadaster, are grounded. It would indicate the means to accelerate and perfect it.

"After having, in the formation of the great map of France, given to other nations an example, which they follow carefully, let us not

be inferior to them; let us not retrograde while they advance. Let us retain among us the glory of the sciences and of the fine arts; this glory, sweet and peaceable, has the advantage to be susceptible of increase without diminishing foreign glory, and to interest all nations by procuring to them new enjoyments."

The Marquis of Equevilly, Director of the General Depôt of the War Department, has equally called the solicitude of the Chamber upon the undertaking of so high an importance, as an accurate topographical map of France is for all the public services, at the epoch when he presented the plan, of which a sketch will be given hereafter, the same as the immortal author of the mechanic of heavens, and his station has rendered him the most able to judge upon this subject, by the various public services to which he has been called.

27th Congress, 3d Session. Rep. No. 170. Ho. of Reps.

COAST SURVEY.

February 9, 1843.
Printed by order of the House of Representatives.

Mr. Aycrigg, as an individual member of the Committee on the Coast Survey and of Weights and Measures, with the consent of the committee, reports his views and conclusions drawn from the testimony taken before said committee, and from the reports of the superintendent of the coast survey, as follows:

(1.) That the original object of the work has been lost in the extensive operations of the coast survey, which include much work unnecessary for the purposes of the navigator. (Page 7.)

(2.) That triangulation is the most accurate mode of making the survey so much desired, wherever the features of the country present the proper elevations, and that this triangulation depends on the measured base. (Page 8.)

(3.) That the "*measured* base" on Fire island is not the "*actual* base," and that its exact length has never been given.

That the "actual base" is the calculated side of a triangle, of which only *one side* (the measured base) is measured, and that the "monument" is not placed at the end of the measured base, as we should infer from Mr. Hassler's report of 1834–'35, but at the end of the "actual base;" and that the length of the "actual base" has not only never been measured, but probably never can be; and that, even supposing it possible to find the eastern termination of the measured base by a triangulation that admits of error, to find a point which was left by triangulation that also admitted of inaccuracy, still we cannot measure from this point to the other extremity of the base, on account of the washing away of the beach; and, consequently, that we can never verify even this part, the foundation of the whole work, which is placed upon a moving sand bar called Fire island, exposed to the ocean, between high and low water mark. (Page 9.)

(4.) That the longitudes of the different parts of the survey have not been yet obtained. (Page 11.)

(5.) That the secondary triangulation has gone far beyond the limits of the primary triangulation, and that the primary has never yet been verified. (Page 12.)

(6.) That we have not even the compass bearings, and, consequently, two of the three important parts of a chart (viz: longitude and compass bearings) being wanting, and the survey not tested, we can as yet have nothing certain; but still that this approximation should be published. (Page 13.)

(7.) That Mr. Hassler has taken but 20 primary stations for the whole time since he began, while the European works show a very different state of things. (Page 13.)

(8.) That Mr. Hassler remains in his office, and proposes to use the secondary surveys to find primary station points, in place of looking for them himself, and pushing on the main triangulation at least as fast as the secondary. (Page 14.)

(9.) That the secondary covers 11,000 square miles, while the primary covers but 3,577, although the primary is broad in proportion to its length, while a part of the secondary runs in a narrow strip along the Jersey coast. (Page 14.)

(10.) That very trifling causes are taken by Mr. Hassler as good ground to excuse his neglect of the work. (Page 15.)

(11.) Consequently, that the whole work is yet in doubt, arising from the culpable neglect of the superintendent; but that there is no evidence of fault on the part of his assistants. (Page 15.)

(12.) The proposition is therefore submitted, whether an expenditure of one year's time, and a tenth part of the yearly expense of the coast survey, might not have been so applied as to have been of more benefit than all that we have yet received from this work. (Page 16.)

(13.) Again it appears that the whole work of the coast survey is subject to great risk from fire and robbery. (Page 16.)

(14) That the present mode of conducting the work will have a tendency to destroy the confidence in its accuracy. (Page 17.)

(15.) That the chart of Newark bay is a mere picture, without latitude, longitude, compass bearings, or north point, or any means to enable us to use it, except the scale (correctly copied from the original) "three inches to the mile," and the scale divided accordingly, making the length of Newark bay 11.8 miles.

That the copperplate copy, presented by one of Mr. Hassler's assistants, with a *corrected* scale, makes the length of the bay 5.82 miles, because the *corrected* scale is $\frac{1}{6}$ of an inch too short.

That the length of the bay is really 5.62 miles.

That it requires nothing more accurate than a carpenter's rule to measure the maps herewith presented, and an examination of the documents to prove that Mr. Hassler has lost his memory, and that the charge of wilful injustice against one of the committee cannot possibly have any foundation;

That Mr. Hassler has suppressed the date of this map, and given those of the other seven that he enumerates;

And that he has forgotten to mention another map of Newark bay regularly called for by the House, and now on file. (Page 17.)

(16.) It also appears that Mr. Hassler calculates to change the system of measuring the three angles of every triangle, and to depend on a single angle on the planes at the south. (Page 20.)

(17.) Therefore, a few suggestions are made, as to the difficulties, and the question raised, whether it would not be better to get further information before we advance in a manner that leads to results of doubtful utility? (Page 21.).

(18.) From the above, the objections to the present organization lead to the examination of a change to that which has been adopted by other countries with better success. (Page 22.)

(19.) The peculiarities of Mr. Hassler, taken from his own communications to the committee and other documents, are thrown in for the exam-

ination of those who consider him identified with the survey, as being the *only* man capable of conducting it. (Page 24.)

(20.) Conclusions from the above. (Page 24.)

In order that the House may be able to decide what importance should be attached to the evidence taken before the committee, from a knowledge of the means of information, relating to the subject under investigation, possessed by the witnesses, the following extracts are presented, in which each individual speaks for himself.

In order to prevent any injurious impression that might be produced, from a misunderstanding of the observations contained in this report, it is proper to remark, that no doubt is intended to be cast upon the testimony of any of Mr. Hassler's assistants; but at the same time we may naturally suppose that delicacy of feeling would cause them to put the best construction on every thing respecting their chief officer.

Extracts from a pamphlet distributed among the members of the House of Representatives.

20. My age dates from 6th October, 1770. It is with life or age, like with all other things, it lasts the longer and remains the longer effectif; the better it is used and husbanded.

21. It is a direct injustice to reproach to the officers issuing from the military academy of West Point, and from the naval schools, their not being competent to take the lead in a work which they are not instructed the very first principles of, nor provided with any means for. The thing *is impossible for them*, I must state my own experience. Immediately after President Jefferson had approved my plan of operation for the coast survey in 1807, from among the thirteen plans handed in, and examined, by the committee held in Philadelphia, he also decided the postponement of the execution of the work, on account of the warlike appearance of affairs in England.

At the same time the first professorship of mathematics and natural philosophy of West Point was vacant; Mr. Garnet, a private gentleman of New Brunswick, N. J., well known eminent mathematician, and Colonel Williams, chief of the engineers and of the military academy, proposed me for that professorship, which I occupied 1807–'8–'9, to such satisfaction as letters in my possession, and the opinion of students of those times may show.

I attempted to give to some (then new) lieutenants just dismissed from the academy, some practical information, in a direction leading to works of the nature in question. I even wrote upon it, but they found themselves entirely unprepared, I could do only little, and they soon left. During the time I was there, and one of my friends (who afterwards died in Arkansas) there was some teaching in this line of the science, which was ever since interrupted until, as I have just been told, it was again begun last year—but it requires longer years of instruction and practice to acquire proper proficiency in that branch of science.

In 1808, I made a plan for the studies and organization of the military academy, which may still be found in the War Department. What they

are not taught in the academy, the students *cannot be expected to bring out of it*, their future practice alone can put them in the possibility of acquiring it, according to the special duties, they may be placed into, which is entirely a chance of circumstances.

The naval schools are well known to be only for practical seamanship, without sufficiently entering into higher branches of mathematics, as are required for works similar to the coast survey. I made also for a naval academy a plan in 1832, which may perhaps be found in that Department, it is well known that no change has taken place in this respect, therefore also the *naval officers are entirely innocent of the accusation lanced against them.*

22. When in 1834, a bureau was proposed to direct the coast survey, a meeting of one half hour proved the inadequacy of it completely.

23. I was in London for the instruments from fall 1811, to fall 1815, under the disagreeable situation of an alien enemy, by the then war with England.

24. The State over whose territory the coast survey has the most extended, is New Jersey, therefore also in that State the most money of the coast survey expenditure has been disbursed.

25. I arrived in the United States in October, 1805, but had been in public business in Switzerland before, since 1786, though there engaged in the archives and as a member of courts of justice; always, however, applying to mathematics and natural philosophy as subjects of predilection. In April, 1807, I entered my first appointment in this country at West Point, (as stated above.)

26. A suspension of the work of the survey now, would be attended with very great direct loss, as well in work as in objects on hand for its continuance; and principally because it would most likely not be possible to bring it up again within more than a man's age, as the interval lost between 1818 and 1832, may easily lead to conclude under existing circumstances.

27. It must be evident to any reflecting mind, that a scientific work changing hands, loses the advantages of the experience, and practical skill acquired by the operators, and loses the character of a systematic work.

28. Since the resolution of 24th June, 1841, so much of my time has been taken up by polemic discussions, pressed upon me first from Congress, which has, of course, other disagreements in its consequence, that actually more than one year of my work was lost, which I would, with immensely more satisfaction, have applied to the forwarding of the interesting and valuable works which I have engaged for with the Government.

F. R. HASSLER.

WASHINGTON CITY, *January* 10, 1843.

James Ferguson examined.

1. Question. How long have you been employed in the coast survey?

Answer. Since 10th May, 1833.

2. Question. In what capacity?

Answer. As a principal assistant; one of the three principal assistants.

3. Question. What particular part of the duty do you at present perform?

Answer. Making the secondary triangulation.

4. Question. Who makes the primary?

Answer. Mr. Hassler. (P. 14.)

Examination of Edmund Blunt.

4. Question. How far inland from the coast has any part of the work been carried?

Answer. I am unable to say, except in regard to the secondary triangulation, which I have in part conducted. I am one of the principal assistants. (P. 22.)

Examination of Captain Swift.

1. Question. Are you employed in the coast survey; and if so, in what capacity, and since what time?

Answer. As an assistant, since 4th April, 1833. I am also the disbursing agent, since about 2d July, in the same year. (P. 24.)

Examination of Captain Thomas R. Gedney.

1. Question. Are you an officer of the navy?

Answer. Yes.

2. Question. Are you now employed in the coast survey; and if so, since what time, and in what capacity?

Answer. I have been employed in it since October, 1834, in charge of one of the hydrographical parties. (P. 37.)

Examination of Lieutenant George Blake.

1. Question. Are you an officer of the navy, employed in the coast survey; and if so, in what capacity, and since what time, and on what part of the coast?

Answer. I am a lieutenant in the navy, and have had charge of a hydrographical party from 1835 to the present time; I have been in Long Island sound and Fisher's Island sound, and in Delaware river and bay.

2. Question. What vessel or vessels, and what number of officers and men, have you under your command?

Answer. My force has varied very much; I had last year the schooners Gallatin and Nautilus, with nine officers and forty-one men.

3. Question. Have you been engaged in the outer or the inner waters?

Answer. The inner, altogether. (P. 40.)

William J. Stone in examination.

1. Question. What is your business and residence?

Answer. I reside in Washington, and am an engraver.

2. Question. How long have you followed that business here?

Answer. From twenty-three to twenty-four years.

3. Question. Have you been accustomed to engrave maps and charts?

Answer. Yes; that has been my chief, and is at present my only business; I have abandoned other branches of engraving, to devote myself to that. (P. 42.)

It is acknowledged on all hands that the charts of our coast are very defective. (1) We have hitherto had nothing to depend on but that obtain-

ed by the British Government at the time that we were colonies, and, subsequently, with a few isolated exceptions, the corrections applied by the energy and perseverance of individuals.

For all practical purposes, the action of our Government has been almost a nullity, (2) and, while other nations (19) have not only a thorough knowledge of their own coast, but have even sent out their vessels and taken surveys of the coasts of distant and almost uninhabited countries, the United States, possessing a marine both naval and mercantile at least equal in energy to any in the world, and ranking in commercial importance second only to that of Great Britain, does not even know the position of her own thickly-settled coast in the immediate vicinity of her most important harbors, (40) cannot even now tell the exact position of any part from the point to which all our navigators refer their calculations, (41) and has harbors and channels that were proved during the last war to be known to our enemies, and unsuspected by ourselves. The consequence of all this is, in the first place, a discreditable position in the eyes of the civilized world. This amounts to something, although of minor importance. But a grand difficulty is the want of a knowledge of our own coast for naval purposes during war, so that our own vessels cannot take advantage of the facilities afforded by nature, or avoid the hidden danger. And, again, that we are, in fact, most exposed where we feel most secure, and, consequently, take no precautions to prevent a surprise. Witness the exposed condition of the city of New York and of the navy yard at Brooklyn.

Again: The innumerable vessels covering the ocean, and approaching our coast, have no means of judging of their relative position, except from their charts. Our navigators ascertain their longitudinal position on the globe only with reference to the observatory at Greenwich, near London, the point from which the almanac used by them is calculated. If, then, a navigator wishes to know what course he must steer to avoid danger or reach his port, he first ascertains by astronomical observation his latitude, and his position with reference to the place for which his almanac is calculated; then, turning to his chart, marks upon the same his position in latitude and longitude. If his chart is correct, he then knows whether he is in danger, or the direction to his harbor; but, if his chart shows an open sea where there should be land, it is a treacherous guide, and worse than useless. He believes that he knows the distance to land. He moves on in confidence during the night, in high anticipation of meeting his friends at home within a day, but, before midnight, where his chart shows him yet remaining many miles of clear sea room, he is suddenly startled with the cry of "breakers ahead," and, before his vessel can be put about, she strikes, becomes a wreck, and all on board subject to the risk of destruction.

This is not a sketch from fancy. It is believed to be a correct description of an actual occurrence; but, for present purposes, it may be taken as a supposed case, for it is evident that such must be the result arising from the use of inaccurate charts.

It is not necessary to go further into this part of the investigation, for it must be evident, to all who will reflect on the subject, that humanity alone would rank a survey of our coast among the most important duties of the Government.

What, then, does the interest of navigation demand? Is it necessary

to wait until we ascertain the precise figure of the earth, and the exact length of a degree, to know whether a given arc of the meridian is a few inches, or even a few feet, longer or shorter, (41) when the navigator cares nothing about the figure of the earth, provided you will tell him what angle a certain star will make with the horizon in each position on the earth, and also what proportion of the circumference of the earth there is between that position and his fixed meridian from which he makes his calculations, and when he has no means of measuring *distances* that can even be compared with the approximation obtained by the pedestrian pacing off distances on land?

But the navigator does not depend upon this distance. The astonishing discoveries in astronomy have furnished him with certain guides in the *heavens*, to point out his exact position on the *earth*; and, according to the magnificent conception of a former President, (which has been oft and again ridiculed by those who had not sufficient knowledge of the subject to know that the expression was *philosophically correct*,) has converted the stars into "light-houses in the skies," by whose unerring light the mariner directs his course across the trackless ocean.

Must he be doomed to travel over hidden sand bars, among rocks and islands, and even along the very coast of the main land itself, with a storm in his teeth, and a lying chart before him, in the darkness of a stormy night, with the horrible anticipation of being wrecked, not because he does not know his position, although constantly in motion, but because he has no chart upon which he can depend for the position of the land, that is fixed and immovable—has always been there, and always will be there? Must we see wrecks upon wrecks, and thousands of lives sacrificed, for the want of information that has been obtained, and quietly doze over the drowning shrieks of the mariner and the traveller, while we enjoy the golden dream that, in a "few years," the "*result*" will be reached that will be "creditable to a man of science," (41) and then the *whole* will be published?

The idea is preposterous. We have now had a Government survey, in charge of the same individual, from August, 1816, to April, 1818, and from August, 1832, to January, 1843—a period of not less than thirteen years, and at an expense of $720,000 to the Government, besides the pay of the army and navy officers, between $200,000 to $300,000, making a total of about $1,000,000. And what has been the result, in practical utility to the navigator?

We have, in all, eight maps (2) of small districts, and of these the only one that belongs to the outer coast is the bar of New York harbor, a distance along the coast of a very few miles.

In view of this condition of things, let us examine the original intention of the survey.

1.

The act of Congress in 1807 shows that the object of the survey then authorized was for "such examinations and observations," &c., as "may be especially subservient to the commercial interest of the United States." (3)

Mr. Hassler was engaged to take charge of the work, to "make frequent reports," "to deposite here" (i. e. with the Treasurer) "all surveys," &c., to

"make himself the principal part of the general large triangulation," and to deliver charts when "required by the proper authorities, *or prepared for publication.*" (4) Of the views that governed the work in 1816, 1817, and 1832, we have no official information; but as soon as we get an official report we find that the original object was much extended by the superintendent, and that the "coast survey" must include the military information (5) which other nations reserve for the possession of the Government alone. (6)

In his next report he appears to have altered his views to the other extreme, and considers the survey as having no reference to national vessels, but only the commercial. (7)

But, in his report for 1841, his views are again expanded to the fullest extent. (8)

When examined before the committee, Mr. Hassler evaded the question, and would not state the general objects that governed his work, (9) but we can infer from his reports of 1834 (5) and 1841 (8) that his views embrace much more than was intended or is now desired. The committee endeavored to get precise answers as to the distance included in the topography, but very little information was obtained in this way. (10) We conclude, from this circumstance, that the detail surveying is carried many miles inland. We have the assertion of Mr. Hassler, that it is necessary to carry on the topography to the high ground in the rear of the coast, to include the station points, (11) that the survey of the coast cannot be accurately made without surveying the bays and rivers, (12) that there is no more topography on the maps than is absolutely required, (13) and that the hydrographical parties have not been detained for want of the topography of the coast proper. (14)

Now, we find, from the examination of those who know more about the actual progress of the work, that the sounding has been in advance of the plane table; (15) that the detail considered necessary (11 and 12) by Mr. Hassler would add greatly to the expense, and delay the execution of the work; (16) that there is no use, for the purposes of navigation, in having the topography far from the coast, nor is it customary. (17)

But it must be evident, to any man of common sense, that the minute topography of the land, that can only be seen at a distance by birds high in the air, or by the land traveller on the spot, is a matter that the mariner does not require and cannot use. That a chart should contain much of the topography of the country, for the use of the landsman, is certainly no objection, unless obtained at an unreasonable expense of time or money; but that it should be necessary to follow up the triangulation, (18) and fill up the space with minute topography, for the benefit of the "commercial interest," is a statement that will puzzle the sailor.

Amid the different opinions that have been expressed respecting the mode in which the survey has been conducted and the results obtained, it is gratifying to observe a desire, almost unanimous, to have the survey completed. This point being settled, we proceed to examine the testimony as to the

2.

TRIGONOMETRICAL SURVEY.

By referring to the notes appended, (19) it will be seen that nearly the whole of Europe has been triangulated, that it is the only correct method

of taking surveys of extended surfaces, and that it can be done with surprising accuracy.

This is doubtless a fair statement of the case; and hence it appears very remarkable that Mr. Hassler, in 1791, (19 and page 3) at twenty-one years of age, long before many of these works were commenced, was able to do the work that he thinks not one of his assistants is now able to do, (32) although they have had "his instruction" for many years, and the command of works, in French and English, giving detailed accounts of all the European field work and calculations. So he thinks, but they do not agree with him. The pretension that he is the only man in the country capable of conducting the work is ridiculous; but we shall hereafter enter more fully into this part of the investigation.

The only point of present importance is, that triangulation is the most correct mode of surveying.

3.

In carrying on a trigonometrical survey, the foundation of the whole work is the

MEASURED BASE (20.)

The length between its extreme points is determined with the greatest care, and the bounds, or termini, marked in the most permanent manner.

If then, when the triangulation is carried on to verification, a discrepancy is found, they are enabled to remeasure the original base, and compare the latter with the original determination. Or, in case of doubt at any future time, the exact length of the standard base can be determined, and consequently the whole survey corrected, if necessary (20); or a comparison of the measures used in the determination can be obtained, supposing even a doubt as to the length of the standard yard or foot in use at the time. Such is the usual mode of proceeding, and from the care in establishing the base on Hounslow Heath a remeasurement showed a difference of 8 inches. (20) It must also be observed that this error increases in proportion to the distance; and, consequently, the further the triangulation is carried the greater will be the error, for the measurement of the angles alone gives us nothing but proportions.

The undersigned has the following verbal information from Lieut. Blake, of the coast survey, respecting the "measured base," the "actual base," and the "mountain base:"

"The 'measured base' has no monument to mark its eastern termination, which was on the beach, between high and low water mark at the time of measurement. The 'actual base' was not *measured*, but the length calculated from the monument at the western terminus of the measured base to the east monument on the sand knoll. The position of the east monument was obtained, not by measurement, but by calculation, from three triangles having one side common—two of them being founded on distances taken backwards along the measured base, from its east terminus, and the third upon a short base, measured at an angle from the east terminus of the measured base.

"The position of the east end of the measured base not having been marked, it can be obtained by measuring 180 degrees from the station at Ruland's, since the east monument is in the line between Ruland's and the east end of the measured base.

"The mountain base represented on the sketch from the office is about 12 miles distant from the nearest point of the actual base, or from Ruland's to the east monument. From the west end of the actual base to the west end of the mountain base, at West Hills, is about 17 miles, and the length of the mountain base between West Hills and Ruland's is about 20 miles."

These are about the distances, according to recollection, of the conversation, and they correspond with the distances shown by the sketch from the office.

The letter of Lieut. Blake (20 bis) informs us that the distance between the east terminus of the measured base and the monument at the east terminus of the actual base is 162 metres, and that the sea has encroached upon the measured base line, but the actual base is believed to be out of danger.

Being desirous of having *certain* information respecting these points, from Mr. Hassler himself, and in such form that there could be no mistake, the letter at note (20 bis) was sent to him on the 6th instant, but, as yet, no answer has been received.* We must therefore depend upon the information derived from Lieutenant Blake, since this is doubtless good authority, although he stated that he was not present when the base was measured

The three sketches herewith presented, of which two are copied from draughts received from the office of the coast survey, and one from the Treasury Department, show the changes that have taken place at the west end of Fire island, which is a sand bar thrown up by the ocean, varying in breadth from 800 to 230, yards along the part on which the base is situated. The following extracts will show the variable nature of our coast, (21) even where we have reason to suppose it more permanent than a mere sand bar thrown up by the sea, and having sand hills blown upon it similar to the "dunes of Holland," subject even to be blown away by the wind. (21) The ocean side of Cape May is known to be washing away rapidly, and the sea is encroaching on the ground in front of the bath-houses.† We might also refer to the breach forming the Shrewsbury inlet; but, since it is not known that we can find authority, either written or on this floor, to add his knowledge to the statement of the fact, we pass this merely as a hint.

Now, supposing the remarks of Lieutenant Blake were correctly understood—(and if there is an error it can be corrected by information from the office of the coast survey, within a quarter of a mile of this House)—the "*base*," upon which the whole triangulation of the United States thus far depends, has nothing to mark its eastern termination, so that this line no longer exists, but in its place we have the "actual base," with one end on the beach at the level of the ocean, or very near it, and the other elevated on a "sand knoll," whose height we do not know. The "actual base," whose termini have been marked by monuments, has never been measured; and from that fact and the inspection of the map, showing different intervening irregularities, we infer that it never can be measured.

Should it be desired at any future time to verify the measurement, (20) we must use the "actual base," which is the calculated third side of a triangle, of which only one side was measured, and triangulate back again, to find the east end of the "measured base," using for that purpose the station at Ruland's, 12 miles distant, and, as far as we know, without any

* Received on 10th instant, and inserted. (Note 20 bis.) † See note (94.)

permanent monument to fix the spot. Thus the monument was fixed by triangulation that might have been inaccurate, (for we cannot now prove whether it was accurate or not,) and we must work back by another triangulation, that again admits of error, (even supposing the point at Ruland's to be fixed ;) and thus, after passing through two triangulations, of which the latter will be the most difficult, we may *guess* that we have the position of the eastern terminus of the measured base.

But, after we have obtained this point, we can make no use of it, for the sea has encroached on the measured base. Therefore, it is already *impossible* to *verify* the foundation of the whole work, for the base is practically gone; and in view of all the changes that constantly occur on our coast, we may well question whether, in the situation of this narrow strip of sand, exposed to the full swell of the ocean, the sea that has raised it, and made the changes that we see exhibited by the maps, may not, in a few years, sweep the whole of it away to some other place, and leave no vestige of the base.

This base cannot be remeasured, even in the present situation of the beach, but we are informed that "the elements of will be preserved by the mountain base inland from the original base." (21)

This mountain base is 12 miles from the *nearest* point of the measured base; it is 20 miles long, and its termini on two mountains!

We have never yet received any account giving the exact length of either of the three bases.

The east monument on the "sand knoll" is *not*, at the end of the line, "laid out accurately straight." (20)

4.

The base being permanently established, the primary triangulation (24 and 41) commences from the extremes of the base. Angles are measured between each terminus and some distant conspicuous point. The distances to these points are then calculated. These points in turn serve for new triangles in the same manner as the original points at the extremities of the base—the only difference being that the distance between the extremes of the base was measured, while the distances between all the other points are calculated from the angles. (19)

The latitude and longitude of every point in the whole survey are given by the distance of that point from certain other points whose latitude and longitude have been ascertained. (23)

The primary triangles are chosen with especial reference to accuracy in the general result, without regarding the minute topography. But, before we can ascertain the certainty of the result, it is necessary to know the figure (41) and density (26) of the earth in that part over which the survey is carried. This can only be ascertained by astronomical observation at different points, and by the measurement of different bases. (39 bis.)

Therefore, since the whole of a survey by triangles is a connected work, (37) if the foundation is not correct, the whole is false. The soundings depend upon the topography, (36) the topography on the secondary triangulation, (34 and 35) and the secondary on the primary triangulation. (28, 32, and 33) Thus it is evident that every thing is uncertain until the primary triangulation is certain, and this cannot be certain until it has been carried on to verification. (27)

Therefore, until the primary triangulation has been verified, we shall have no certain results from the secondary triangulation, even where the secondary is kept within its proper limits, in the immediate vicinity of the primary triangulation.

Much less can we depend on the secondary triangulation when carried beyond the primary, (38) being in its nature less accurate, and adding error to error, for want of new station points, furnished with greater certainty by the more perfect instrument used, and more favorable size and shape of the main triangles. (24 and 39)

Hence the primary triangulation should be carried on to verification (27 and 39 bis) with all possible industry, in order that, if any error should be discovered, it might be corrected immediately, so that each point in the main triangles being certainly established, in distance, in latitude, and in longitude, the whole of the remainder of the work would depend on a foundation *proved* to be correct. (39 bis.)

Consequently, the secondary triangles, the topography, and the soundings, depending on points whose positions would be certainly known, the whole work, in all its details, would be reduced to a certainty, and perfect maps could be made of each part, in succession, as fast as the notes were taken, (40) showing not only a *detached picture of the proportions*, but giving the latitude, longitude, and compass bearings of each part, and admitting exact measurement in miles or feet; or, in other words, the navigator would have perfect charts, as fast as they could be made, and not be compelled to wait, as is now the case, (41) for an indefinite period, until the primary triangulation converted the *uncertain* modulus, used in the detail works, to a *certain* measure. (33.)

Now, we find, from the testimony of one of Mr. Hassler's assistants, (41) that we do not know the exact difference of longitude between any point in the survey and the meridian of Greenwich, near London, from which all our navigators calculate their longitude, since they use the Nautical Almanac calculated at that observatory. But, from Mr. Hassler's testimony it appears that he has *one* perfect astronomical station on Weasel mountain, in the interior of the country. (23) That the calculations of the triangles *will give* in ultimate results the longitude and latitude of every point in the survey, cannot be denied. But before we arrive at this "ultimate result," we must have more astronomical observations, and his main triangulation carried over his secondary triangulation, and verified.

5.

To say that his main triangulation should be carried over his secondary may sound strange, but such is the present condition of his work. (38) In the early stages of the work, Mr. Hassler confined his secondary to the immediate vicinity of his main triangulation; (29, 30, 31) but, in 1839, (32, 50) he refers to a change in the mode of operation from the ordinary and regular arrangement to one that resembles the operation of a surveyor who measures his angles and paces the distances, trusting to his chainmen to give him the actual measure a "few years hence," to enable him to correct his approximations. The main triangulation extends from Mount Carmel, in Connecticut, to Yards near Philadelphia, a distance of about 150 miles in a direct line, while his secondary, after filling up this space, has extended to Point Judith, (41, 51) about 75 miles east of his main trian-

gulation, and to Annapolis about 100 miles south of his main triangulation, besides a *fringe of small triangles*, running along the Jersey coast, from Sandy Hook to Cape May, about 115 miles. (38, 41) The whole *without verification*, (25, 27) for the coincidence mentioned (in note 38) is no verification, without a *measurement of the actual distance*, to ascertain whether both triangulations are not in error.

Thus we have the whole of this work extending beyond the main triangulation suspended in doubt, for the want of the main triangulation establishing the points with greater accuracy; and the main triangulation itself, even as far as carried, yet requiring a few years before it can be verified. (41, 42)

6.

But it seems that Mr. Hassler had *no time* even to take the *compass bearings*, from station to station, although remaining on the spot for months. (43)

Thus it appars that we must yet wait a "few years" before we can have perfect maps, such as we have a right to demand in return for the million of dollars that have been expended, while, in the mean time, all that we can get will be approximate picture representations of the proportions, without latitude, longitude, or compass bearings. (Page 20.)

Although the survey has not all the certainty that it should have, still the figure of the earth is so nearly ascertained, by the triangulations in other countries, that we shall probably find but trifling errors to correct when the main triangulation has been verified.

The present information arising from the survey, both in the general position of the coast over which the work has been carried, and in the detail operations of soundings, &c., must therefore be vastly superior to any thing which we have at present. We should therefore have an immediate publication of the outlines of the draughts that have been reduced, showing the approximation thus far obtained, executed in the simplest manner, and with regard solely to accuracy, without respect to appearances. (44)

To withhold this information until the work is complete in all its parts, and the engravings executed in a style superior to any thing known in this country (44)—and that proceeds so slowly that Mr. Hassler's engraver could not feel certain that the maps of New York harbor alone would be finished in two years, although they have now been ready for engraving—and to wait until the work shall do credit to the superintendent "as a man of science," while wrecks upon wrecks are occurring annually on our coast, for want of the information that must of necessity have been obtained by the survey of the coast, appears to be a wanton trifling with the distresses of our fellow-beings, and not more reasonable than to refuse the miserable shipwrecked mariner a morsel of food, to save him from immediate starvation, while, with all due deliberation, we prepare a magnificent entertainment, of which he may partake, if he happen to live long enough.

7.

That we may form some opinion as to the relative position of this work and similar undertakings in Europe, we will refer to the countries with which Mr. Hassler invites a comparison (47, 51, 58) that we may be

able to judge whether there is any reason to blame him for the present uncertain condition of the *whole* work, arising from the want of certainty in the main triangulation, which Mr. Hassler claims as exclusively belonging to himself. (24)

In 1792, 1793, and 1794, Delambre and Mechain measured 9 degrees of latitude, requiring 115 triangles. (45) Allow each triangle to require but one station point, and we have an average of 19 per annum for each observer.

General Mudge, in his trigonometrical survey of England, &c., took 226 primary stations in 19 years, or about 12 per annum. (46)

In conducting the French triangulation of the kingdom, the Commission of the Depot of War give, among their general orders, the following:

"Each triangle of the first order being valued (on an average) at five myriametres of surface, the Committee of the Depot of War has fixed the number of stations which should be finished in one campaign at *fifteen* for the first order, and *twenty-five* for the second, not including those of the first order where they may be forced to return.

"The number of points of the second order, to determine in a triangle of the first order, is fixed at five. All these points should be station points." (*Memorial du Depot de la Guerre, vol. 6, page 31.*)

Now, what are the facts respecting the work of our survey?

By examining the appended extracts from Mr. Hassler's reports, and the evidence derived from his assistants before the committee, it will be seen that he has taken the angles from TWENTY stations (48) in ten years, "of which the two first, 1816 and 1817, were rendered useless by the overthrow of the work in 1818." (49)

Why useless? The hills were still in the same places! How can his work be useful to *others*, in carrying on any future operation, if he *himself* cannot use it? But grant him all the time he asks to be deducted from the time of his employment, and then compare his work with that done in other countries, where the surveys were regulated by those who were either willing to work themselves, or who knew what should be done by others!

8.

In the early stages of the work, (29, 30, 31) Mr. Hassler considered it necessary to carry the primary triangulation in advance; but subsequently, (32, 50) he considers it much better to remain in his office in Washington than to run about the country. No doubt, it was much less fatiguing, and, besides, he cleared a large proportion of the $3,000 given to him for the difference between living at home and in the field. (50, 72.)

9.

It must be observed that, when Mr. Hassler says (51) that "the works of the survey of the coast cover now upwards of 11,000 square miles with primary and secondary triangulation, topography, and soundings," he does not mean to include the primary triangulation for the whole, since we find, (52) from Mr. Ferguson's evidence, that the primary covers only 3,577 square miles.

The remark of Mr. Ferguson, as to the importance of the primary triangles, puts a wrong construction on this matter. (53) No objection is made

to Mr. Ferguson on this score, for it is not only natural, but even commendable, that he should put the most favorable views forward respecting his principal. The real question is the amount of time and labor required to do the work, and not its importance.

We may here, in passing, advert to the remark, made elsewhere, as to the great importance attached to this work, and the anxiety of the scientific world on account of it. (54) This importance does no more attach to the superintendent of the work than the worth of a diamond to the lapidary. The astronomer who should make an exact survey of a coast in a remote and unfrequented part of the world would deserve as much credit as one who did the same amount of work, and in the same style, in the most commercial district.

10.

It appears, again, that very small causes are sufficient to prevent Mr. Hassler (55) from taking the field. The report referred to by Mr. Hassler is Document 28, made Dec. 2, 1841. It contains:

1. A general view of the progress of the work.
2. A reference to documents that answer the question.
3. The number of stations occupied for the triangulation.
4. A statement that it is not necessary to answer the questions put to him, as they are contained in 180 volumes in his office.
5. A general view of the "astronomical observations."
6. An inventory of the books and charts, containing the work of himself and assistants.
7. The names of the three charts published, and general remarks as to the rest.
8. A statement of the expense for instruments, and the gross expense for each year.
9. General views of instruments and books purchased.
10. Refers to Treasury Department for answer.
11. General account of appointments.
12. General views as to expenses.

13 and 14. General remarks, that he cannot estimate the time nor expense of finishing the work.

15 and 16. A statement of triangulations in other countries, and general views of the plan of surveying.

17. A list of instruments belonging to the United States coast survey.

This report of eighteen pages, containing no details except the inventories, and no calculations—that contained nothing pertinent to the questions which any one else acquainted with the coast survey could not have written as fast as he would write a business letter—that was not answered for more than five months, and that from the field—caused Mr. Hassler to lose "most of last year's work," by occupying him "three or four weeks."

11.

Therefore, viewing the present uncertain condition of the whole survey, and tracing the whole cause to the superintendent, we hold it proved that we must attribute the present condition to the culpable neglect of the superintendent. (58)

The assistants of Mr. Hassler are in no wise to blame, as far as we have any evidence. That their work is uncertain arises from the circumstance that Mr. Hassler claims the main triangulation as exclusively his work, and has neglected to drive it ahead.

12.

In view of all the results that have been obtained from the heavy machinery of the coast survey, the question is seriously submitted to practical men, whether a small appropriation to fit out the vessels now employed in the coast survey, (58 bis) furnished with charts, chronometers, and other instruments, from the depot, and directed to determine the latitude and longitude of the light-houses, (now amounting to about 250 in number,) with the principal headlands, islands, bars, and other important points, together with a few observations on the most important soundings, (while in certain detached portions of the coast, where the intermediate distance is laid down on the charts with *dangerous* inaccuracy, a surveyor with compass and chain might take a rapid survey of the line of coast between the points of observation,) would not in one year have done more real service to the commercial interest of the country than all the information yet given to the public, derived from all the work of the coast survey. (2)

Grant that in this way we could not obtain minute accuracy, still it would reduce the present uncertainty to within very narrow limits, and the navigator would direct his course with comparative security.

Let it not be supposed that these remarks are intended to show that this mode of *improving* our charts should be substituted for a *correct* survey. This is by no means what is intended. (Page 9.) We want a survey as accurate as it can be made, and there can be no question but that the most correct mode is by triangulation, where this is practicable. Our Eastern and part of the Middle States undoubtedly admit of this mode of surveying, but it must be left to scientific men to devise the ways and means of getting the best survey of our Southern flat coast.

But we want an immediate survey, for immediate use, to correct the gross errors in our charts; and the method above suggested would effect this object at trifling expense, and produce an approximation that might again be corrected when we get more certain data, by a more tedious, but, at the same time, more accurate process.

Since the above views were committed to paper, the recommendation of a former Secretary of the Treasury (58 bis) has been met with. It will be seen that the views contained in each are identical as to the general plan, and the only difference is in the above going somewhat into the details. We have therefore the support of one whose position at the time gave him the best opportunity of judging.

13.

The whole of the observations, charts, &c., connected with the works of the coast survey, are concentrated in an ordinary building, exposed to the risk of fire. (59) For the same reason, they are exposed to robbery; and a more valuable offering could hardly be made to a foreign nation, meditating an attack upon that part of the coast. Consequently, the fire of a single night might destroy the whole; or, still worse, the whole might be off in one night, moving, with all the force of steam, to some foreign Power.

14.

The fullest assurance of the accuracy of the maps should be produced, and means given whereby to judge of and correct errors, if any should be found to exist.

This confidence, or certainty of the accuracy of the charts, cannot be produced without publishing the data, or in some other way placing them out of the hands of those whose characters, as scientific or practical men, are concerned in their accuracy.

If these data or observations be withheld until the work be verified, the operator will be enabled to "force results." (60)

Mr. Hassler says that the operator would not be able to force results. (61) True, he cannot if he keep to his data; but every common country surveyor knows how to "force results," and make his survey look well *on paper*, so that it shall accurately meet and describe *a* piece of ground, although he may not be able to make a correct survey, and describe *the* piece it is intended to represent. The fact is, as stated by Mr. Hassler in his reports of 1842–'43, we have nothing to depend on but the "moral strength of confidence," if all the observations are kept secret until he measures his "verification base on the Chesapeake," which he expects to "reach" "in a *few* years."

The discrepancy in the results obtained in France by Mechain having caused him to conceal his manuscripts, and even hastened his death by distress, it is evident that there would be a strong temptation to conceal an error. (62)

To preclude all doubt on the score of authenticity in the observations, the French require copies of all the notes to be sent regularly from the ground to the department at Paris, and in some cases the original manuscript, signed on each leaf by the observer and his assistant. (63)

Mr. Hassler objects to allowing any of the documents (64) to go out of his sight until the work shall have been verified, although in the original agreement (4) it appears as if the Secretary intended to pursue the plan as described in France, (63) and although most of the notes are in duplicate. (59)

We shall therefore have no certainty until the work is completed, and even then have nothing but the "moral strength of confidence" to depend on for its accuracy. (65)

The numerous instances of deception daily occurring should warn every individual holding a responsible post to make such arrangements as to preclude the possibility of his being even suspected of deception, and therefore that every possible check should be adopted to preserve undoubted confidence in the authenticity of the coast survey. This cannot be effected without a publication of the observations as they progress, or else placing the notes or copies, duly authenticated, beyond the reach of those who would have an interest in concealing an error. (63)

15.

That Mr. Hassler is not infallible is proved by one of his extracts from the coast survey, containing a very defective representation of Newark bay.

Although this map is far from being "complete, and of use in itself," as stated by Mr. Hassler, (2 and 66) still it might have received but a passing

notice, except that it has assumed a collateral importance, by showing the character of the superintendent, and giving rise to some pointed remarks on the floor of this House. We shall therefore examine the subject at length.

The three maps of Newark bay, herewith presented, were in evidence before the committee. They are marked, respectively, "A," "B," and "C."

The first, marked A, is the original manuscript, having the scale marked "3 inches to the mile." (70)

The second, marked B, is the copperplate copy of the same, with the original scale cut out and another substituted with the pen, (67, 70) marked $\frac{1}{10000}$, presented to the committee by Mr. Ferguson.

The third, marked C, is an impression from the same plate as B, (70, 67) but having the scale unaltered, and, like the original manuscript, "3 inches to the mile." (70) It is one of the House documents, of which copies are bound up with the other documents of 1838–'39.

Mr. Ferguson is in error respecting this map having been "printed at the request of the collector of Newark," (68) as the documents of the House prove, since this map was furnished to the House of Representatives on motion of Mr. Aycrigg, (69) and Mr. Hassler states that there were but three maps published, (66) viz: New Haven, Newark, and Bridgeport; consequently, we must conclude that he depended on erroneous information, even without the additional evidence (68) from the collector, that Mr. Hassler refused to let him have this map that he requested. From the manner in which Mr. Ferguson's testimony is written down, the appearance to the eye, on seeing the fractional representations of the scale, might lead to the erroneous impression that these figures are found on the map. (67) We therefore give the exact description of the three scales.

On the original manuscript ("A") (70) we find in the middle of the map, immediately below its title, the following: "Scale of three inches to the mile;" and immediately below it a line marked off into thirds and quarters, the quarters having the figures $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$. The thirds are not numbered.

This scale, representing one mile, is *exactly three inches long.*

The distance from Shuter's island to the head of Newark bay measures, on this map, 2 feet $11\frac{3}{8}$ inches, or in inches and decimals 35.375. Consequently, since there is *nothing* on the map but the above *scale* by means of which we can ascertain the distance, we find the length of the bay 11.80 or nearly 12 miles long.

On the unaltered copperplate copy ("C") we find the scale marked as *in the original manuscript (67, 70)* "THREE INCHES TO THE MILE" in small capitals.

The scale itself is about one per cent. shorter than the original, being 2.965 inches long, and divided and marked as in the original.

The map is likewise about three-tenths of an inch shorter than the original, (70 *bis*) giving the length of the bay about the same as the original manuscript. This is the House document, of which copies are found in the bound volumes, while the rest of the impression has been distributed, all showing the length of the bay 11.80 miles.

The map, ("B,") with an altered scale, was presented to the committee by Mr. Ferguson, one of Mr. Hassler's assistants. (67 and 70)

This map has the original scale cut out, and a small piece of paper pasted underneath, to fill the opening. Immediately above this opening is the word "scale," on the small piece below "$\frac{1}{10000}$," and below this, on the

original paper, a graduated scale with the quarter miles marked ¼, ½, ¾, and below the scale are the words "1 English mile."

This scale measures on the paper 6.17 *inches.* Let it be kept in mind that this is not the original scale of "3 inches to the mile," but the corrected scale.

This map, with the exception of the scale, is identical with the former; and Mr. Ferguson informs us (67) that, according to this, the length of the bay "is 5.82 statute miles, but that this map has an erroneous scale attached to it," and that "the actual distance between the two points specified is 5.623 miles, obtained by me [Mr. Ferguson] by measuring on the original topographical map."

Whence comes this last "miswriting of a fraction?" (71) Turn to the length of the corrected scale for one mile, and we see that its length on the paper is 6.170 inches, while the note above, on the same map, says, "scale $\frac{1}{10000}$." Now, 10,000 times 6.17 inches will not make 5,280 feet, or one mile, but it requires 10,000 times 6.336 inches; consequently, the *corrected* scale requires *correction*, and to be made 0.166 or one-sixth of an inch longer before it will be *actually* correct.*

Since these three maps are presented with this report, any member of the House can satisfy himself in a few minutes that the above statement is correct, without depending upon any thing but his own eyes and a common carpenter's rule.

A similar examination will show that one of the members, at least, was deceived by incorrect statements, which led him to remark, on this floor, that, "while the original, and the copy, too, as far as it is a copy, were perfect in every part, the scale of 3 inches on the margin, placed there by the copyist, errs in giving 3 inches instead of 6 inches to the mile—an error which Mr. Hassler hastened to correct;" since we find that the only correction in any of these maps is the *single* map "B," (70) in which one incorrect scale, with an error of 3 in place of 6.336 inches, as it ought to have been, (that was exactly *copied* from the original,) was cut out, and another *incorrect* scale, with 6.17 in place of 6.336, substituted *with a pen on the single copperplate copy.* So that, after *two attempts* from the coast survey, we can ascertain nothing from any of these *maps* but the picture proportions, since none of the scales on the maps are correct, as we ascertain from the investigation before the committee. (67)

Fortunately for the engraver, he had preserved the original manuscript, which was not known by the committee to be in existence until six weeks after the altered copy had been produced.

It is a serious question for the House to determine whether a person is fit to conduct the coast survey whose mind is in such condition that he denies his own map, in a circular over his own name, (71) (distributed among the members,) and charges one of the committee with doing him a *wilful injustice,* (which, taken in connexion with the context, means that he has made a false and malicious statement, to injure Mr. Hassler,) although Mr. Hassler had a full knowledge of all the circumstances connected with the history of this map, not only from recollection and from the notes in his own office, but from the printed documents quoted in the notes, (69) and when the whole circumstances of the case, as described by him, are proved

* If, in forming the corrected scale, it was intended to allow for the shrinking of the paper, and consequently to reduce the length of the scale that would have been placed on the manuscript, then the length of this scale should have been 6.27 inches, or 1-10th of an inch longer.

by these maps, now presented to the House, to have been impossible. It is also very remarkable that Mr. Hassler has suppressed the date of this map in the statement (2) which he gave to the committee, and which is ascertained, by re-examination, to be correctly copied from the original "183–." And, again: in his late circular, printed at Philadelphia, the same date is given still more indefinitely, "18 ," at page 26. This map, whose date he has forgotten, and apparently cannot discover, is one of the only three maps that have been published, and one of the eight which are all that Mr. Hassler shows have been produced by the coast survey. The remaining five have never been published. (2)

But, in his enumeration, (2) he has forgotten to mention a ninth map, being a chart of the upper end of Newark bay, on a scale of about 13 inches, or one French foot, to the mile. The map is on file among the documents of the House, having been officially sent there by the Secretary of the Treasury, who received it from Mr. Hassler; but, like the other five maps, it has never been published. (69 bis.) These omissions of Mr. Hassler are noted without further comment.

Copies of the printed map were distributed, in 1840, among those who navigate that bay, but, fortunately, it was so extremely inaccurate that no one was deceived by it, and it has fallen stillborn from the press, having neither latitude, longitude, compass bearings, nor divisions, along the margin; and the top of the map is not north, but northwestward, so that we have nothing but a picture with a scale showing the length 11.80 miles, in place of 5.623, which Mr. Hassler calls "an accidental miswriting of a fraction by one of his [Mr. Gedney's] subalterns," (71) unless he refers to the second error in the altered scale, making the bay 5.82 miles long.

Is Mr. Hassler to be excused for presenting, officially, a false map, because the error was made by an *assistant's assistant?* If so, what becomes of our confidence in the coast survey?

It was stated on this floor that this was "but a solitary fact in a survey which has been going on for the last ten years."

Things unseen are judged by those that are seen. We have, besides the map not noticed by Mr. Hassler, but eight "facts" from the whole work; and this one fact, after having been *corrected*, still requires the *correction* to be *corrected*, besides being in other respects useless, on account of *omissions!*

The other charts have not been examined by the committee.

16.

The system of triangulation contains within itself an inherent defect, that is avoided in a measured survey. In the latter case, each course (or azimuth) and distance is entirely independent of that which preceded; so that, if we commit an error in one line, it does not affect those that succeed; but in a system of triangles we get nothing but proportions, after we leave the measured base. Consequently, if an error be made in any part of the work, that error vitiates all that follows, unless the place of the error be discovered; and, without a double series of triangles, we cannot discover that there is any thing wrong, until we get to the verification base. Still, a trigonometrical survey is far superior to a *measured* survey, where the country is adapted to the former, because the three angles of every main triangle being measured, (19 and 45) and the dimensions of the earth being very nearly known, the sum of the three observed angles, when compared

with what they should be, according to calculation, will show if there is any material error. But when we reach a flat country, without any natural elevations, (78) we may reasonably doubt whether much confidence can be placed upon a survey *without linear measurement*, when that survey is to be made by measuring two angles, or even only one angle of a triangle, and calculating the others from data furnished by astronomical observations—thus reducing a triangulation into what we might term a *biangulation*, or an *une-angulation*. Hence we may infer the cause of the difficulty that Mr. Hassler found in making the committee *comprehend* what he meant by "mixed astronomical and geodetical observations," and that caused him to send in the communication containing the *une-angulation* problem. (78 bis.)

17.

Mr. Hassler commenced by taking the primary triangles with sides 30 or 40 miles long. (22, 52) It has been said on this floor that stages can be erected and the trees cleared away. If the trees are to be cleared, it will be a Herculean labor, for the length of the lines of the primary triangulation alone will be about three times the length of the coast surveyed, if the survey is to be accurate; and to see the station points, for the secondary triangulation, will require the woods to be cleared away to a still greater extent. Neither will the erection of stages be so small a matter as might be supposed at first sight. If we wish to take a sight of 40 miles, it will require a stage at each end about 400 times eight inches high, or 266 feet; if 30-mile sights, then the stages must be 225 times eight inches, or 150 feet; if 20 mile sights, the stages must be 100 times eight inches, or 66 feet high, even supposing no irregularity of the ground between the points rising to a higher level than the station points.

But this is not the only difficulty. After we erect a stage of 150 feet high for the theodolite, and another 150 high for the heliotrope, for a sight of 30 miles, we are *just* able to see along the surface at half the distance between the points, even supposing the ground to be as level as the ocean, and clear of brush.

If any obstruction exist, *each* stage must be raised that much higher, and we are then just able to *see* over the top of the intervening object. But something more than this is required. We must see accurately. The extracts from Mr. Hassler's papers on the coast survey, published after the suspension of the work in 1818, show the difficulties that he met in taking observations on objects but a few miles distant. (52 bis and 50) We may hence infer the quality of the observations that would be obtained by long sights, sweeping along close to the surface of the earth half way between the extremes, and leaving the surface but eight inches for the first mile, thirty-two inches for the second, and so on as the square of the distance, each way from the centre, amid the irregular refraction produced by the boiling, eddying currents of air of unequal density, that are almost universally met with near the surface either of earth or ocean.

Now, it is through difficulties such as these that Mr. Hassler proposes to carry on his survey entirely by angles, without any linear measurement. (78)

The undersigned will not undertake to say that this is not all right in principle. But we hold it to be our duty, as men of common sense, to call

a halt, and, by application to the scientific and the practical men of the country, to ascertain whether our Southern coast admits of triangulation, or whether we shall not waste a large sum of money annually (41 bis) in carrying on a survey that will be much inferior to one which might be made in less time, and at a vastly reduced cost, even supposing the present superintendent to work more rapidly in the midst of difficulties than he has thus far done, where the country was suitable to a survey by triangulation. (78)

The total report of 1842 is given in the notes, (90) as far as it contains any information respecting the coast survey, that part being comprised in *sixty-nine* lines of Document 23, exclusive of a few lines respecting the appropriation of "$100,000," (for the next year's work,) "which several of the latter years have proved to be exactly adequate," &c. (41 bis.)

Of this same report, *sixty-seven* lines are occupied by a description of a dividing instrument (88) for his *machine shop*, about which *he* made some great mechanical improvement!

The House will judge whether this report of generalities, in return for $100,000 expended, is in accordance with the directions of the Secretary of the Treasury, (4) and whether Congress would be justified in passing an appropriation bill for $100,000, without any estimate being submitted, solely because Mr. Hassler says that it is "exactly adequate." (41 bis.)

18.

The next question that presents itself is the organization necessary to carry on an extensive survey; and, to settle this point, we must trace its progress of triangulation from the beginning to the end. The object of the primary survey is to connect the extremes by a series of triangles, (24) having the sides of the most approved length, and so that the angles may be as nearly equal as possible. This gives us the greatest accuracy, both in the extreme and intermediate points. The secondary triangles, founded on the primary, must depend for their shape upon the country to be surveyed. The angles of the secondary triangles are necessarily irregular in many cases, and consequently, independently of their being more numerous, they are not as accurate as the main triangles, which are chosen with especial reference to their being as nearly equilateral as the country admits. But this error in the secondary triangulation is not continued through the survey further than to the next points of the main triangulation, where a new start is to be made from the main triangle points. The plane table comes in and fills up the details on land, and the naval parties take the soundings at sea.

Now, the *field work*, in all these operations, requires very little *science*. For the primary triangles, any man of common sense can choose points that will fulfil all the conditions required; and, when the points are fixed, it requires nothing but *good eye-sight*, and a knowledge of the mechanical use of the theodolite, (which can be acquired in a very short time by any one acquainted with graduated instruments,) and care and attention in making the observation. It would certainly be no objection that the observer should be able to reduce his observations, but this is not necessary. He may furnish the best of observations for the use of the mathematician, although he may understand nothing of the scientific principles that govern the *result*. The same is true of the secondary triangulation, and of the soundings, whether in sight of land or in deep water. The plane-table

operations (35) are so simple that any common surveyor could do the work, which is in fact much less difficult that many questions that occur in a farm survey.

There is therefore no positive necessity of having any person of high scientific attainments engaged in the *field work*, to collect the *data* for calculation. (24) The observations require mainly the attention of careful men, who possess both mental and physical activity sufficient to keep themselves and assistants in motion, that the data may be collected with the greatest accuracy, in the least time, and in the most economical manner. These observers can be kept in constant motion. During the summer they can operate at the North, and during the winter at the South. Their observations not being reduced by themselves, they cannot *force results*, (60 to 64) for they will not know what will be the result; and their work being reduced by others, who would have no interest in concealing an error, they would feel the full importance of being accurate, since any error would certainly be exposed.

The observations thus made might be regularly transmitted to this city, (4, 63, and 59) and placed in the hands of a mathematician, who, with his office assistants, should be constantly engaged in reducing the work, and preparing draughts for the engraver. (40)

As to the engraving, there can be but little doubt but that it would be best executed by one who has made this trade the study of his life, and that there are many engravers in this country who can put accurately on copper all that the draughtsman can put upon paper.

We should then have the survey conducted on a system of practical utility, and moving *right* end foremost; (33) we should not be compelled to wait, as in the case of Mr. Hassler, yet a "few years" (41, 54) before we can get any full account of the work; while, in place of attending to the main triangulation, which he claims as his exclusive property, he is concentrating about himself his workmen in his foundry, his machinists for the manufacture of weights and measures, (88) his machinists for making instruments, (88) his engravers, (88) his copperplate printers, (88) besides all the persons engaged in the coast survey, (28) mixing up the several branches of mechanics that are ordinarily looked upon as separate trades, each of which requires the separate attention of any ordinary man. Perfection in any thing requires the undivided attention of the individual; and the "division of labor" is carried even into the European observatories, where one man takes the observations, for others in the same room to reduce by calculation. The observer and the mathematician are different persons. This is the mode in which the operations are conducted in a *single stationary* observatory in *Europe*.

Compare this with the mode of conducting the *American* coast survey.

There is no inclination to detract any thing from the reputation of Mr. Hassler as a man of science. (19.) We are willing to assume all that his friends claim for him on that score. We might even grant more than they ask; but this will not alter the position of the question at issue. Without undertaking to judge of his mathematical knowledge, our duty is to take a common sense, practical view of the subject; it is not necessary to decide whether he is *capable* of conducting the work properly, but whether he has actually done so. That this is not the case has been already shown, from his own testimony and that of his assistants.

19.

The objection to a scale of "so many miles to the inch" is not very evident. (91) If we formed our scales with reference to the actual mile, it might be correct; but, since we use the small measures for a small scale, and since the scale is theoretically of no importance as long as it is in proportion to the map, it becomes a mere question of convenience, whether we shall adopt the scale of $\frac{1}{10000}$, which requires 6.336 inches to the mile, and consequently is not only a difficult scale to form accurately, but, not being in general use, must be formed expressly for these maps.

It is also a little peculiar that our survey is calculated in French metres. (92) It is a measure not usual in the country, and, with the exception of a few metres that have strayed into this country, must in general be deduced from our foot or yard measure. The English used their own measure; but, after all the expense of constructing standards for this country, it seems that the very individual who had charge of this work rejects his own measure. These two points are of no great importance; but it is an important fact that our standard measure, as constructed by Mr. Hassler, contains nothing but yards and decimals, and has neither a *foot* nor an *inch* marked on it.

If, then, we desire to ascertain the length of the foot, we must divide the standard yard into *three* parts, which is not a very easy matter, if we desire accuracy, while it might have been done in the first instance with as much ease as to make the decimal divisions by means of the expensive apparatus used for the construction of the standards.

It also appears that, in addition to the innovation of using a difficult scale for the construction of the maps, of using the French measure as the basis of our calculations, and of forming a standard without containing the most common measures in use, we must also calculate in *triangular* miles, (93) since the research of the committee "exceeds itself again, when it comes to determine the square miles covered by triangles which have but three corners." (For other peculiarities, see note 71 bis.)

20.

In conclusion, the following suggestions are submitted:

That the President be requested to take such measures as may preserve the measured base, and also the actual base, if, in his opinion, the same be practicable; and to inform this House, at its next session, of the existing condition and the prospects of the future preservation of the same, together with such suggestions as he may deem advisable.

That the President be requested to procure information from the best sources, both scientific and practical, as to the best mode of surveying the different districts of the United States coast, and the proper organization of the corps of surveyors and mathematicians, in order that the work may be done in the shortest time and at the least expense consistent with the greatest accuracy and certainty in the results; and that he cause the same to be transmitted to this House at the next session, in order that the field work be resumed and prosecuted with the greatest vigor, in accordance with such provisions as the wisdom of the next Congress may establish, after being in possession of the scientific and practical information which the late investigation proves to be requisite to enable Congress to act judiciously on the subject. Also, that all who take an interest in the proper

organization of the work be invited to transmit to the Clerk of this House such hints as they may consider useful, to be endorsed "coast survey," in order that the House may be in possession of all the information that can in any way be obtained.

That the office of the coast survey be no longer devoted to the mechanical operations of manufacturing surveying instruments, of engraving, and of printing, but, leaving these to be performed by those who devote their time entirely to these trades, the office be used exclusively for the scientific purposes of reducing the observations and protracting the charts for the engraver.

That all the duplicates now in the office of the coast survey be signed by those who made the observations or reduced the same.

That duplicate copies of all the works in the coast survey office be immediately transmitted to the Secretary of the Treasury, signed by those who are responsible for their accuracy.

That all the observations that have thus far been made be reduced to their final results, and manuscript charts protracted from the same, giving the latitude, longitude, and compass bearings, as near as they can be ascertained from the data as known at present; and that the extreme error that may possibly exist be marked on the face of said charts; and that the said charts, when finished, and containing all the information that has been collected, be transmitted to the Secretary of the Treasury, who shall cause the same to be engraved, in part, and published for immediate use; and that the Secretary of the Treasury retain the plates and manuscripts, in order that the engraving may be finished as soon as it is ascertained that they are correct, or what corrections require to be made; (89) and that the publication of said charts be done by contract, according to specimen, and with the condition that the copy shall not vary from the original beyond a minute fixed limit, so as to be *practically* identical with the original; and that the plates now in the hands of the engravers, in the office of the coast survey, be considered as coming under the same condition as the preceding.

In the mean time, that the vessels now engaged in the coast survey (after devoting about two months in order to finish the soundings in those places where the signals are now standing) be furnished with charts, chronometers, and other necessary instruments, from the depot, to be allowed to refit from the public stores, and to be employed in determining the latitude, longitude, and compass bearings of all the light-houses, capes, headlands, islands, sand bars, and other important points along the coast—to be employed at the South in winter and at the North in summer; to transmit monthly returns of all their observations and results, signed by the officer who takes and calculates the same, with a note as to the confidence that he places in his own observations; and that the public be informed through the newspapers of all the inaccuracies in our charts as soon as they are ascertained, giving the name of the individual upon whose observations the determination rests.

Also, that these nautical observers be directed to take such soundings as may be of immediate importance, in order to correct the errors in our charts, and that the same be published in like manner, to warn the navigator of a hidden danger.

Also, that observations be made, so as to connect the points, whose position

in latitude and longitude have been ascertained, with some fixed conspicuous objects in the neighborhood, in order that the identical spot may be found by any other observer at any future time, when the survey of the coast shall be carried over that district.

That the Topographical bureau be directed to take all the detail surveys on land, including the military information necessary for the defence of the country, from points furnished by the general survey of the coast, and that the draughts prepared from the same be preserved in the War Department, for the exclusive use of the Government, while the navigator's chart shall exhibit no more of the inland districts than such as shall be necessary for the navigator, according to the system pursued in preparing the sea charts by the Governments of France and England.

That, in future, detailed estimates of the expenses be made to this House, and that no appropriation be made hereafter, in the form of one grand contingency of $100,000; and that the Secretary of the Treasury be required to transmit an annual statement, in detail, of the expenditure of the appropriation.

That there be a revision of the salaries and emoluments of the persons engaged in the coast survey.

And, finally, that the superintendent be appointed by the President, with the sanction of the Senate; that all officers receiving more than $1,000 per annum (exclusive of the officers detailed by the Topographical bureau, as above stated) be appointed by the superintendent, with the consent of the President; and that the number, duties, and compensation of all the subordinates be submitted by the superintendent to the President, and sanctioned by him, before they be employed by the superintendent.

Respectfully submitted.

JOHN B. AYCRIGG.

NOTES.

[The references to Document No. 43, January 12, 1843, being the journal of the proceedings of the select committee on the coast survey, are simply marked with the name of the individual under examination, and the page of the document on which it will be found.

The references to Hassler's Coast Survey show the pages from which the extracts are taken, from "papers on various subjects connected with the survey of the coast of the United States by F. R. Hassler, extracted from the American Philosophical Transactions, vol. 2, new series, Philadelphia, 1824."

The references to the documents are principally to the reports of Mr. Hassler.]

NOTE (1.)

16. Question. Are we not greatly deficient in knowledge of soundings in Buzzard's bay, Nantucket shoals, Cape Cod, and Massachusetts bay?

Answer. Yes.

17. Question. Is not a knowledge of those soundings of the greatest importance to navigation?

Answer. Yes; it is more wanted there than any where else. More tonnage passes. Most vessels from Europe, for New York and Philadelphia, come between the Gulf stream and Nantucket shoals, in addition to the navigation north of Cape Cod. Most of the coasting trade comes through the Vineyard. [*Blunt, p.* 23.

NOTE (2.)

List of the individual maps executed and delivered.—[Hassler, p. 62.

No.	Maps.	By whom made.	Scale.	Date.	Remarks.
1	Harbor of Bridgeport, Ct.	Lt. G. S. Blake	1-10,000	1835	Engraved.
2	Newark bay, N. J.	Lt. Th. R. Gedney	1-10,000	183–	Engraved.*
3	Harbor of New Haven, Ct.	Lt. G. S. Blake, and Wm. M. Boyce.	1-10,000	1838	Engraved.
4	Country between the Thames and Niantic, from the sound up to Mohigan creek.	F. H. Gerdes	1-10,000	1840	Treasury Department, for the honorable J. W. Williams.
5	Sandy Hook bar	C. Renard	1-10,000	1841	Treasury Department, light-house, Mr. Pleasonton.
6	Thames river, topography and hydrography.	F. H. Gerdes	1-20,000	1842	Treasury Department, for Senator Huntington.
7	Sandy Hook bar	H. L. Whiting	1-10,000	1842	Topographical bureau.
8	Fisher's Island sound, and the entrance of New London harbor, Ct.	F. H. Gerdes	1-20,000	1842	Treasury Department, for the honorable J. W. Williams.

* N. B. Mr. Hassler has forgotten the date, 1839. (See page and note 20 and 69.)

NOTE (3.)

AN ACT to provide for surveying the coasts of the United States.

SEC. 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the President of the United States shall be, and he is hereby, authorized and requested to cause a survey to be taken of the coasts of the United States, in which shall be designated the islands and shoals, with the roads or places of anchorage, within twenty leagues of any part of the shores of the United States; and also the respective courses and distances between the principal capes or head lands, together with such other matters as he may deem proper for completing an accurate chart of every part of the coasts within the extent aforesaid.

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

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

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

[*Approved, February* 10, 1807.]

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

SEC. 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That for carrying into effect the act entitled "An act to provide for surveying the coasts of the United States," approved on the tenth day of February, one thousand eight hundred and seven, 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. *And be it further enacted,* 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 and naval service of the United States, and such astronomers and other persons as he shall deem proper: *Provided,* That nothing in this act, or the act hereby revived, shall be construed to authorize the construction or maintenance of a permanent astronomical observatory.

[*Approved July* 10, 1832.]

* See volume 4, page 79.

NOTE (4.)

The Secretary of the Treasury, August 3, 1816, says: "You will make frequent reports of your progress to this Department, and deposite here all the surveys, draughts, notes, charts, maps, journals, and documents, in anywise belonging to the survey of the coast; and you will return the public instruments and books to such place as shall be directed, when they are no longer required for the business of the survey."

"If at any time it should be necessary to explain the nature of your engagement," &c., "the articles submitted by you on the 12th of July, 1816, will be resorted to" particularly.

July 12, 1816, Mr. Hassler proposes "to make, himself, the principal part of the general large triangulations and the consequent calculations." That he shall receive $5,000 per annum for all his expenses, except those of a public nature, and (if understood correctly) that the following shall be, excepted from the other expenses of the work, viz: "The clear executed copies of maps and charts, either general or particular, which will be required by the proper authorities, or prepared for publishing." Observe the concluding sentence—"*or prepared for publishing*"

On the reappointment of Mr. Hassler, August 9, 1832, the Secretary of the Treasury says: "You will receive, in full for all your services, a compensation at the rate of $3,000 per annum, and for all your personal expenses an allowance at the rate of $1,500 per annum," &c. "In all other respects than those indicated by this letter, the terms and nature of your employment will be the same as were fixed by the letter addressed to you by this Department on the 3d of August, 1816."

NOTE (5.)

"Survey of the coast" "must present the localities of all the passages and gorges that lead to these valleys, &c., because it must contain all that is needed for the proper defence of the coast in the case, of any attack whatsoever, just as much as the outlines of the coast and the soundings, because, like these, furnish the guide to the navigation," &c. (See this extract—military purposes, statistics, and article 47, for use of State surveys, 1834–'35, Doc. 2, page 372.) [*Hassler.*

NOTE (6.)

"In the years 1793 and 1794, Mr. Gardiner and the gentlemen of his department accompanied us in the survey of the coast of Hampshire and the Isle of Wight, and have since finished the military description of both, drawn on a scale of three inches to the mile; but those plans, together with one of the country round Tunbridge, and another of that around Bagshot and Farnham, are lodged in the Tower, for the use of the Government, and not submitted, from obvious motives of policy, to public inspection." (Preface to Mudge's Trigonometrical Survey, vol. 1, page 12.)

NOTE (7.)

"Both works" (*i. e.*, the coast survey and weights and measures) "are equally in the interest of commerce, and have no reference to the navy.

The accurate survey of the coast is made with the view to protect the property afloat on vessels from shipwreck, and the regulation of the weights and measures is to," &c. (1835–'36, Doc. 2, page 385, vol 1.)

NOTE (8.)

The aim of the coast survey is, and has always been considered to be, by all the successive administrations since its existence, to furnish, with the fullest accuracy possible, all the geographical, topographical, and hydrographical data that may in any way be needed for the navigation and the defence of the coast, in their generality, and to the extent of the country in the rear of the coast, to which the valleys extend, that empty their waters into the Atlantic, and are thus separated from it by some chain of mountains, or what may be called the nearest chains of elevations separating the interior from the coasting countries; and that this work should also furnish the elements to any future map of the country desired, as it is by its nature so extensive, and so situated, as to furnish the elements of maps of all the States. In fact, some States have already united in the work, to extend these elements to the advantage of an accurate map of these States. (Doc. 28, page 3, 1841–'42.) [*Hassler.*

NOTE (9.)

96. Question. Do you regard the survey as a great scientific enterprise, embracing delicate problems of geodetic research, beyond what is necessary to an accurate but rapid survey of the coast for nautical purposes?

Answer. There is not a single movement in all I do which is not necessary for the honorable and faithful execution of the work.

97. Question. Is it intended as the basis of a topographical, military, and statistical survey of the whole United States?

Answer. That is the Government's business, and not mine.

98. Question. Is the survey conducted now with a view to any such ultimate purposes?

Answer. That is not given in any charges by the Government; therefore I do nothing with it. [*Hassler, p.* 11.

NOTE (10.)

31. Question. Of what use are the plane tables, so far as regards navigation?

Answer. I do not consider it of any use to extend the survey any further back than the slope of the hills at the head of navigation.

32. Question. Are the plane tables further back?

Answer. I do not know how far back. I presume they are.

[*Blunt, p.* 24.

NOTE (11.)

"The limitation to any determined distance from the coast would require that the mountains, which are indispensably necessary for the station points of the survey, be within that distance." [*Hassler, p.* 46.

16. In general, a limitation to three miles from the coast, as has been

talked of, is a virtual abolition of the work itself, as well from the side of the natural as the moral difficulties it would suscitate, and the impossibility of giving to the work the required accuracy; nor would any other limitation be less injurious. [*Hassler, pp.* 54, 55.

17. The shore line of a coast is never seen from a ship approaching it; the picture of the elevated land is what presents itself to the sailor; in this he is guided by so much of the topography as can be seen at a reasonable distance at sea, and this lies back in the country at distances which are not determinable but by actual survey; thence the only rule is that which I have followed, and long ago stated, namely: the "topography must go to the ridge of mountains which determine the heads of the coasting rivers or creeks, or their passage through such mountains, what is called in France, technically, '*le versant de la Vallie côtiere*,' or '*le voisant de la cote*.'"

Such it has always been understood and proved.

18. My rule of action, and guide in the work, must be my contract to make the work "*honorable* and *permanently useful, to the nation*:" the way to obtain the aim must be left to me; if I was to be guided by any foreign direction, except mathematical principles, some of my assistants might even rise up against me, refusing to do what they might think to exceed my powers, and I would either have to dismiss them for such refusal, or the work would become impossible. [*Hassler, p.* 55.

NOTE (12.)

101. Question. Cannot the survey of the bays and rivers be postponed, without injury to the general work, till the survey of the coast proper is completed?

Answer. It is impossible, because no accuracy could be got for the coast. [*Hassler, p.* 11.

NOTE (13.)

79. Question. What benefit results to navigation by having all the details of the topography of the country?

Answer. There is no more topography in the maps than what is necessary for that object.

80. Question. Cannot a portion of the topography be dispensed with without detriment to the object of a knowledge of the coast for navigation?

Answer. Not to that extent to which it is carried now. I could not dispense with any of the topography as it is now done. [*Hassler, p.* 9.

NOTE (14.)

81. Question. Do not the hydrographical parties have to wait for those engaged on the topography?

Answer. They cannot go six inches without it, but they do not wait; the topographical part has always been ahead. [*Hassler, p.* 9.

NOTE (15.)

30. Question. Are you able to keep up with the triangulation?

Answer. Yes; and I have been in advance of the plane-table parties.

31. Question. Are the plane-table parties necessary to the soundings?

Answer. Yes. [*Gedney, p.* 40.

NOTE (16.)

10. Question. Can a topographical map, so constructed as to give in detail a full and self-explaining picture of the country, that, with the map before the eye, the military operations may be properly judged and guided in the cabinet, be obtained, in carrying on the coast survey, without adding greatly to the expense, and materially delaying the execution of the work?

Answer. No, it cannot. [*Blake, p.* 41.

NOTE (17.)

27. Question. Is the topography of the country within the coast of any importance to navigators?

Answer. It is not, except for four or five miles, or where there is any remarkable eminence or other object inland.

28. Question. Is it customary to lay down the topography of the country on the charts of navigators?

Answer. I have never seen it in any charts except of islands. In charts of the West India and other islands it is sometimes given; but in those cases it is not necessary for purposes of navigation. [*Gedney, p.* 39.

59. Question. What necessity is there of plane-table parties, except near the coast?

Answer. No absolute necessity, except for the secondary triangulation near the coast.

60. Question. How far in from the coast have plane-table parties gone on the survey?

Answer. I cannot say precisely. They are carried on by Mr. Gerdes, Mr. Sands, Mr. Boyd, Mr. Dickens, and Mr. Werner.

61. Question. Do the plane-table parties require much science?

Answer. They require practical skill. [*Ferguson, p.* 18.

NOTE (18.)

"It is now necessary to execute, if possible, in continued regular succession, all the topographical part of the country that is now covered by primary and secondary triangulations."—(1835–'36, vol. 1, Doc. 2, p. 383.) [*Hassler.*

NOTE (19.)

The surveys made in Europe, of sufficient note to apply to them the mathematical and physical sciences, which are, in principle, to be applied, and without which *success is directly impossible,* were all begun in the last century upon similar plans of triangulation; varied as they all are in the methods and mode of the detail execution, they all agree in that principle.

Austria began already, after the times of Cassini and Liesganig, (1768,) using the triangles of Liesganig, made for the determination of degrees of the meridian, in Austria and in Hungary, as the primary mathematical elements of her future maps.

Russia began under Catharine II, and has since constantly either taken up at different points or extended the triangulations successively made,

with always more perfection of men of science. Now, these triangulations form a fully connected series from north of the arctic circle to south of Dorpat. The work goes now on, with a great abundance of means, as well in persons as money, for the topographical and hydrographical parts, to which the triangles give the foundation, principally around the Baltic.

Sweden has similarly taken advantage of the trigonometrical operations of Svanberg, in Lapland, for a measurement of a degree of the meridian begun in 1801, for its maps and the charts of its coast.

Denmark began, under Bugge, before 1784, for its peninsula; and not many years ago the part of Holstein was triangulated, in conjunction with Hanover.

The kingdom of Hanover has been triangulated by Professor Gauss.

Prussia, having taken advantage of the extension of the French triangulation in Germany over its present Rhenish provinces, has not only extended this triangulation over a great part of its dominions, but has added new measurements of degrees all over, until lately, Mr. Bessel, astronomer royal of Königsberg, joined these works with those of Russia just quoted. All these works have been, and are still, used as elements for the geographical, topographical, and hydrographical surveys of the country.

Swabia was triangulated by my university friend, Professor Bohnenberger, of Tübingen, and I accompanied him, in 1795, in the junction of his triangles with mine in Switzerland.

The operations of the triangulation of Bavaria are well known and fully described.

All the States of Germany have either made triangulations upon their own base lines, independent of the French triangulations, which were constantly carried on in the rear of the French armies, during the whole of their campaigns, from 1791 onwards, or used these very triangulations; and the different States have grounded upon them the maps of their countries.

The same is the case with Italy, where the triangulations of Boscovich, Beccaria, Zach, Nouet, the joint Austrian, French, and Sardinian commission, and others, from before the French Revolution, during the same, and since, have been, and are, constantly used as foundation to any maps or charts that are constructed.

Naples and Sicily proceeded in the same manner; and the whole was executed *without any naval officers* being employed in it.

In 1791 I had already begun myself in Switzerland a similar operation, by the measurement of a base line of about 7½ miles long, upon which some triangles were grounded. The several subsequent revolutions interrupted the work, but it was taken up again repeatedly, by me and others, upon the same plan, and with these *my* very same *first elements*. According to the latest accounts, the topography has now been completed. It was the notice of that work of mine, which came to this country about the time of my arrival, in 1805, which occasioned first the proposition to me to do the same here: thence the law of 1807, and the call for plans of operation, of which mine, now proceeded upon, was selected from among thirteen, by the unanimous vote of a special committee assembled in Philadelphia, and by the President himself. (See the historical part of the printed documents, vol. 1.)

France began its first map, after the triangulation of Cassini, in the early part of the last century. The defects which this work presented in its detai

execution, which was not made with the care now used, and the improvements of the sciences that progressed rapidly after those times, produced first in 1786 the triangulation to join the observatories of Paris and Greenwich, under Cassini, the third in France, and General Roy in England. Immediately upon it followed the decision of measuring 12 degrees of the meridian, to serve equally as a base to the establishment of standards of weight and measure, upon an unit of length derived from the quadrant of the meridian of the earth, and by the most accurate principles of natural philosophy, applied to the capacity measures, and the weights.

Only after these works had passed the ordeal of approbation of the men of science sent from all the continental nations of Europe, assembled in Paris in 1800, (England alone refusing to take a share in a *scientific useful aim*, while it employed its arms and treasures to the destruction of the continent of Europe,) the French, as well as the foreign members of this scientific convention, reporting jointly and unanimously—only then, the accurate elements thus obtained were decided to be applied to the construction of a new map of France and to the charts of its coast.

When all the interior that had been done by the triangulation and the topographical works, which always must form the base of the hydrographic operations, had been executed, the western coast was begun in 1816, and account rendered of it in 1829. The coast of the Mediterranean, as far as hitherto known, is not yet finished; but, during the whole of the wars of the Revolution, the triangulations whose bases laid in the French works were carried on as their armies proceeded.

England grounded the first starting of its survey upon the very base line measured in 1789 by General Roy, on the occasion of the junction of the observatories mentioned above, and has continued it ever since upon the same plan. Several volumes of the work are extant, but the whole is not yet completed. About the year 1818, according to English accounts of that time, upon the part of the work in Ireland, "above 600 persons, of different conditions, were and are continually employed," &c. According to later verbal accounts, the work goes on now from Dublin, south, towards Cork.

In the East Indies, the English began already, in 1800, trigonometrical surveys, upon which the topographical and hydrographical details are grounded and carried on, like all the rest, upon the same principles as the survey of this country now is, but with immensely greater expenses, and a *personel* far more numerous. The work is proceeding now always upon the same plans and principles, having been extended many degrees of latitude north in the new territories, under Lambdon, Everet, &c.

Europe is covered with well-connected series of triangulations, from the south of Sicily to past the north polar circle; from Ireland, through England, France, Germany, to the interior of Russia; from Bordeaux to the frontier of Turkey, and in all the intermediate parts: so that no map need be, nor actually is, attempted without the elements of these triangulations. The works which I have made in Switzerland are included in this series. (*Doc.* 28, 1841–'42, *pp.* 12, 13, 14.) [*Hassler.*

Surveys of all the countries of Europe have been or are being made by the system of triangulation, to wit: Austria, Russia, Sweden, Denmark, Hanover, Prussia, Swabia, Bohemia and the States of Germany generally, Italy, Naples and Sicily, Switzerland, France, England, the British possessions in India, and the French colony in Algiers.

"Europe is covered with well-connected series of triangulations—from the south of Sicily to the polar circle; from Ireland, through England, France, Germany, to the interior of Russia; from Bordeaux to the frontier of Turkey, and in all the intermediate parts."

To the question, "Whether no other mode exists by which accurate results can be obtained within less time than they can be furnished by a trigonometrical survey," the answer is, *No.* There is no *short* method by which these results are attainable.

Usually, the experience of the world is justly considered when any great object is to be attempted or effected. Why should it be excluded from the category, in judging the merits of this magnificent work? We have the combined testimony of all the science of Europe in favor of making surveys by triangulations, and, in fact, the positive assertion that it is the *only* proper method. Why should we not adopt the conclusions of nations which, to say the least, are older in these matters than we ourselves are, rather than to resort to methods which are a century behind the age we live in? [*Swift, p.* 35.

"It might be desirable that they" [*i. e.* the signals and secret marks placed in the ground] "could be properly protected by a special law, as that is the habit in Europe, where such well-secured triangulations exist, and are still daily making from Sicily to Lapony, and from Brest and Ireland to Turkey and Petersburg." (1835–'36, vol. 1, page 383, Doc. 2.)

To the question, whether the mode of making the survey of the coast by triangulation is better than any other, it may be said to be the *only* truly correct method which can be pursued. It is the only method by which a *connexion* in the work can be preserved. Of its accuracy the proofs are continually before the observer, and an error need not be extended beyond a single triangle. The three angles are measured in every principal triangle of the work; and, as this is all the *measurement* which takes place after the base is determined, it is obvious that the observer has his proofs of correctness continually at hand. There can be no *cooking* of observations, as is sometimes practised in astronomical determinations.

An idea of the exceeding accuracy attainable in works of the nature referred to may be formed by referring to the account of the measurement made by the French astronomers of the arc of the meridian between Dunkirk and Cabrera, for the determination of the figure of the earth, being 12 degrees of latitude in extent. After a great number of triangles had been measured, and an extent of about 500 miles upon the meridian determined, (between Melun and Perpignan,) a base of *verification*, as it is denominated, was measured at Perpignan. This verification consisted in *measuring* with the greatest accuracy one of the sides of a triangle in the series, which had been previously determined by computation from the original base. The difference between this computed side and the actual measurement was less than 2 feet. [*Swift, p.* 34.

NOTE (20.)

7. When I could join my assistants upon the beach, in the beginning of July, though by no means in a good state of health, and after having visited the projected lines, the difficulties they presented decided me to try to lay off a straight line upon the outward sandy shore of the ocean, between the sea and the sand hills, which appeared to present a nearly

straight line, little different from parallel to the shore. This succeeded so well, that a line was laid out starting from a sand hill of moderate elevation, somewhat southeast of the light-house, and extending over eight miles upon the sandy beach, only in a few instances edging the sand knolls, and some others going between the high and low water mark on the seaside; the lowering of the first as much as needed, it was easy to accomplish; and the second apparent difficulty was equally easily overcome by so regulating the work, as to meet these places during low tide.

8. This line was then laid out accurately straight by means of a transit instrument, and measured, preliminary, by the same chain of 20 metres which had been used in 1817, for the preliminary measurement of the base line in English Neighborhood, and which serves now for the detail plane-table survey of the south side of Long Island. At every 400 metres a peg was driven into the ground, bearing the mark of the distance; these precautions are always required as a great means of security against mistakes, by the omission that might happen of inscribing a measuring bar-box in the registers, as thereby constant verifications are presented.

9. During the months of August, September, and October, this line was then measured in forty-five days, of which, twenty-seven in August, fifteen in September, and three in October; the other part of that time being taken up either by interruption from unfavorable weather, or such days as were necessarily employed for the moving of our encampment along the line, for which it was always necessary to employ all the helps otherwise engaged at the manual part of the base measurement, there being never any doublets of men engaged in our work; and I must add, near the end of it, also, my own increased state of sickness was unfavorable.

10. At every 400 metres, as determined by the accurate measurement, and at every 1,000 metres, strong pegs were driven in the ground, marked by their distance from the west end; and every 2,000 metres was besides furnished with one of the stoneware cones that are always used at the station points; these are intended as fixed points, from which the detail points of the soundings in the sea that they border are to be determined.

11. Both ends of the base line thus resting upon two sand knolls that will, by their position, in all appearance, always be secure from the sea, have been marked by two monuments, each consisting of a Newark red sandstone, about four feet high, hewn square for about eighteen inches from the top, with an even top of one foot square, and a round hole in the centre; under the square cut part a frame was fixed in, consisting of four pieces of hard wood scantling, embracing it closely by grooves made expressly in the stone, the lower part being left rough. These stones were sunk entirely even with the sand, together with their frames, which, by their extending about twenty inches on each side further in the ground, will make them stand more solid, and maintain their perpendicular position.

12. The distance between the monuments will exceed 14,050 metres, or $8\frac{34}{1000}$ miles; the accurate number will result from the calculations that I shall make next winter upon the reductions needed for.

1st. The varied state of the temperature.

2d. The elevations and depressions that the localities of the ground obliged to make in many places.

3d. The reduction of the line actually measured upon the shore sand, to that between the monuments, for which all the data have been determined upon the place. (Doc. 2, vol. 1, p. 377, 1834–'35.)

"No material alteration will be found in General Roy's account of the measurement on Hounslow heath, if we except a correction of about eight inches in the reduction of the base, which was 27,404.7 feet, instead of 27,404.01. For this reason all the sides of the principal triangles to the 14th, and the distances depending on them in the account of the operation in 1787, 1788, are reduced in the proportion 27,404.7 to 27,404.2; the latter being the mean of the two measurements." (p. 138.)—[*Preface to Mudge's Trigonometrical Survey*, vol. 1, p. 7.

Besides, in all cases where the triangulation is to serve for geographical purposes, it may most generally be expected that several base lines will be measured in the course of the work. [*Hassler's Coast Survey*, p. 166.

"It is necessary that the stations of a work of the nature of the coast survey shall be preserved for future times and uses, in any other surveys, to which the determinations made by it will serve as fundamental units." (1834–'5, vol. 1, Doc. 2, p. 366, sec. 14.) [*Hassler's Rep.*

NOTE (20 bis.)

OFFICE COAST SURVEY, *February* 7, 1843.

SIR: I find that the distance between the eastern extremity of the measured line and the monument, which is in the direction of Ruland's, is 162.02 metres.

The measured line has been encroached upon in one place by the tide, but the line between the monuments is considered perfectly safe from such encroachments.

The preservation of the monuments is intrusted to the light-house keeper at Fire Island, who corresponds occasionally with the superintendent. At the last advices, the monuments were secure. No additional local surveys have been made, to show the encroachments of the tide upon the measured line.

Very respectfully, your obedient servant,

GEORGE S. BLAKE.

Hon. Mr. AYCRIGG.

HOUSE OF REPRESENTATIVES U. S.,

February 6, 1843.

SIR: I will be obliged to you to furnish me with a copy of the draught herewith returned, showing the high-water mark and the low-water mark of Fire Island, upon which the base line was measured; also, the position of the measured base line, as thereon shown, and the connexion of its eastern end with the monument.

Nothing more is desired than the lines above described; and, for the purpose of expedition, a copy drawn with a pen, upon tracing paper laid over the map, will answer the purpose, if you find it most convenient. I wish also to have a scale attached to this, showing any given distance; also, to state the year to which this map refers, as to the condition of the beach.

Also, a sketch of the beach from the western end of the island to the eastern end of the base, showing its present condition with reference to the measured base, and to its condition at the time the base was measured

Should its present condition not be known, the latest accounts are desired, and a statement of the year to which the sketch refers. These sketches are not desired to be finished drawings, but merely outlines sufficiently accurate to be measured so as to give a general idea of the subject, and such as may be furnished in a few hours.

Also, a draught of the connexion between the eastern end of the measured base and the monument at the eastern end of the actual base, giving simply the lines, showing which are measured and which are calculated, to be on a large scale, with a scale attached to it.

I also wish you to state the length of your measured base, the distance from the eastern end of the measured base to the monument on the sand knoll; the height of the monument above the measured base, and the distance between the said monument and the monument at the western extremity of the measured base.

I also desire to know whether the length of the actual base, or, in other words, the distance between the western end of the measured base and the monument on the sand hill (in the direction of Ruland's) near the east end of the measured base, was measured or calculated, and whether the actual base admits of actual measurement.

Also, whether the eastern end of the measured base has been positively fixed by a permanent monument; and whether the position is now covered at ordinary high tide, and above the water at low tide, or permanently covered at low water, in consequence of the washing away of the sand; and if so, how deep.

In case the eastern termination of the measured base has not been permanently marked by a monument, and it should be desired at any future time to remeasure the base, how would that point be ascertained? If by taking angles to any distant station, in what manner has that distant station point been permanently fixed?

Would it be possible in the present state of the beach to remeasure the measured base?

That the object of the above may not be misunderstood, it is proper to remark that no minute details are desired, but merely a general description, such as may be prepared and ready for me by to-morrow morning.

I have received from different sources very different information respecting the above points. I therefore write to you for information, since I understand that you correspond with the keeper of the light-house, who has the base under his charge, and since the other points must of necessity be well known to you.

Your obedient servant,

JOHN B. AYCRIGG.

F. R. Hassler, Esq.,
Superintendent Coast Survey.

The following letter was received in answer to that of the 6th instant, after the report was presented. It is here inserted, simply noting, that the changeable nature of Fire Island is very strongly described; that the difference of "*less than a tenth of an inch* in a distance of 8¾ miles," which "is certainly not worth a *cavil*," is not understood to signify a difference between two separate *measurements*, but either an error in the numerical calculation, or in the theory of reduction from the *same measurement*;

and, finally, that there have been no confidential communications with Mr. Hassler, but that the information was requested by the undersigned as one of the members of the committee of investigation, and, consequently, that the letter containing this information belongs to the House.

WASHINGTON CITY, *February* 7, 1843.

SIR: The direction of the tides being always from east to west, and reverse, alternately, and the coast of Long Island presenting to this direction a resistance under a small angle, the effect of the tides upon the washing, therefore the alteration of its south coast is only proportional to the versed sine of this small angle.

The effect of the currents occasioned by the relative position of the coast of Long Island and of New Jersey, which are met by the whole weight of the North river, occasion a recoil of the movable sands at the offings of New York bay, which occasion deposites on the Long Island shore, which have often little consistency, and, of course, are at all times variable.

Thence arises, that the south coast of the island, till up to the more elevated sand hills, is so variable that no distinct *high* or *low* water line can exist which could be marked upon a map. The breadth of the line between the two, varies according to the more or less declinity of the *sand bank*, which lies between the sand *hills* and the *water*, from 10 to 30 and 40 feet about. But even this indication is only stating a mean of what was the case at the time when I measured the base line, and its great variation was proved by six or eight wrecks being yet in the length of the base line when I measured it, and two new ones brought in by the sea during the time of our measurement.

Temporary irruptions of storms act of course here, like on all shores, uncertain extraordinary results, which to enumerate would be endless and useless.

The base line lies in that part of Fire Island beach, which, by its situation towards these currents, and their direction, appears the least liable to encroachment. The nature of the hills show that; particularly the two between which the determined base line lies, upon which the triangulation rests. The encroachment across the line measured upon the sandy beach has been trifling, and I suppose also only temporary, as happened even once while I was actually engaged in the measurement, occasioning that I had to wait for the low tide to pass on in the direct line.

On the western side the land is actually making so much, that the end of the Fire Island beach, which ended rounding off towards Grassy beach, has now advanced westerly for half a mile, and turned into the entrance of the Great South bay, so as to form a commodious harbor, as you have seen by the additional paper, which Lieutenant Blake handed to you, *and which I must request you to return to this office.* [It is now received.]

From all this it is evident that no map with the requisite of your question, which could show the high and low water line, *at this locality*, would be possible, that would fit any other month, perhaps week, or day, than the one in which it was made; to make it for the instant, for *instantaneous only it can be*, would require to place simultaneous observers at every quarter of a mile distance along the whole line. That such a map would be of not the slightest utility, cannot but strike you at once; the sand hills form the invariable unit, as far as any sea shore may be considered so.

In 1833, when the coast survey was resumed, the distances were, of course, grounded upon the base measured through English Neighborhood, in New Jersey, starting from Weasel mountain and Harrow hill, the two last determined points, to Buttermilk hill, by means of an operation which I have mentioned in another place; that base had been measured preliminarily in 1817 with a metre chain, constructed in my house at Newark, under my direction.

This base line was not so convenient to measure, particularly by the apparatus I had provided, for obtaining the greatest accuracy, on account of watery, marshy parts, which it had to pass. Therefore, I was all the time of 1833, observing closely where I might meet with a better adapted locality.

When upon Ruland's and Westhill's station, I observed by the shape which Fire Island beach presented to me, parallel about to these two points; that, without doubt, there must be a possibility to locate upon it a proper base line, from which this distance would be determinable under the best conditions for accuracy; those points furnishing what is called "a mountain base," that is, a distance upon eminences of about the same elevation as the mountains of that part of the country are, which is to be surveyed.

These circumstances made: that early in 1834, I sent immediately the whole apparatus for the measurement of the base, with all the assistants, to the west end of Fire Island beach, with direction: to survey the beach preliminarily, investigate, and project, whatever line they might think could be found measurable to the best advantage, and prepare some mechanical parts for the execution of the base measurement, while I in Newark prepared yet some other parts.

My assistants had in their different excursions projected several lines, which all, on examination, presented considerable difficulties for an accurate execution of the measurement. Therefore I took at once a start across the beach from the northern shore, where they had encamped, to the southern shore; meeting it at about the broadest part of the sandy beach, between the sand hills and the sea, at near ¼ of the present base line, from the western end, in the measurement's beginning of the base; there seeing in both directions the sea and the sand hills running out, so: that I could place myself in a position where it presented itself like a double row of parallel trees, in the middle of which I stood; I placed a stake, and sent forwards an assistant to place another, at about hailing distance, in the place where I should direct; thence we proceeded easterly in the same straight line till we met the side of a sand hill which the line would have cut into, if continued; this happened a short distance before the hill called: *Head and Horns*; here I turned off so much as I thought was needed to avoid all cutting in the hills; then giving a direction backwards the line was staked off westward, until it met a secure somewhat elevated point for the beginning of the base. Such a point was found, very well, and opportunely, situated, and the most eligible point of it was selected.

A monument was now buried at that point, consisting of a Newark red sand stone, cut square at the top, and for about 20 inches downwards, presenting at the upper part, which was made level with the ground, a square of 12 inches side, with a round hole in the centre of 2 inches diameter; at the lower end of the square cut part the four sides are cut in for about 3 inches, to receive a jointed frame of hard wood, of about scantling

size, presenting horizontally 8 arms to about 18 inches from the corners. The lower part, of about the same length as the upper, is left rough, to give the stone an overweight under the above frame, for better solidity, and perpendicularity, while the side arms prevent its sinking by this support, assisted by the support of the frame thus—

[There are two diagrams here.]

From the centre of this hole the actual measurement started exactly.

The line was now laid off exactly, with a transit instrument, and measured preliminarily with a chain, placing marks in the ground at every thousand metres, which gave, of course, a preliminary guide, and check, for any case of accident that might occur in the actual measurement, a directing stake was placed near these marks.

The apparatus with which the final measurement was made, is described in my papers upon various subjects connected with the survey of the coast, printed in the Transactions of the Philosophical Society of Philadelphia, and quoted in the review of these papers, more especially favorably, by Chevalier Bessel, of Koenigsberg, the astronomer, now holding the first rank in Europe, (who since then remained in constant correspondence with me,) in the Astronomical Journal of Mr. Sachumher, of Altona, a translation of which is found in the 1st volume of printed documents upon the coast survey, page 66.

The double-focus microscopes of my invention, the arrangement, and accurate determination of the bars, and the whole apparatus, has been described in the above papers, and belong again to the final account which is to be given, in due time, of the main triangulation, when once included between two base lines; all previous statements are out of place, because they forestall a part of the system which should appear in one whole mass of the scientific exposition of the whole system of the work of the coast survey, upon which ultimately the work must depend.

The journal of the base measurement contains, in three folio volumes, the statement of every individuality that are proper to be recorded, the hour and minute at which every bar was laid off, the temperature of 8 thermometers of each laying off of the bars, the indication of each small elevation or depression of the bars laid off when not exactly horizontal, with their reduction, &c., &c. I may remark that there were in this base line far less reduction than in any other known.

At every 1,000 metres of the so microscopically measured line, an earthen cone was dug deep into the sand, as a mark of accidental reference if needed, and for the detail survey.

Thus was proceeded uniformly until to the crossing of the line which would pass from Ruland's hill, through the centre of an earthen cone, placed upon the small hill called *Head and Horns*, which was marked and noticed particularly in the journal, out of precaution, in case not a sufficient length could be measured to meet another more advantageous point affording the same advantage for the intersection of a line from Ruland, with an advantageously placed hill.

Such a point was found about 110 boxes, that is 880 metres further east. A monument, similar in all respects to that placed at the beginning of the measurement, was placed in the middle of that hill, and the measuring continued until to a certain point between high and low water, which was marked by a peg, as well as several of the preceeding near ends of the far

boxes, yet falling upon the part above high water, as in the figure A and B.

A theodolite was then placed over the centre of this monument directed upon Ruland, and by inverting the telescope the line was prolongated to the intersection of this prolongation with that of the last box of the measurement, made by means of a brass bar of a beam compass; this determined the point R, in the figure.

To multiply the means of accurate reduction to this monument, last placed, I measured a separate base from R to Z again with the same microscopic apparatus that had served for the long measurement, and of such a length and in such a position as formed a favorable triangle for this determination. An earthen stoneware cone was buried at Z, like at a triangulation station point. Thus a combination of triangles was formed between the monument's place and the points A, B, R, and Z, of which all the angles were measured, grounding upon different bases, and affording a variety of combinations, each giving a special determination of the actual base line intended to be determined between W and E, or west and east end of the line that forms the base of the triangulation.

In reverse again the determination of the distance E R (—) 162.0224m., can serve at any time to point out with the same certainty this point R, where the measurement with the metre boxes, with complement, lies, whether it be dry or under water when it may be desired.

My operations at that point were of course made at low water, when the point was accessible.

This point is given 13997m., 637052718 from the beginning at W by the final result of all reductions; in this the decimals after the 3d are evidently insensible.

The line between the two monuments, which forms the actual base line, to be employed in the survey, was determined by my calculation= 14058.9862m.

As it was desirable, a second calculation of the whole was made of the reduction of the measurement by Captain Swift, and of the reduction to the eastern monument in somewhat a different form, by Mr. Dahlgren, lieutenant of the navy, then an assistant in the work, the result of which was 14058.9878m., both reduced to the temperature of 32° Farenheit, or so called, freezing point of temperature; the difference between the two results of 0.0016m., *or less than a tenth of an inch* in a distance of 8¾ miles, is certainly not worth a *cavil.*

In point of the scientific standing and advantageous particulars and position of this result, I am *perfectly allowed* to claim preference over the greatest number of the base lines measured for large surveys, as will at once strike by the diagrams of a variety of such bases, which I will join here to be compared with it.

A verification of the result was obtained immediately the next year, by deducing from this base line that of the base in English Neighborhood, New Jersey, measured in 1817, the calculation being carried upon this old line measured only with the chain, though somewhat carefully, from the new accurate base, coincided within the limits of the expansion of the iron, between the two different temperatures under which they were measured.

By two well-conditioned triangles, the base between the monuments upon the beach, is transferred to the distance between Ruland and West-

hills, which form, what I called above, the mountain base of the triangulation.

The point upon West hills is secured by a stone monument, exactly similar to the two placed at both ends of the base line. That of Ruland's hill is marked by a stoneware cone, buried under ground sufficiently to prevent its being disturbed.

I may be allowed here to add: that it is even *improper*, that the particulars of the monumental marks be publicly discussed, and made known, in any other way: but by *the journal*, in order not to awaken the attention of *mischievous persons* to attempt their destruction, *as has been done with some of the marks of* 1817. The proper way to make these marks, is entirely under ground, and deep enough to be unattainable by any plough.

The base monuments, you know, are given in charge to a public officer of the United States, whom besides I know as well disposed. The proper measures have been, and are still, taking, to increase the hills upon which they stand, in the manner habitual in that part of the country to increase the land, and preserve it. I have myself begun it at both ends, at the time when I measured the angles at the base ends, to full success. (See addition.)

These data to which I could still add more, *if you should desire*, will however, I hope, be sufficient to convince you that the contradictory reports, which you state to have received, upon the subject of the main base of the coast survey, measured upon Fire Island beach, are, what all contradictory *reports* are, namely, *untrue;* for *truth* is *but one*, and in mathematics there is no possibility of cavil with its decision.

I have only to regret: that you, in the situation of a member of the *select* committee of investigation upon the coast survey, (though your application is not made in that capacity, or with that authorization,) have suffered yourself to be misled by such reports, which may oblige me to make your and this letter public, which I think you might have a considerable interest to keep between us, by *fairly* and *decidedly* turn friendly to the work, as you stated at first, but which you have so much attacked, and to let me alone; who certainly have done nothing that could in any way in the world be taken ill in me, neither in the work, nor against you, unless you should think: that I have no right of self-defence, which belongs, by natural right to all, even the dumb creation, and I therefore shall not give up, having so plenty means for it on hand. Within *two days*, I hope to get your decision upon *this point*, because I am not sure of the use you mean to make of the information, which I herewith give to you, in the fullest candor, I am decidedly obliged to act, and so to act, that neither this country nor Europe can remain in doubt upon the subject of your questions; you cannot but see, that the subject you attack, (namely, the accuracy of the base line,) belongs to the scientific world, which is not limited by the boundary of the United States, even as settled by the last treaty; that mathematics furnishes means to ascertain truth, which even politics cannot, (for even the decision of large assemblies by plurality of votes, has been calculated by mathematicians—see "Condouet" Probabilité' des decisione par la pluralité des voix.)

Besides, please to observe, that every stroke you may think to do at the coast survey, by raising doubts upon its accuracy, and reviling it, may be also a stroke at some vessel, bearing, perhaps, a friend or relation of

yours, whose groans will cry vengeance upon you, for having prevented, or discredited, the execution of an accurate survey of the coast, upon which you may be long in search of his corpse.

With best wishes, your obedient servant,

F. R. HASSLER.

Hon. JOHN B. AYCRIGG, *Member of Congress.*

ADDITION.

You will find, herewith, a sketch of the base line and the beach, upon tracing paper, as you desire; it will exhibit what you seem to wish, namely, the manner in which the triangulation base is connected with the actual measurement along the sand hills, and with the main triangles. It cannot escape any man, understanding the subject, and having any practice, to see by the inspection of the figure: that this reduction was eminently favorable, both by the nature of the locality, and by the manner in which it was made, and the verifications which it affords; besides the details of the results given so eminently prove.

To afford a comparison, I caused the diagrams of several of the most important base measurements, and their reduction, and connexion with the triangulation, to be copied upon a separate paper, by which you will see, for instance, that the two principal bases of the French survey are broken lines, with very obtuse angles, and to reduce them to the monuments, needed superstructures of small triangles at both extremities. The English bases I suppose you know.

The bases of Prussia, Russia, and India, were of very small size, and thence needed to go through a number of smaller triangles before they could determine any actual triangle side, one as much as five triangles. While in the coast survey the very first triangle, at the base to Ruland's, is immediately available for large distances; and the second presents a line upon two independent eminences which furnish a sufficiently large line, to serve as a base line over the sound. The elevation of the monuments over the sandy beach upon which the measurement is made, has nothing to do with the horizontal determination which is the only one needed, it is therefore not determined, as it is not intended to make a railroad there to be graded by it.

The sketches of the base line of the coast survey I must take the liberty to request you *to return to me*, as they are communicated without any proper authorization, in confidence; and their spreading in the public in this form, would not be appropriated to the security of the work by copying, &c., and they would be liable to be abused, for the destruction of the monuments, by indicating their locality, &c., as stated before from experience, which is a *danger to be decidedly avoided.*

The scale of the base line sketch is sufficiently evident, from the marks of the every thousand metres upon the measured line; the logarithm of the base in metres is = 4.147954029335477.

Constant logarithms for reduction of the metres: in yards = 0.0389834
in miles = 6.7935392

The bases for the East India surveys are only measured with chains of the form of Ramsden's; no special detailed account is given of their measurement. The situation of my base line measured in Switzerland towards the triangulation, can be seen in a map of the country which I have here.

F. R. HASSLER.

NOTE (21.)

30. Question. What is the present condition of the place of the original base line?

Answer. I have not been there since 1836. Then the beach was considerably washed, but the points were undisturbed. Now, I understand, the beach is changed, and the base in danger; but the elements of it will be preserved by the mountain base, inland from the original base.

[*Ferguson*, p. 16.

The dunes or sand hills which extend along the coast of Holland, from Dunkirk, nearly without interruption, to the Helder, are formed entirely by the action of the wind blowing up the sand of the sea shore; they are a source of good and evil to the country; they serve as a natural barrier to keep out the ocean; a benefit which, but for the ingenuity and contrivance of man, would be more than counterbalanced by the injury done by their progress inland. On the sea shore they are mere loose heaps, driven about by every blast, like snow-wreaths on the Alps; and, were they not restrained, would move onward year by year, and inundate the country. In passing over a desert of this kind at Schevening, on a windy day, the atmosphere appears dim with the particles of sand blown like smoke through the air.

The height of the dunes depends on the fineness of the sand, as the wind has of course the most power in transporting the minuter particles. Campendown, memorable in the naval annals of Britain, is one of the loftiest on the whole coast, for this reason.

To check the dispersion of the sand, and put a stop to this evil, the dunes are sowed regularly every year with plants congenial to it, for even sand has a vegetation peculiar to itself, which may be called luxuriant; but a species of reed grass, which grows near the sea, (arundo arenaria,) is principally employed, and to great advantage.—*Murray's Handbook for Travellers on the Continent*, p. 13.

Light-house establishment, 1842.

That some of our light-houses should be undermined by the encroachment of the sea, and have to be taken down and removed further back, is not strange; it is a circumstance they will always be liable to. It is no fault of those who selected the sites or built the light-houses. I have had an opportunity of observing the encroachment of the sea on our whole coast for thirty years, visiting every light-house in the United States once every year for sixteen years. Capes, with the ocean on one side, and the rapid current of some river on the other, as Cape Henlopen and Cape Henry, are the most liable to wash away; but your light-houses must be located at those capes, and must not be set too far back from the shore. The shore continuing to recede for a series of years will oblige you to remove some of your light-houses further back. This cannot be avoided. There are many places, particularly in bays, where light-houses have been built, at which a work might have been constructed at the time to prevent the sites from washing away; but there were no funds for it, the appropriation being barely sufficient to build the light-house and keeper's dwelling.

NOTE (22.)

33. Question. What is the signification of the words "primary triangulation?"

Answer. They signify the main series of triangles on which any work to be surveyed is based, extending as far as possible throughout the work. [*Blunt*, p. 24.

1. The main or *primary triangulation*, upon which all the work depends, is made up of triangles, having sides of from 10 to 50 miles in extent. The angles in these triangles are all measured by Mr. Hassler. [*Swift*, p. 35.

The principle upon which the survey of the coast is conducted is, essentially, that which is known as the trigonometric method. By the relations which subsist between the sides and angles of a triangle, we are enabled, from certain known data, previously determined by actual measurement, to compute certain other parts which are unknown. For example: in a given triangle, by measuring one of the sides and the angles, the two remaining sides can be determined by computation. These computed sides then serve as bases for other triangles, and subsequently, by measuring the angles *alone* in the triangles thus formed, the work is extended *ad libitum*. This is called a triangulation, and may be made upon any part of the earth's surface upon which a line of a given extent can be measured. [*Swift*, p. 33.

5. Question. Is there any essential difference in the scientific principles of the primary and the secondary triangulation; and if so, what?

Answer. The primary requires an instrument of great power, and of nicer graduation; there is no other difference. There is no difference in the mathematical elements. [*Ferguson*, p. 14.

NOTE (23.)

It is necessary to ascertain the true position of the district or country triangulated upon the earth's surface—that is to say, its latitude and its longitude. The first of these is independent, it being simply its distance from the equator; while the second is not independent, but refers to the position of some other point on the earth's surface, and under another meridian. This latter place, or meridian, may be assumed at will; and the question then to be determined is simply the difference *in time* between the two places of observation; and this, being converted into degrees, constitutes the longitude, or rather the difference of longitude between two places.

For these determinations, observations upon the heavenly bodies must be resorted to. It is not necessary, however, that celestial observations should be made at every point determined by the triangulation; on the contrary, a few well-determined positions, ascertained by a long series of observations, often repeated, are sufficient, the connexion between the same being determined by the triangulation; hence the survey of the coast, as now conducted, is made by combined or mixed geodetic and astronomical observations. [*Swift*, p. 33.

In the triangulation the two kinds of observations, astronomical and geodetical, are *disconnected*, each operation is *separate*, and they are only compared to draw conclusions upon one another, for a new, different re-

sult, required to place the survey in general in its proper place upon earth; therefore the astronomical parts are only made at a few properly selected places, and with general views for the work, not for details, like in the other case, so as I have stated in my answer to question 5, article 3, of my report of December 2d, 1841. [*Hassler*, p. 53.

To 10, 11, 12, 13, add: These stations were not exclusively astronomical stations; the astronomical observations were intended more for preliminary determinations at the beginning, to guide the work, and to take advantage of the presence of the assistants, who were all present, to introduce them and to exercise them in this kind of observations. The main aim of these stations was the determination of main triangulation points.

To 12 add: There also a solar eclipse was observed.

To 14 add: Upon the station of Weasel mountain all the means for astronomical determinations and azimuths were united, and a regular system of these observations executed, with its appropriated combinations, upon peculiar methods, which I made and prescribed, and which succeeded to satisfaction. The isolated observations of the preceding stations were of course reduced to this by way of comparison. [*Hassler*, p. 49.

91. Question. Of how many points in the United States have the latitude and longitude been ascertained and verified in the course of the survey?

Answer. The calculation of the triangles in my work gives, in ultimate result, the latitude and longitude of each point of the triangle, primary and secondary, according to my special form of the work. [*Hassler*, p. 10.

Question 5. "The astronomical observations made for the determination of latitude and longitude."

Upon this question it must be at first observed that the ultimate clause of the renewed coast survey law of 1832 has cut off the most favorable means by the phrase—"provided, that nothing in this act, or the act hereby revived, shall be construed to authorize the construction or maintenance of a permanent astronomical observatory." This proviso forms an unfortunate limitation of the work. The disadvantages therefrom arising for the acceleration and easing of the accuracy, by the determination of ever-standing points of reference for the whole work, is too evident for men acquainted with its scientific requisites to need being treated here.

That the very object prohibited by this clause must unavoidably, however, once be established in this country, is easily seen, as it is one of the requisite tools for a nation having a navy; if done early enough to let the coast survey enjoy the benefit of it, the expense would be comparatively trifling, and immediately recovered by the advantages arising from it in this *national work* of the survey.

Circumstances have not yet allowed to supply this absence fully, nor is it the time, as yet, nor appropriate, nor *possible* in the state of the work within the present limits of it, to do more than what has been done, namely, the following:

1st. In 1833 and 1834, the first years* of the new operations in the coast survey, observations for latitude with the sun, and with stars, were made upon every station of the main triangulation, with an astronomical repeating circle of 18 inches diameter, and with 10-inch reflecting circles, upon my own plan of construction, which is such as to compensate all the errors reflecting instruments may be subject to. At several of these stations, also, azimuths were observed with the sun.

* N. B. The first years.

2d. A special station was made in 1838 upon Weasel mountain, near Paterson, N. J., for latitudes and azimuths; and a solar eclipse, occurring just at that time, gave occasion for an observation of longitude at the same place.

3d. Every solar eclipse that has occurred during the time the work has as yet lasted, has been observed at some one of the survey stations.

It is well known that all those results are to be† united, in due time, with those of future times, into one general result, by means of the primary triangulation; while the results obtained hitherto, being for the immediate use of the geographical works of the survey *only*, must be preserved within it until this union into a regular system is accomplished. It would be highly *improper* to give them to the public earlier, as well according to good principles of science, required in the work, as in obedience to a positive, and very proper prohibition, stipulated by Government in my original contract of 1816, confirmed in 1832.

The results of the coast survey constitute a property of the nation at large, which it acquires by the labor and expense bestowed upon the work; for which compensation will, in proper time, be obtained by the *authentic publication* of the results. All interference of private publications are directly *unjust*, and *derogatory to the lawfully acquired property* of the *nation*, and *the ultimate proper utility* of the work. The garbled publications which would be occasioned by partial communications would interfere with very unjustly, if not destroy entirely, the advantages of the future authentic publication of the work in its appropriate connexion, turning the public expense into profit for the private pockets of single individuals, having no exclusive claims to its benefit; and the *public* would be *deluded* by being presented with results falsely set up as *authentic*. It is self-evident that none but the maps published by *authority*, as results of such a work, either deserve or will ever obtain, the confidence which is an indispensable requisite in the estimation of the public. The Government that undertakes such a work takes by that act the *engagement* towards the public to provide such maps as shall deserve full and exclusive confidence; therefore, also, it must *discountenance* all that might have any tendency to occasion *doubts*. These considerations were made by all the Governments of Europe which have executed such works. They have followed, in full, all the principles here exposed. It is a very essential consideration for the public *security*, *aimed at* by the work, to prevent all possible abuse.

[*Hassler*, Doc. 28, p. 5, 1841–'22.

The indispensable observations of latitude are of course to be referred to the permanent observatory of the country, if such a one exists; if not, they also become necessary at such stations more particularly as are made for the series of latitude. [*Hassler's Coast Survey*, 1818, p. 179.

NOTE (24.)

For the main triangulation, those stations have been occupied by me which bind up the station points of the works of 1833 and 1834, and unite the secondary triangulation of the eastern side of Long Island and Rhode Island on the east, and of the Jerseys, below the bay of New York, on the southwest, with proper extensions. [*Hassler*, 1837–'38, Doc. 14, p. 2, vol. 2.

†N. B. Are to be.

Diagram of triangulation for the survey of coast in 1817 and 1833, and secondary triangulation 1833 and 1834. (1834, *Doc.* 2, *p.* 381.)

To 40, 41, and 42, add: The main triangulation determining large distances with greater accuracy than the secondary triangulation, it serves as element and groundwork for the latter. [*Hassler, p.* 61.

41. Question. Who conducts the main triangulation?

Answer. I myself, according to positive stipulation. [*Hassler, p.* 7.

Though the mathematical theory of such works is fully treated and well known, their practical application is left completely to the practical man; and the success and accuracy depend in a great measure on the organization and different details of arrangement which such a work requires.

[*Hassler's Coast Survey*, p. 165.

NOTE (25.)

A triangulation may be complete in itself, and, when the necessary corrections have been made for the figure of the earth, the actual distance between two points can be accurately determined. [*Swift, p.* 33.

60. Question. What difference is there in the mathematical elements of primary and of secondary triangles?

Answer. The larger triangles require more attention to the figure of the earth and to the mathematical elements arising from it. [*Hassler, p.* 8.

"If therefore in the state of the country and the nature of the demand upon the work, it cannot begin by the determination of degrees of the earth's surface, upon which all works of that nature are now habitually grounded, the work would, however, be positively shamed out of the annals of the science and of such works, unless its results would be used in future proper time, according to any future desire or exigency, to contribute their proper share to the determination of the figure of the earth *in this country*. This very last result will form one of the principal means for its ultimate proof and credit for accuracy."

[*Hassler's Report, Doc.* 28, *p.* 14, *Jan.*, 3 1842.

To 55, 56: It is very natural that in this, like in every other subject of science, or knowledge, the acquirements and improvements are gradual; they develope themselves as the occasion for them is given, and with a considerable and proportional consummation of time. So much so, that even in Europe this branch of science is not so much spread, as it is pretended, to be already in this country, where it has never yet been employed at all; for the detached small surveys, made so abundantly, do not come at all in comparison, nor under the principles of science, which is absolutely required for such an extensive work as the coast survey, especially in the form and in the locality of the earth in which it lies. *Hassler, p.* 52.

16. Question. You have exhibited to the committee abstracts of the whole work on the coast, from Point Judith to Cape May; what objection is there to the publication of those abstracts?

Answer. The first objection is, that no base of verification has yet been measured; the second is, that we are uncertain as to the difference in any meridian in this country and any in Europe, to a minute and a half in longitude; and the third is, that we have not yet determined the ellipticity of the earth. (See note 23.) [*Ferguson, p.* 15.

NOTE (26.)

The oblateness of the earth at the poles is however a fact so well established by more extensive measurements, that we must suppose either that some error has been committed in the observations—a thing, however, not probable—or else, what is more probable, that, by inequality in the density of the strata producing a local attraction, the plumb line of the sector has suffered a deflection at some of the stations. [*Encyc. Brit., vol.* 1, *p.* 143.

NOTE (27.)

76. Question. What is the object of the second base line?

Answer. The verification of the whole work, which is in the system of all such works.

77. Question. If the object be to verify the survey, and suppose it does not agree, what is the consequence?

Answer. That the error, if any, is to be investigated. [*Hassler, p.* 9.

70. Question. What is the object of the proposed second base line?

Answer. To verify the work. [*Ferguson, p.* 19.

NOTE (28.)

31. Question. What is a secondary triangulation?

Answer. It is a series commenced within the primary triangles, extending in whole or in part through the same, and dependent on the primary series.

35. Question. Is it possible for a series of secondary triangles to exist where there are no primary ones?

Answer. No. [*Blunt, p.* 24.

1. The main or *primary triangulation*, upon which all the work depends, is made up of triangles, having sides of from 10 to 50 miles in extent. The angles in these triangles are all measured by Mr. Hassler.

2. Within these main triangles, smaller triangles are formed; this constitutes the *secondary triangulation;* the sides of these vary in length from 2 to 10 miles. [*Swift, p.* 35.

NOTE (29.)

The survey cannot be carried into its details until such a portion of the above work shall be executed and actually calculated, as will serve to occupy two or three detail surveyors in a certain district.

The same is to be observed with respect to the nautical survey, which is to extend from the coast as far as any object important to navigation may occur. It will be most proper to use in these parts of the work well-informed officers, brought up at the military academy, and naval officers. [*Hassler's C. S., page* 17.

When I had executed the station at Mount Carmel, the extreme eastern one, to which I had intended to extend my observations that year, I considered myself authorized to form two parties to carry on the secondary triangulation within the limits of the country that my main triangulation embraced, as the triangles could all be sufficiently determined to allow the verifications required in future. Keeping, therefore, only two of my assistants

(Captain Swift and Lieutenant Bell) with me, Mr. Ferguson was directed with the assistance of a secondant to fill up, with secondary triangles, all the parts included between the main northern triangle points and Long Island sound; and Mr. Blunt with another secondant was directed in a similar manner, for all that related to both shores of Long Island; both equally proceeding from the eastern extremity of our work towards New York. (*Doc. No. 2, 1834–'35, page 369.*) [*Hassler.*

NOTE (30.)

"Captain Swift has extended the triangulation," &c., "so far eastwardly as the main triangulation would allow."

"Mr. Ferguson has made the secondary triangulation, which is included in my main triangulation of 1817," &c. (1835–'36, *vol.* 1, *Doc.* 2, *p.* 382, same page.)

NOTE (31.)

"All the secondary triangulation and topographical parties" are engaged "at filling up the details within the main triangulation of former years." (1836–'37, *vol.* 1, *Doc.* 13, *p.* 41.) [*Hassler.*

NOTE (32.)

38. Question. When you commenced, was not the secondary triangulation intended to be, as the name imports, secondary to and within a primary triangulation?

Answer. Yes.

39. Question. Is it so now?

Answer. East of New Haven I have extended a main triangulation to Newport, and filled up the same with a secondary series of triangles. [*Blunt, p.* 24.

14. Question. Did you use the main triangulation as the basis of your work (the secondary triangulation) when you commenced?

Answer. Yes.

15. Question. Do you not in fact proceed in the secondary triangulation at present in the same manner as in the primary?

Answer. The only difference is the difference of the instruments. [*Ferguson, p.* 14.

42. Question. Why is not the main triangulation carried as far eastward as the secondary?

Answer. Because it was not needed.

43. Question. When will it be needed?

Answer. So soon as the junction is made with the base line on the Chesapeake.

44. Question. When that junction is made, do you propose to suspend the work south, and go back east, or to have two parties?

Answer. When the junction is made, while the secondary triangulation goes on south, I shall continue the primary triangulation east.

45. Question. Cannot the main triangulation be carried on except under your immediate personal supervision?

Answer. Not in the present state of things.

46. Question. Why not?

Answer. Because there is no body to do it, and the circumstances are contrary.

47. Question. Is there nobody else attached to the survey who can do it?

Answer. Not now. [*Hassler p.* 7.

"The works of the preceding years had filled up with main and secondary triangulation, and the topographical as well as hydrographical detail, most part of the district from the Jersey shore of the Raritan 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.—1839–'40, Doc. 20, p. 2.

"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."—1839–'40, Doc. 20, p. 3. [*Hassler.*

6. Question. Cannot any scientific person, who is competent in and well practised in the secondary triangulation, perform the primary?

Answer. The primary requires more mathematical knowledge than the secondary, and greater knowledge of practical means; but to the whole question, I answer, yes.

7. Question. If Mr. Hassler should die, must the survey stop, for want of any person in the survey, or in the country, to take it up and carry it on?

Answer. No.

8. Question. Which has proceeded furthest in advance, the primary or the secondary triangulation?

Answer. The secondary. I add, that the secondary is necessarily imperfect, inasmuch as it depends on the primary for its verification.

9. Question. If the primary had preceded the secondary, might not the latter have been verified as it proceeded?

Answer. Certainly.

10. Question. Why has the primary been allowed to remain in arrears of the secondary triangulation?

Answer. I cannot say. [*Ferguson, p.* 14.

NOTE (33.)

62. Question. When a secondary triangulation precedes the primary, is it not a second without a first?

Answer. Technically, it is.

63. Question. Is it not working wrong end foremost for a secondary to precede a primary triangulation?

Answer. I think not, because the secondary loses none of its accuracy by the primary following it.

64. Question. Can you ascertain what the errors of the secondary are until you have the primary?

Answer. No. [*Ferguson, p.* 18.

NOTE (34.)

3. The secondary triangulation, in turn, forms the basis of the plane-table or topographical surveys; these include all the details of the ground, outline of the coast or shore, courses of bays, rivers, roads, &c. [*Swift, p.* 36.

NOTE (35.)

36. Question. Is not the use of secondary triangles for plane-table parties to furnish detailed points?

Answer. Yes.

37. Question. If in any work there be but one series of triangles, does any such fact exist as primary and secondary?

Answer. No. [*Blunt, p.* 24.

59. Question. What necessity is there of plane-table parties, except near the coast?

Answer. No absolute necessity, except for the secondary triangulation near the coast.

60. Question. How far in from the coast have plane-table parties gone on the survey?

Answer. I cannot say precisely. They are carried on by Mr. Gerdes, Mr. Sands, Mr. Boyd, Mr. Dickens, and Mr. Werner.

61. Question. Do the plane-table parties require much science?

Answer. They require practical skill. [*Ferguson, p.* 18.

NOTE (36.)

4. The hydrographic determinations are made entirely by the naval assistants of Mr. Hassler. Points on shore are furnished by the triangulation, both main and secondary, together with the coast or shore line from the plane-table surveys. By this means the sounding parties are enabled to determine the true position of their soundings, by measuring the angles subtended between stations previously established upon the shore. [*Swift, p.* 36.

NOTE (37.)

Here, then, is the essential difference between a survey by triangulation and astronomical determinations, or even the so called "chronometric survey," (a misnomer, by the way, for it is not a *survey*.) One consists in a *connected* work, carried on upon the earth's surface, and made by means of an uninterrupted series of triangles; while the other is composed of a collection of observations upon the celestial bodies, made at detached points, each place of observation being independent of the other. In the first method the connexion is complete, while in the others there is no connexion whatever. [*Swift, p.* 34.

NOTE (38.)

"The secondary triangulation east of this has been continued, joining the parts reported upon heretofore, and extending further to Block island, and over the shores of Rhode Island and onwards, grounding upon the eastern side of the main triangulation, made for its guide. In a similar

manner, the secondary triangles south in New Jersey have been properly multiplied between the sea shore and the Delaware, and extending southerly to the neighborhood of Philadelphia, grounding upon the lines of the main triangulation, laid out for that purpose, between Neversink and the neighborhood of Springfield mountain, which had already been a station point of my triangulation in 1817. (1837–'38, Doc. 14, page 3, vol. 2.

"The extension of the secondary triangulation over New Jersey, between the Raritan bay, the Delaware, and the sea shore, 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 were carried in advance of the main triangulation, with the view at the same time to explore for the main triangulation the most favorable points," &c.—1839–'40. Doc. 20, p. 4, vol. 2.

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 further 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.

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.—1840–'41, Doc. 14, page 3, vol. 1.

"South of Neversink, the secondary triangulation has been carried," &c. "in advance of the main triangulation," [see details, p. 56—gives no sketches.]—1836–'37, page 56, vol. 1, doc. 13.

In the work of the survey of the coast, the *secondary* triangulation now encompasses the southern part of the State of New Jersey, from Staten island to Cape May; one series of triangles was carried around on the east or coast side, while a second was carried down the Delaware river and bay, uniting near the southern point of the State. The length of the side of the triangle which was common to both series was, of course, determined by each chain of triangles—one by the coast, and the other by the Delaware bay; the difference between the two determinations was two metres, or about six feet.* In the primary triangles this difference will, from present appearances, be less than one foot.† [*Swift, p.* 34.

19. Question. What objection is there to publishing the details and mathematical elements of the work, as completed, from Point Judith to New York harbor?

Answer. The main triangulation has not been completed so far as Point Judith, but only the secondary. The main triangulation has been completed only between Friar's Head, opposite New Haven, and Mount Carmel, in Connecticut, eastwardly, and Mount Holly, New Jersey; and Yards, (Newton township, near Philadelphia,) southwestwardly. Th secondary triangulation has been completed from Point Judith to Cape

* N. B. This is the difference of two triangulations, not of triangulation and actual measurement.—(See note 19)—A.

† How is this ascertained?—A.

Henlopen on the coast, and from New York across to the head of the Chesapeake. [*Hassler, p.* 5.

40. Question. Why is not the main triangulation up with the secondary?

Answer. On account of the difficulty of finding suitable elevations on both sides of the Delaware.

41. Question. Who conducts the main triangulation?

Answer. I myself, according to positive stipulation.

42. Question. Why is not the main triangulation carried as far eastward as the secondary?

Answer. Because it was not needed.

43. Question. When will it be needed?

Answer. So soon as the junction is made with the base line on the Chesapeake.

44. Question. When that junction is made, do you propose to suspend the work south, and go back east, or to have two parties?

Answer. When the junction is made, while the secondary triangulation goes on south, I shall continue the primary triangulation east.

[*Hassler, p.* 7.

(Note 39.)

Upon the question of limitation of the works for the survey of the coast.

1. The limitation to any determined distance from the coast would require that the mountains, which are indispensably necessary for the station points of the survey, be within that limited distance.

2. This is well known not to be the fact; therefore, also, the limitation not adapted to the nature of the country; hence this limitation would become impossible to be observed, if even decreed.

3. If even smaller elevations were found within these limits, which, it might be said, are fit to substitute instead of the greater ones, it would be improper to use them otherwise than so as they are used now, namely: for secondary triangles and the plane-table operations.

4. These smaller elevations, from their too great proximity to each other, would occasion triangles by far too small to give the accuracy required for the connexion of the work.

5. The multiplication of the triangles would evidently also require a much greater length of time to execute them, because every one of them would require as much time and trouble as one of the large triangles, which might cover six or twelve of these small ones.

6. With this increasing of the operations, the necessity of cutting through woods, &c., increases actually in still greater proportion than the triangles themselves, and these cuttings are one of the great difficulties of the work.

7. Such smaller triangles are even much more tedious to make properly than the large ones; therefore, they consume each more time, and, of necessity, retard the work, by limiting the greater strides which the freedom of the work at present admits. The improper increase of the expenses is self-evident. [*Hassler, p.* 53.

Note (39 bis.)

To guard against the errors which might accumulate on the last sides of a long trigonometric net, attached to a single base, the whole of the

triangulation of France shall be attached to the bases of Melun, of Perpignan, and of Ensisheim, as well as the three others that shall be measured, &c.—*Memorial du Depot de la Guerre*, vol. 1, p. 29.

The extremities of the new arc were at Mallörn and Pahtawara. The distance was found to be 92,778 toises, and the difference of the latitudes 1° 37′ 20.3″; whence 1° = 57,196 toises. This agrees much better than the result of Maupertuis (57,422 toises) with other measures; but the difference which implies an error of 12″ in the latitude of Kittis, as determined by the French academicians, has not been satisfactorily accounted for; so that there is still some doubt about the length of a degree in that latitude.—*Encyclopædia Britannica*, vol. 9, p. 550.

NOTE (40.)

5. Question. Are you acquainted with hydrographical surveys in England?

Answer. Yes.

6. Question. Do they publish results as soon as ascertained?

Answer. They are published in sheets so soon as completed, to be useful to navigation.

7. Question. Can copies or information be obtained by individuals?

Answer. Yes; I have known copies to be obtained repeatedly for my brother, who is a chart seller; as from the Thunder and from the Blossom.

8. Question. Does the hydrographical office in England derive any profit from the sale of the charts?

Answer. I think £200 or £300 per annum. The charts are published under the direction of the Admiralty, with the seal of the Admiralty to authenticate them.

9. Question. Have you applied at any time, as an individual, to the hydrographic office?

Answer. Captain Beaufort offered to give me personally any information I desired. This was when I was a private individual, before being connected with the survey. [*Blunt, p.* 22.

6. Question. Have you, in the examination of Delaware bay, discovered any great errors in the supposed location of any shoals?

Answer. Yes; very great.

7. Question. In what cases?

Answer. In that of Cross ledge, especially; but there is no proper chart of Delaware bay; the only one extant is a mere rude sketch. The error in the case of Cross ledge was four miles, I think.

8. Question. Is it not important that these errors should immediately be made known, and a correct chart of the bay published?

Answer. Yes, undoubtedly.

9. Question. Do you know of any reason for withholding from the public a knowledge of the soundings of Delaware bay, as far as verified by you?

Answer. I know of none. [*Blake, p.* 41.

110. Question. Have the grossest errors in the position of places, stated in one of your reports to have been ascertained by you during the survey, been pointed out by you, for public information?

Answer. They have not yet been made public, but will be when the works relating to those places are published. [*Hassler, p.* 11

19. Question. Did you sound the new channel, commonly called Gedney's channel?

Answer. Yes.

20. Question. Would you have been able, with the ordinary facilities for sounding, to ascertain that channel, without the previous triangulation of the coast?

Answer. Yes; I could have buoyed it out so far as to make it equally useful to navigation.

21. Question. Is the knowledge of that channel of great importance to the shipping of New York?

Answer. I think it is.

22. Question. Could not a master of a vessel, when employed off the harbor of New York, with such information as a good chart of the harbor would furnish, run his vessel in with tolerable safety by that channel?

Answer. Yes.

23. Question. Do you know any reason why a chart of that channel has not been published?

Answer. I do not know any, unless it be that it was not ready. Mr. Hassler has charge of that; I have not.

24. Question. When did you sound out that channel?

Answer. In 1835. [*Gedney, p.* 39.

11. Question. What is the chief occasion of wrecks on Long Island?

Answer. When vessels are running in, and are caught by a heavy south-easter, it is difficult to get out, from the trending of the two coasts of Long Island and of New Jersey, and the current setting from the New Jersey coast, by reason of which vessels, being thus embayed, are apt to be driven on shore.

12. Question. Have you sounded Jamaica bay?

Answer. Yes, in 1835.

13. Question. What depth of water did you carry into that bay?

Answer. Six feet at low water, eleven and a half at high water, in common tides. At the present time, the depth at low water is seventeen feet.

14. Question. Would not the knowledge of the actual depth of the water in the channel leading into Jamaica bay be useful to a vessel which was unable to claw off the coast?

Answer. Yes; it might preserve a vessel from being stranded.

[*Gedney, p.* 38.

35. Question. Do you know any reason why the soundings taken by you should not be published?

Answer. I do not. [*Gedney, p.* 40.

NOTE (41.)

16. Question. You have exhibited to the committee abstracts of the whole work on the coast, from Point Judith to Cape May; what objection is there to the publication of those abstracts?

Answer. The first objection is, that no base of verification has yet been measured; the second is, that we are uncertain as to the difference in any meridian in this country and any in Europe, to a minute and a half in longitude; and the third is, that we have not yet determined the ellipticity of the earth.

17. Question. Is either of those things necessary to give practical utility to the soundings and distances in particular bays or harbors?

Answer. Perhaps not; but the superintendent will of course take care of his character as a man of science.

18. Question. In your opinion, ought the practical use of the work, by its publication, to mariners, to be deferred indefinitely, for the supposed purpose of allowing the superintendent to take care of his character as a man of science?

Answer. No. [*Ferguson, p.* 15.

28. Question. Have the mathematical elements of the charts of Bridgeport, New Haven, and Newark, been published?

Answer. No; that will come into the general account.

29. Question. When do you propose to publish such a general account?

Answer. So soon as I shall have reached the verification base on the Chesapeake.

30. Question. When do you expect to reach that point?

Answer. In a few years. [*Hassler, p.* 6.

93. Question. Have you determined the latitude and longitude of any points on the coast; and if any, how many and what?

Answer. I have ascertained the latitude and longitude of points on the coast as well as inland, according as the triangle fell.

94. Question. Why have not these important points on the coast, thus determined, been made public?

Answer. The time of the publication is when the general account of triangulation is given, before which it will be of no use. [*Hassler, p.* 10.

31. Question. Will a minute and a half's difference between the European and American meridians show on ordinary maps?

Answer. Yes; it would be about a mile.

32. Question. Why has not this difference, in the course of the ten years since the resumption of the survey, been ascertained?

Answer. I cannot answer that. We have observed eclipses of the sun. We have made no other observations for the longitude.

33. Question. Have the observations thus made been reduced?

Answer. Yes, and calculated. I add, that, if we had considered it a sine qua non to determine the longitude, the time occupied in this way might have retarded the other work.

34. Question. But you have previously said that the want of the determination of this fact was one of the objections to publishing any part of the work.

Answer. I said it was an objection, but I did not mean to be understood as saying that it was an insuperable objection. [*Ferguson, p.* 16.

1. Question. Do you know any sufficient reason why maps and other results of the survey should be withheld from the public knowledge?

Answer. None, when they are in sufficiently complete state to be useful to navigators. [*Blunt, p.* 22.

NOTE (41 bis.)

120. Question. Do you think that, under the most favorable circumstances, and with continuance of a yearly appropriation of $100,000, the survey of the coast can be completed in twenty years?

Answer. Perhaps. The progress is slower at first, and the means increase as the work proceeds. [*Hassler, p.* 12.

Classification of the expenses.

The whole amount expended for the survey of the coast from the *appropriation* therefor, for the year 1841, was $96,174 98.	
1. Of this sum, the general expenses of the work, including the main triangulation, compensation of all persons employed therein, instruments and books, and all expenses not enumerated in the items below, amounted to -	$32,671 09
2. The secondary triangulation, including compensation of persons therein employed, 3 parties - - -	19,352 06
3. The hydrographic surveys, including the cost of repairs of the vessels, boats, &c., and allowances to officers for expenses, 2 parties and 4 vessels - - - -	25,459 16
4. Plane-table or topographical surveys, including compensation of all persons employed therein, 6 parties - -	18,692 67
	96,174 98

[*Swift, p.* 36.

With reference to the appropriation to be proposed to Congress for the coast survey for this session, I take the liberty to suggest the propriety: that it shall be again one hundred thousand dollars, which several of the latter years have proved to be exactly adequate to the proper, and in proportion to its effect, and success in the results, most economical amount of expenditure; though it must be considered that it will have to provide for two spring's outfits of the going into the field of the surveying parties, and that the expenses are of course increased by the whole amount required for the engraving and printing of the map of New York, &c. But on another side, the nature of the field work will, it is hoped, allow some slight reduction in the amount of expenses; and that at the time the appropriation will be made, a small balance of the present appropriation may yet remain disposable.—1842–'3, Doc. 23, p. 5.

NOTE (42.)

B.

Remarks upon the survey of the coast of the United States.

1. The law authorizing the survey of the coast was passed February 10, 1807.

2. Circular letters were addressed by the Treasury Department to various scientific men in the United States, asking for a plan of operations. Thirteen such were received, and submitted to a committee of learned men in Philadelphia, with the late Professor Patterson at their head. After full consideration, the plan proposed by Mr. Hassler was adopted.

3. From the passage of the law until 1811, no active steps were taken, in consequence, principally, of the unsettled state of the country.

4. In August, 1811, Mr. Hassler was sent to England to procure instruments, in accordance with the plan proposed by him in 1807. These instruments had all to be *constructed;* and, for the purpose of superintend-

ing the same, he remained in England until 1815, at which time he returned to the United States, with all the instruments and appendages requisite for the work. The war, want of remittances for payment of the instruments purchased, the difficulty of procuring suitable artists to construct the same, &c., conspired to protract his stay in England nearly two years beyond the time which he had allotted to this part of his labor.

5. In August, 1816, Mr. Hassler was appointed to superintend the survey of the coast, under the law of 1807. The necessary preparations for the work, including reconnoitring, &c., consumed the time between August, 1816, and April, 1817. At that period a proper locality for a base line was discovered in New Jersey, and in July of the same year the actual triangulation was commenced. [*Swift, p.* 30.

11. July 10, 1832, the law of 1807 was revived, and the employment of such "astronomers and other persons" as the President should deem proper was again authorized.

12. At the request of the Treasury Department, Mr. Hassler submitted a plan of operations for the work, being, in fact, the same which he had proposed in 1816. On the 9th August, of same year, he was again appointed to the survey, and to carry into effect the law of July 10. Prior to this period he had been employed by the Treasury Department in making comparisons of the various weights and measures in use at the several custom-houses, with a view to the construction of uniform standards of the same for the Union.

13. The two works, of the coast survey and that of the construction of standard weights and measures, being, by their nature, intimately connected, and the means of accomplishing each being in many instances the same, Mr. Hassler was charged by the Treasury Department with the execution of both; and, since the period referred to, the two works have received his whole attention.

14. Since 1832 the survey of the coast has been diligently prosecuted. The remainder of the season, between August and December of that year, was employed in reconnoitring and other preparations; and early in the following year (1833) the triangulation was recommenced, and has been making steady progress from that time to the present. In 1834 a new base line was measured on Long Island, and the secondary triangulation, hydrographical work, and plane-table surveys, have also been in active progress, *pari passu*. *Swift, p.* 32.

NOTE (43.)

Another addition, particularly useful to navigation, was to obtain a complete series of observations of the variation of the magnetic needle over the whole extent of the coast.

I intended that the magnetic bearings should be observed at all the stations every day, by an assistant, the needle being stationary in one point for that purpose; but during the short time that I worked, the multiplicity of my other occupations, and other circumstances, hindered me from doing more than just to observe it once myself at the close of each station.—*Hassler's Coast Survey, p.* 175.

A second will act as an assistant observer in such observations as require it, observe regularly at stated hours, and, at the time of every observation requiring it, the barometer and thermometer, of which he will keep a reg-

ular journal, make the observations of the magnetic needle, in cases where it is of interest, as in the survey of a sea coast—*Hassler's Coast Survey, p.* 174.

Mr. Hassler says: He made certain observations "last summer" "on the declination of the magnetic needle of one foot length, arranged for inversion, and constructed for this purpose already in 1813;" that he "had intended to carry on constant observations" "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."—1840–'41, Doc. 14, p. 5, vol. 1.

NOTE (44.)

20. Question. What reason is there for concealing from the public the elements of the work between Friar's Head and Mount Holly?

Answer. None.

21. Question. Has it been published?

Answer. No; it is not proper.

22. Question. Why is it not proper?

Answer. Because it will introduce imitations of the work, to the detriment of its validity.

23. Question. Imitations by whom?

Answer. By common chart sellers, or others. [*Hassler, p.* 5.

To 107 and 108: It is *well known* that the finer style of topography is not in practice yet in this country; my duty required, that this part of the execution of the work should be of the best quality, to answer honorably the aim of the work, in its final appearance in the public: therefore I procured, with authorization of the Treasury Department, two men known in Europe already in this line, from the quarter in best renown for the appropriated style of these works, which will guide the style of the work, also with the engravers, to be engaged hereafter. [*Hassler, p.* 61.

To 20, 21, and 22: For concealing. But it would be of no use whatsoever to any body except copyists, who would, by abusing the public property in the work, degrade it. It would be, therefore, an expense not only useless, but very detrimental. It will, besides, all appear in the account referred to in the addition to 19; in fact it would be highly improper to do it, before the publication of the more extensive system, of which it shall form a part in proper time. There is however no concealment about it.

To 23 add: It is the duty of the Government to let no parcelling out be possible, under penalty of seeing the Government's own work ultimately discredited; such a desire cannot be fairly entertained.

To 24 add: This quality of being official is absolutely required to give confidence to the public, therefore security to the navigation, (see question 5, in my report of December last.) [*Hassler, p.* 50.

NOTE (45.)

Delambre and Mechain remeasured the arc of the meridian of Paris, and extended it from Dunkirk to Barcelona, a distance comprehending altogether an arc of about 9 degrees. This work occupied the years 1792, 1793, and 1794; the triangles amounted to 115 in number. Each of the three angles of every triangle was separately observed with a repeating circle.—*Encyclopedia Brit., vol. 9, page 550.*

NOTE (46.)

Mudge's primary stations 1792 = 12.
'93 = 15.
'94 = 6, and base measured.
'95 = 8.
'96 = 17.
'97 = 22.
'98 = 13.
'99 = 26.
1800, '1, '2, '3, '4, 5, 6, '7, 8, '9 = 107.

19) 226 (11.9, nearly 12 per annum.
[*Mudge's Trigonometrical Survey.*

NOTE (47.)

116. Question. You stated in your printed report that you had accomplished more in a shorter time, and at less expense, than had been done in any other work of a similar kind; with what works do you make this comparison?

Answer. The English general survey of England, Ireland, and Scotland; the French survey of the inland and coast of France. [*Hassler, p.* 12.

NOTE (48.)

Times of going to the field work, and returning from it, each year.

In 1832.

September 25. Having received the instruments, I left Washington the 26th September, at 8 o'clock, A. M., to reconnoitre for the continuance of my works of 1817, towards the east of it; returned to Washington the 31st January, 1833, in the evening.

1833.

April 5th. Left Washington for the first beginning of actual primary triangulation; returned to Washington the 3d January, 1834, in the evening.

1834.

After having finished all the preparations and comparisons for the measurement of the base line, I left the 29th May, at 9 o'clock, A. M., having made also stations; returned 21st January, 1835, in the evening.

1835.

There being much calculation to be made, and many arrangements for the organization of the parties, the State of Maryland having offered an arrangement, to join the survey of that State with that of the coast survey, I went out only at different intervals, to reconnoitre the country in Maryland, and until Washington, and the outer bays, accompanied by Mr. J. H. Alexander, of Baltimore, until late in the fall and winter.

1836.

The present office was established. I left 17th August, and returned the 8th January, 1837.

1837.

I left Washington 4th June, and returned 5th January, 1838.

1838.

I left Washington July 19th, and returned 24th December, 1838.

1839.

I left Washington the 9th June, and returned the 5th January, 1840.

1840.

I left Washington the 17th September, 1840, and arrived again at Washington the 20th January, 1841.

1841.

I left Washington 29th August, 1841, and returned 22d December, 1841.

This enumeration shows how the office work has increased since the beginning, when the elements for it were first to be collected in the field. In the progressed state of the work, the calculations, making of projections, to take to the field for the topographic and hydrographic works, their plotting, and working out, &c., require as much, and in most cases even more, work in the office than out of doors, so that indeed the going out for the field work is considered a real relief from the harder and tedious works of the office.

For the time of the going out or returning of the assistants, for their part of the work, they must be called up themselves individually; it is easily comprehended that they depend entirely on the favorable or unfavorable season for the going out as well as for the return.

F. R. HASSLER.

WASHINGTON CITY, *March* 30, 1842. [*Hassler, p.* 12.

[To be annexed to Mr. Ferguson's testimony.]

1833—Buttermilk.
Round.
Bald.
Tashua.
Mount Carmel.
Ruland.
West Hills.
1834—Base measured.
1835—Reconnoissance in Maryland.
1836—West Hills.
1837—Ruland.
East base.
West base.
Harrow.
1838—Weasel.
Springfield.
1839—Beacon Hill.
Disborough.
Stony Hill.
Mount Rose.
Newtown.
Willow Grove.
1840—Willow Grove.*
Mount Holly.
1841—Yard.

[*Ferguson p.* 21.

25. Question. Was any body else engaged in Maryland in 1835?

Answer. Only Mr. Hassler, with Mr. James H. Alexander, as a mere reconnoissance. [*Ferguson, p.* 15.

* The station of Willow Grove was occupied both in 1839 and 1840.

NOTE (49.)

"Only ten years were employed in the actual work; of which the two first, 1816 and 1817, were rendered useless" "by the overthrow of the work in 1818."—Doc. No. 28, page 3, 1841–'42. (See note 51.)

"The results of the coast survey will furnish for the future regular systematic data to ground any detail surveys upon."—Doc. No. 28, page 11, 1841–'42.

NOTE (50.)

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 standard 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 me *a considerable loss of time in travelling about the country*, which I considered far better employed in the manner I did.

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.

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.—(1840–'41, Doc. 14, p. 2, vol. 1.) [*Hassler.*

19. Question. What sum is allowed to Mr. Hassler, annually, for expenses, exclusive of compensation?

Answer. Salary $3,000, and expenses $3,000.

20. Question. For what expenses is this $3,000 designed? Is it for personal expenses?

Answer. I suppose it is the expenses of living.

21. Question. Is he paid for other expenses when he goes into the field?

Answer. He is furnished with an instrument carriage and horses for the instruments and himself, and a baggage wagon besides, for instruments, at the public expense.

22. Question. Is it the same carriage which he is accustomed to use in Washington?

Answer. Yes.

23. Question. Are horses and men paid at the public expense for the carriage and wagon through the year?

Answer. Yes; four horses, one permanent driver, and one other man, who also assists about the office. [*Swift, p. 26.*

NOTE (51.)

Questions of the resolution of Congress of June 24, 1841, relating to the survey of the coast of the United States, with the answers to the same, by F. R. Hassler.

Question 1. "The progress which shall have been made in the survey of the coast."

The works of the survey of the coast cover now upwards of 11,000 square miles, with primary and secondary triangulation, topography, and soundings; from the east end of Rhode Island to the neighborhood of the Chesapeake and Cape May.

This is evidently a great progress for the time that the work has as yet lasted; particularly if it be considered that every thing was to *be created*—even the ability of the assistants, they being at first now in the business. It is actually *much more than has ever been done in any similar work before;* for it must be recorded: that since the first law of 1807, nineteen years were entirely unproductive for the work, by postponement and interruption; five years were used in procuring the necessary instruments, and in preparations, as before that time there was not a single instrument in this country applicable to such a work. Only ten years were employed in the actual work; of which the two first, 1816 and 1817, were rendered useless, and the expenses made became a bill of loss, by the overthrow of the work in 1818; so that the whole work now producible is the result of hardly about eight years actual work.—(Doc. 28, p. 3, 1841–'42.)

Question 19. What objection is there to publishing the details and mathematical elements of the work, as completed, from Point Judith to New York harbor?

Answer. The main triangulation has not been completed so far as Point Judith, but only the secondary. The main triangulation has been completed only between Friar's Head, opposite New Haven, and Mount Carmel, in Connecticut, eastwardly, and Mount Holly, New Jersey, and Yards, (Newton township, near Philadelphia,) southwestwardly. The secondary triangulation has been completed from Point Judith to Cape Henlopen, on the coast, and from New York across to the head of the Chesapeake.

[*Hassler, p. 5.*

NOTE (52.)

To the question of the committee, "How many points were determined in 1833 in the main triangulation, and what distance were they apart; what extent of country did they cover; what number in 1834, 1835, 1836, 1837, 1838, 1839, 1840, and 1841; and what extent of country do they cover?" Mr. Ferguson answers:

That the part of the question *as to the distances "apart"* is answered by giving, in the following schedule, the length of the longest and shortest lines of the survey each year; that it is difficult to divide the works of successive years from each other; and that the computations are given in gross in square statute miles, presuming that the committee merely wished an approximate and comparable estimate.

In 1833, length of longest line, miles	-	41.3	Square miles covered, 1,350
length of shortest line, miles	-	7.2	

In 1834, 1835, and 1836, though other stations were occupied, the primary triangulation did not cover any additional space.			
In 1837, length of longest line, miles - 20.69 length of shortest line, miles - 8.73	Square miles,		318
In 1838, length of longest line, miles - 38.41 length of shortest line, miles - 23.29	Square miles,		300
In 1839, length of longest line, miles - 31.00 length of shortest line, miles - 10.93	Square miles,		1,070
In 1840, length of longest line, miles - 18.51 length of shortest line, miles - 12.30	Square miles,		209
In 1841, length of longest line, miles - 31.02 length of shortest line, miles - 17.07	Square miles,		730
Square miles covered by whole primary triangulation -			3,577

[*Ferguson, p.* 20.

The work of the principal survey will be to form a chain of triangles, with sides of about thirty miles in length, along the whole extent of the coast, so as to join the distant parts by the shortest and most accurate lines possible, and to determine the azimuths of the sides of the triangles, and the latitudes and longitudes of their angular points. Within these, a series of triangles, with sides of about ten miles, will be formed to join them, part of which it will sometimes be possible to carry on simultaneously with the large ones. The object of these will be to furnish an ample number of determined points to which the survey may be referred in all its details.

[*Hassler's Coast Survey, p.* 15.

NOTE (52 bis.)

In the fall, the atmosphere of the low countries, particularly the sea shore, becomes very untransparent, and the time of the day favorable for accurate observations so limited, that it can hardly ever be expected to take a full series of angles consecutively. For instance: from my station at the east end of the verification base, near Gravesend, in December, 1817, the large light-house off Sandy Hook, only about nine miles distant, was never visible a whole hour in the morning or evening; and as soon as the ground was warm in the morning the signal at the west end of the verification base, near five miles off, moved about irregularly, in a circle of about one minute. [*Hassler's Coast Survey, p.* 167.

The sand hills on the low sea shore, and the looming which takes place upon them, would have rendered necessary for these places the construction of a stand of about 24 feet elevation, solid, and firmly attached to the ground, upon which the instrument, with its stand, might be placed.

[*Hassler's Coast Survey, p.* 169.

NOTE (53.)

It is but fair, and perhaps also necessary, to state to the committee that the effect of the primary triangulation, in the progress of the survey, is not properly estimated by the number of square miles within the polygon which it makes, but by the quantity of secondary triangulation for which it afford

ed the bases. In this view of the subject, the number of square miles covered in each year would be much increased. [*Ferguson, p.* 21.

NOTE (54.)

"The work seems to gain so much in interest and credit, that it must be expected the anxiety of the public to enjoy its results will increase." "With these views, I shall early this winter cause a considerable part of the work to be brought together, to enable me to combine, as early as admissible, plans for the future creditable publication under the authority of Government."—(1837–'38, Doc. 14, p. 5.) [*Hassler.*

NOTE (55.)

33. Question. Does the work on the weights and measures occupy any of your time, which might be appropriated to the survey?

Answer. No. It does not take any of my time.

34. Question. How much of your time is devoted personally to the coast survey?

Answer. All the time, except the inspection and reporting on the weights and measures.

35. Question. How much time does it take to inspect and report upon the weights and measures?

Answer. About half an hour in the morning and half an hour in the afternoon of the day, but not of each day. This is only while I am in the office. I am generally in the field from the middle of May to that of December; sometimes I am in the field to the end of December.

36. Question. At what time in the spring do the different corps start on their duties?

Answer. Generally in April, remaining until the middle or end of November.

37. Question. Did you lose part of a year last year; and if so, why?

Answer. I lost the most of last year's work, in order to answer the resolution of the House of Representatives on the coast survey of June 24, 1841, and by the fever which seized me in October.

38. Question. At what time did you take the field last year, and how much of your time did the resolution occupy?

Answer. I did not take the field until the middle of September. The resolution occupied me three or four weeks. I was also detained to make a report on weights and measures. [*Hassler, p.* 6.

NOTE (56.)

15. Question. Is the main triangulation in arrears of the secondary; and if so, why?

Answer. It is. I am not aware of the reason, except the illness of Mr. Hassler, and his inability to do it, caused thereby.

16. Question. Cannot that work be performed by one of his assistants

Answer. Yes.

17. Question. How long has Mr. Hassler been so ill as not to be able t attend to that work?

Answer. It was in October of last year that he became ill. He was also ill the preceding year, in September.

18. Question. What prevented his taking the field and performing the work in the spring and summer of those two years?

Answer. I am unable to say. [*Swift. p.* 26.

NOTE (57.)

20. My age dates from 6th October, 1770. It is with life or age, like with all other things, it lasts the longer and remains the longer effectif, the better it is used and husbanded. [*Hassler's pamphlet 10th January*, 1842.

NOTE (58.)

And I dare to assert, with full confidence, that never so much actually valuable work was obtained in the same space of time, and for the same proportional amount of money, in any other survey whatsoever. (1834–'35, vol. 1, page 380, Doc. 2.) [*Hassler.*

45. Question. Cannot the main triangulation be carried on except under your immediate personal supervision?

Answer. Not in the present state of things.

46. Question. Why not?

Answer. Because there is no body to do it, and the circumstances are contrary.

47. Question. Is there nobody else attached to the survey who can do it?

Answer. Not now.

48. Question. What are the contrary circumstances spoken of?

Answer. Want of money; that is, of a larger appropriation.

49. Question. Must the main triangulation be suspended eastward until you can take it up personally?

Answer. In the present state of things, yes. [*Hassler, p.* 7.

NOTE (58 bis.)

In two campaigns at sea, with M. De la Bretonniere, he [Mechain] traced the description of 100 places on the coast, from Nieuport to St. Malo. [*Biographie Universelle, vol.* 28, *p.* 49.]

The survey of the coast, before alluded to, has, since the last annual report, been transferred to the charge of the Navy Department, with which it seems to be more intimately and appropriately connected. With this survey, the situation and utility of the present light-houses, already being 199 in number, besides 29 light-boats, and the necessity for others from time to time, would seem to be in some degree fully associated. As a measure likely to lead to economy, in not extending the establishment of light-houses beyond the real wants of the country, and in fixing their exact locality, so important to the safety of our navigation and navy, it is respectfully recommended that, in the survey now in progress, Congress should require the latitude and longitude of every light-house to be carefully ascertained and published—the importance of its position to be inquired into, and that no new one be hereafter erected till a report is made in respect to its public benefits by the two collectors, and the commander of the navy yard nearest the proposed site.—(*Rep. of Hon. L. Woodbury, Secretary of the Treasury*—Doc. No. 3, 1834–'35, vol. 1, page 20.)

NOTE (59.)

6. Question by Mr. Aycrigg. You refer in your report (Doc. No. 28) to a number of volumes in which the work is contained; is the work in those volumes reduced?

Answer. They are reduced.

7. Question by Mr. Mallory. Where are these papers kept?

Answer. In my office.

8. Question by same. Are they safe from fire?

Answer. Yes. [*Hassler, p. 3.*

13. Question by same. Suppose the house should be burnt, and papers destroyed, would not Government sustain great loss?

Answer. Yes; but I conceive the house completely safe, proper measures being taken to guard against fire. The houses have been slated with this view. For better security, the roofs have been slated; and, in general, every arrangement made for convenience and security. [*Hassler, p. 4.*

7. In every one of the three buildings, which connect all through with one another, two persons at least sleep; these are assistants, clerk, workmen, and I myself, so that the buildings are well watched all night.

8. The maps and many other valuable objects, are placed so that even in the extreme case of fire, they would be saved with the greatest ease. [*Hassler, p. 44.*

9. Question. In whose possession are those facts and *data* at this time?

Answer. They are at the office in Washington, so far as completed, and except so far as parts of the work now in progress are in the hands of the assistants.

10. Question. Are there duplicates of the observations, measurements, and other unpublished elements of the survey?

Answer. There are of parts, but I think not of the whole.

11. Question. Are the elements of the base line, and of other primary and essential parts of the work, in such form and situation as to be secure from loss by fire or otherwise, and be capable of being handed over to and understood by any competent successor of Mr. Hassler?

Answer. All this is in duplicate in the office, accessible to the assistants, and susceptible of being understood and used by them. No part of this has been published except the final result of the base measurement. The details have not been published. The papers are subject to the hazard of fire; but not more so, and perhaps less, than in some other buildings in Washington.

12. Question. Is there any objection to depositing one of the duplicates in each case in the safes of the Treasury Department?

Answer. No.

13. Question. Would not this be proper, to guard against accidents?

Answer. It certainly would add to the security. [*Swift, p. 25.*

39. Question. Where are the results of the work, so far as completed, now kept?

Answer. In the depot of the survey, at Washington.

40. Question. Are they in duplicate?

Answer. Some; not all. The primary triangulation is all in duplicate. Of the secondary, mine is not. As to the rest, I do not know.

41. Question. Of that which is in duplicate, are both parts kept at the depot?

Answer. Yes.

42. Question. Several of the public buildings at Washington have from time to time been destroyed by fire; is the depot a fire-proof building?

Answer. No; it is not.

43. Question. If the results and other matters in the depot should be destroyed by fire, must not the work be done over again?

Answer. Yes. Precautions have been taken to enable the speedy removal of the papers, if the building take fire, by their being in cases on the ground floor.

44. Question. Of the work in duplicate, why is not one copy deposited for safe keeping in the Treasury Department?

Answer. I do not know.

45. Question. Is all the work in such a state that, if Mr. Hassler should die suddenly, it may be used, and reduced or calculated immediately by others?

Answer. Yes. [*Ferguson, p.* 16.

NOTE (60.)

"Every time that a certain systematically full part of the work between two base lines and two astronomic stations will be executed, a full report will be made," "until that time, they (the documents and data) *must remain* in the office in which they originate." [*Hassler p.* 45.

17. In a general point of view it must be here observed, that improper advantage might be taken of such communications, if printed as documents of Congress, to transform them into a disgraceful plagiarism of our work, which would forestall the public patronage in an undue and unmerited manner, to the great detriment of the proper future publications, which will, undoubtedly, be made by the Government, whose positive property the results of the coast survey are. In proper time, I should take the liberty to propose a properly calculated and adequate plan to make such publications in that creditable manner, which alone can prevent disgrace. Even the granting of extracts from our work, for the advantage of special localities, must be done with precaution. (Doc. 13, p. 58, vol. 1, 1836–'37.)

NOTE (61.)

24. Question. How is the survey injured by individuals publishing charts copied from those of the survey?

Answer. Because the maps would not be official.

25. Question. Would not the publication of the data with the maps enable scientific men to judge of the accuracy of the work?

Answer. Of course.

26. Question. Would not the withholding of the data until the completion of the survey enable the operator to force results?

Answer. No; in the manner in which the work is carried on it cannot be.

27. Question. Can scientific men judge of the accuracy of the work unless the mathematical elements of it be published?

Answer. No. [*Hassler, p.* 6.

(NOTE 62.)

Delambre, in his biography of his associate, Mechain, says that he was "one of the two astronomers appointed to determine the terrestrial and celestial differences between the parrallels of Dunkirk and Barcelona." Mechain made a mystery of the discrepancy that he found; refused, for a long time, to communicate his registers; exhibited an invincible repugnance to showing his observation; was oppressed by "melancholy, of which they were far from divining the true cause;" "full of the idea of returning to Spain; communicated to the bureau his project of extending the meridians to the Balearic islands." "*His idea was approved.*" *They wished to send another* astronomer. "To their great astonishment, the bureau listened to Mechain, who claimed the ownership of this project with the greatest earnestness, who asserted that no one knew the means of succeeding as well as himself," &c. He guards his manuscripts with the greatest care. He becomes sick. "In his delirium, he demands, at each moment, his manuscripts, with anxiety." He dies. "His manuscripts are brought to us; his secret is known by the very means that he adopted to deprive us most certainly of the knowledge." "We there see the observation of Barcelona, and the the three seconds in which it differed from Mountjouy. His whole conduct is explained to us, and we see with regret that so trifling a cause" "had poisoned his last years and hastened his end."

[*Biographie Universelle, vol.* 28.

What was the nature of the work on which Mechain was engaged? Precisely the same as the main triangulation in the coast survey. The object was different, but the work was the same.

NOTE (63.)

A certain, systematic, and constant form must be observed in them. They must be written with such regularity and perspicuity, that any man, with the proper theoretical knowledge, could execute the calculations, though he might have been unconnected with the work itself.—*Hassler's Coast Survey, p.* 171.

If assistance enough could be had, it would be proper always to make two fair copies from the first journal, kept under the direction of the observer.—*Hassler's Coast Survey, p.* 171.

The general orders for conducting the French triangulation, contained in volume 6, Memorial du Depot de la Guerre, contain the following:

Page 11. "In order to avoid the loss of the registers, which would be prejudicial to this great operation, and to be able to guaranty the authenticity of the geodetical and astronomical observations; perfect and certified copies of all these observations, as well as of all measures that shall have been taken, shall be sent from the stations themselves to the director of the Depot of War, to be there deposited and registered among the geodetical archives."

Page 12. The engineer shall preserve carefully his "notes during his stay in the field, and send them in on his return."

Page 16. "The engineers of the Cadastre shall keep a fair copy of their registers of observation and of the results of their calculations, and shall send to Paris the originals or notes, certified on each page."

Page 17. "In fine, after the verification of the large dimensions on the

ground," (of the details,) "it shall be addressed, together with the canevas and the trigonometrical register, to the administration of the Cadastre. This, having taken all the means to assure itself of the accuracy of the pieces, shall send them to the Depot of War."

Page 32. Order similar to that at page 11, except requiring the name of the assistant also. This is a repetition of the regulation.

NOTE (64.)

9. Question by same. Are there any duplicates of these papers?

Answer. Some; of the greater part.

10. Question by same. Of what papers are there duplicates?

Answer. Of all, except the last year's work.

11. Question by Mr. Aycrigg. Is the Government in possession of any of the data, or are they in your possession?

Answer. They are in the office—a house rented by the Treasury Department—and under the care of persons in the employment of Government.

12. Question by Mr. Mallory. Whom do you mean when you say "persons in the employment of Government?"

Answer. Myself and my assistants. [*Hassler, p.* 3.

9. Question. In whose possession are those facts and *data* at this time?

Answer. They are at the office in Washington, so far as completed, and except so far as parts of the work now in progress are in the hands of the assistants. [*Swift, p.* 25.

113. Question. What reason is there why all the *data* must remain in your office?

Answer. Because they are in daily use there. [*Hassler, p.* 12.

9. The whole of the coast survey work must, in all cases, and at all times, be of the easiest access, nay, present, during the whole time that the work is going on, still more so than in any other office such may be required. [*Hassler, p.* 44.

25. Question. Would not the publication of the data with the maps enable scientific men to judge of the accuracy of the work?

Answer. Of course.

26. Question. Would not the withholding of the data until the completion of the survey enable the operator to force results?

Answer. No; in the manner in which the work is carried on it cannot be.

27. Question. Can scientific men judge of the accuracy of the work unless the mathematical elements of it be published?

Answer. No. [*Hassler, p.* 6.

7. Question. Has the work of mensuration and triangulation connected with the maps of Bridgeport, New Haven, and Newark, been published with them?

Answer. No.

8. Question. Has any part of the mensuration of the survey, and of the other scientific elements of the work, been published?

Answer. No.

9. Question. Has any systematically full part of the work between two base lines and two astronomical stations been completed as yet?

Answer. No; the locality of the coast hitherto surveyed has not permitted it. [*Hassler, p.* 4.

13. Every time that a certain systematically full part of the work, between two base lines, and two astronomical stations, will be executed, a full report will be made, and it is hoped published by Congress, which will rest that part forever, and then the documents of that part may be placed into some specially selected place of deposite, as original record, but until that time they *must remain* in the office in which they originate. [*Hassler, p.* 45.

WASHINGTON CITY, *March* 23, 1842.

SIR: Among the questions put to me in the committee's meeting, there was one, at least, which appeared much insisted upon, and by circumstances was rather discussed than answered.

It seemed to put in doubt the propriety of the journals, and other works of the coast survey, to remain in the coast survey office, and requesting them to be delivered to the Treasury Department for safety. I will here supply more distinct answers.

1. This office here is one of the offices of the Treasury Department, exactly as much as any of the rooms in the Treasury building itself.

2. The extension of the Treasury Department works has obliged to have a number of other offices out of the yet unfinished Treasury building proper, so is this office. [*Hassler, p.* 44.

14. It would be the most effective mode of clearing up any subject whatsoever, that may be desired, and come in question, if the committee would be so kind to come over to the office, which is so near the Capitol, and visit all the parts of the work, as they are in activity, and constantly in evidence for every visiter.

F. R. HASSLER.

Hon. F. MALLORY. [*Hassler, p.* 45.

NOTE (65.)

92. Question. Of the points of latitude and longitude thus determined, how many have been made public?

Answer. None; because it is not yet the proper time. [*Hassler, p.* 10.

29. Question. When do you propose to publish such a general account?

Answer. So soon as I shall have reached the verification base on the Chesapeake.

30. Question. When do you expect to reach that point?

Answer. In a few years. [*Hassler, p.* 6.

4. Question. Is there any objection to the publication of definite and successive parts of the work as they may be completed, as the map of New York now in the engraver's hands?

Answer. No, not in the least, so soon as the engraving is finished. [*Hassler, p.* 4.

To 4 add: It is necessary on the part of the Government to take proper measures to give, with the publication, guaranty to the public, for the authenticity of all that is published. (See answer to question 5 in my report of December, 1841.) [*Hassler, p.* 48.

"For there can, by nature, not be any control upon any observation intrusted to an assistant, or over the assistance rendered in an observation, except the moral strength of confidence." 1834–'35, *Doc. No.* 2, *p.* 374; *Hassler.*

NOTE (66.)

14. Question by same. Have any other maps or charts been published, besides those of New Haven, Newark, and Bridgeport?

Answer. No other. [*Hassler, p.* 4.

1. Question. Have any maps been prepared and completed, so as to be ready for publication, other than the three published; and if so, what?

Answer. Yes: 1. A complete map of New York harbor is engraving. 2 A partial map of the entrance of New York has been prepared and delivered to the Auditor for the light-house bureau. 3. One of the Thames river, in Connecticut, nearly ready for delivery, on order of the Secretary. 4. One for the Topographical bureau, for the site of fortifications of the entrance of New York harbor, at Sandy Hook. 5. One of the north shore of Long Island sound, at New London, called for by the Secretary of the Treasury. The four last named were prepared for the offices.

2. Question. Is either of the eight maps above named so far correct and complete in itself as to be of any utility in and for the localities to which it applies?

Answer. To be sure; each is complete, and of use in itself.

[*Hassler, p.* 4.

NOTE (67.)

48. Question. There is shown by you a published chart of Newark bay, purporting to be an extract from the United States coast survey; is there any meridian on the map? (Annexed, and marked B.)

Answer. No.

49. Question. Is the latitude or longitude of any part of it given?

Answer. No.

50. Question. What is the length of Newark bay, as stated in this map, from Shuter's island to the confluence of the Passaic and Hackensack rivers?

Answer. It is, by the scale of the map, five miles and eighty-two-hundredths. But the scale is an erroneous one, and was not published or verified by the superintendent. The actual distance between the two points specified is five miles and six hundred and twenty-three thousandths, obtained by me by measuring on the original topographical map.

51. Question. Please to inspect the map of Newark bay, which is now shown to you, marked C.

Answer. Itappears to be the same map, engraved from the same plate as B; but the scale is different, and is at the same time erroneous. It seems to be written $\frac{1}{20000}$ instead of $\frac{1}{10000}$, or erroneous in the proportion of 2 to 1, or about that. [*Ferguson, p.* 17.

To the question of the committee, "What is the distance between Shuter's island and the point at the confluence of the Passaic and Hackensack rivers, and what the mean width of the bay of Newark?" Mr. Ferguson answers:

That the distance between the above points is 5.623 statute miles, and the mean width of the bay of Newark 1.37 mile.

That on a map of the said bay, printed at the request of the collector of Newark, the distance between Shuter's island and the point between the Hackensack and Passaic is 5.82 statute miles; but that this map has an erroneous scale attached to it, and was not published or verified by the

superintendent of the survey. The map appears conformable to the original of the survey, but the scale given for it is incorrect. [*Ferguson, p.* 20.

NOTE (68.)

NEWARK, *April* 18, 1842.

DEAR SIR: Your letter of the 16th I received this morning. I am not in possession of any map of Newark bay furnished from the coast survey. A short time after that survey was completed, I addressed the Secretary of the Treasury, requesting such a copy, for reasons then mentioned; he referred my letter to Mr. Hassler, who replied, that the coast survey being a public work and property, such extracts should not be given except upon call of Congress; and such work being under his charge and responsibility, he should be called upon by the proper Department, &c. I very much regretted that it could not be furnished, as our vessels were subject to repeated accidents and delays, by reason of the shoals, which could have been avoided by such information. I presume that Mr. H. would be willing to facilitate any mode you may take to procure such extract, as he expressed himself to me.

I am, dear sir, very respectfully, your obedient servant,

ARCHER GIFFORD.

Hon. JOHN. B. AYCRIGG. (*P.* 21.)

NOTE (69.)

The following is the history of these maps, or of the original and copies:

By reference to House Journal 25th Cong., 3d session, p. 400, it will be seen that, on the 28th January, 1839, Mr. Aycrigg submitted the following resolution: "That the Secretary of the Treasury be directed to furnish this House with a report and extract from the coast survey, containing Newark bay, in the State of New Jersey, and the bars in its vicinity."

January 30, 1839, the Secretary of the Treasury writes to Mr. Hassler: (N. B. This letter is found among the documents of the Department, from which this copy was obtained:) "I enclose, herewith, a copy of a resolution of the House of Representatives of the 28th instant, calling upon this Department to 'furnish the House with a report and extract from the coast survey, containing Newark bay, in the State of New Jersey, and the bars in the vicinity.' I will thank you to have the information called for prepared and reported to me as soon as may be practicable."

February 11, 1840, the Secretary of the Treasury says: "I have the honor to transmit, herewith, a chart prepared by the superintendent of said work."—(House Doc. No. 182, p. 1, 3d sess. 25th Congress.)

February 9, 1839, (same page,) Mr. Hassler says to the Secretary: "Herewith I have the honor to forward to you the chart of Newark bay, extracts from the coast survey work called for by a resolution of Congress, and your letter relating to the same. I join also a copy of the printed report made upon that subject by Lieutenant Gedney, at the time of handing in the first copy of this map." (N. B. This first copy is on file, but was never published, and has nothing to do with the present question.)

The following relates to it:

NOTE (69 bis.)

December 30, Mr. Gillet, from the Committee on Commerce, reported the following resolution, which was laid on the table one day under the rule, viz :

Resolved, That the Secretary of the Treasury be directed to communicate to this House a survey of the bar and obstructions to the navigation of the Passaic river below the city of Newark, in the State of New Jersey, made by Lieutenant Commandant Gedney, together with his plan and estimate for the removal of the obstructions to the navigation of said river. (House Journal 2d sess. 24th Cong., p. 149.)

January 3, 1837. The resolution reported by Mr. Gillet, from the Committee on Commerce, in relation to the navigation of Passaic river, was agreed to by the House. (House Journal 2d sess. 24th Cong., p. 162.)

Mr. Hassler to the Secretary of the Treasury, 26th January, 1837, says: "According to the request of your letter of the 14th instant, an extract from the works of the survey of the coast of the part near Newark, New-Jersey, has been made, and is herewith presented to your Department, by Lieutenant Gedney, of the navy." (1836–'37, Doc. No. 110, vol. 3, p. 1.)

NOTE (70.)

MONDAY, *May* 30, 1842.

Present: Mr. Mallory, Mr. Aycrigg.

Mr. W. J. Stone's examination.

1. Question. Map marked exhibit C being shown, witness is asked if he recollects the map.

Answer. Yes.

2. Question. Who engraved the map?

Answer. I did.

3. Question. Is that an exact copy of the original sent to you from the House of Representatives?

Answer. It is.

4. Question. How long did it take you to engrave and print this map?

Answer. In from seven to ten days it was fully executed and delivered to the House.

5. Question. With what person connected with the coast survey did you communicate at the time you engraved this map?

Answer. Mr. Hassler. I called on him, and had a conversation on the subject.

6. Question. Exhibit B being shown and examined, he is asked if that is an impression from the same plate.

Answer. Yes.

7. Question. Will you please to examine exhibit B, and see if there is any difference between this and exhibit C?

Answer. The only difference that I can perceive is, that another scale has been put in the place of the one engraved by myself, which was copied from the original.

8. Question. In what manner was that alteration made?

Answer. By cutting out the engraved scale and inserting one with the pen. The engraved scale on exhibit C is 3 inches to the mile; while the scale inserted with the pen is $\frac{1}{10000}$th, being, in fact, 6 inches to the mile, instead of 3.

9. Question. Have you the original extract sent to you from the office of the coast survey?

Answer. I have. (P. 41.)

*6. Question. Please to look at the map hereto annexed, and marked A. William J. Stone, and state whether it is the original map sent from the House to you, and from which you engraved the map of Newark bay, as mentioned in the first part of your testimony.

Answer. It is.

7. Question. What is the scale on that manuscript map?

Answer. Of three inches to the mile, as on the map I engraved. (P. 41.)

NOTE (70 bis.)

The scale on the copperplate copy, and the map itself, are both shorter than the original, but in the same proportion as the original. This is neither an error of the engraver, nor can it be avoided. The difference arises from the shrinking of the paper about one per cent. (as it appears) on drying, after the impression is taken. All that is necessary is that the scale shall be in *proportion* to the map.—A.

NOTE (71.)

COAST SURVEY OF THE UNITED STATES.

1. In the last discussion upon the appropriations, it has pleased Mr. Aycrigg, and one more of the members of a committee of five Representatives in Congress, to throw out the broadcast accusation, that I was mentally and physically incompetent to that task which I have now performed for ten years, with full approbation and even praise, on the part of the men of science of Europe and of this country.

2. This statement was made, not only without producing any proof, but also in full contradiction to abundant facts, and without producing the report which the committee is bound to make to Congress with the documents in support, namely: the examination of myself and assistants upon the coast survey, and my report asked by the very member upon my works for the establishment of uniform standards of weights and measures for the United States.

3. As it is impossible that an assembly of the representatives of a whole nation should possibly be guided by mere empty words without any proof, it appears not necessary to go into an actual refutation of an assertion, the nullity of which can be well dismissed, and will be proved, by Congress calling for the examinations, &c., quoted under 2d. So much the rather, as luckily my well known state of mental and physical capacity cannot possibly depend upon the decision of a committee of Congress, and are now in full good state, as they have been observed by the gentlemen who have favored the coast survey office with their visit.

4. I will, therefore, limit myself here to two statements made under the denomination of facts, but which are related in a manner completely different from what they actually are.

5. The wrong scale upon a map of Newark bay, by Lieutenant Commandant Gedney. This fact stands thus:

6. When Lieutenant Gedney was sounding Newark bay, he communicated uncautiously, without any communication with me, and against the regular order of the work, a chart of his soundings, to some persons pressing him for it. When informed of it, I had to call him to the regular order of the work, that nothing should be delivered unknown to me, and without orders previously obtained from the Treasury Department; this to get caused some delay, while local contending interests in Newark were impatient. This Mr. Aycrigg reproached to me, in the committee, that he had so long to ask for it. When the whole summer's work was brought in the bureau, Lieutenant Gedney had a map made as desired, and more extensive, under his direction, wherein the fraction of the scale was mistaken, which map *was never exhibited to me until at the time of the committee*, when he complained to me *that such a great crime was made to him out of an accidental miswriting* of a fraction by one of his subaltern officers. I believe he then told me that the error was corrected; I properly remonstrated with him that this accusation was the reward for his hurrying a work with unreasonable impatience, and without any communication with me. Mr. Aycrigg, who takes up this subject as an accusation against me, is *completely aware of every particular*, as Lieutenant Gedney explained it all to himself, he can therefore not be otherwise but perfectly aware that he does me a wilful injustice.—[*Hassler's Pamphlet, December* 23, 1842.

NOTE (71 bis.)

The following extracts will show his peculiarities as an individual. They have been collected from the documents, while examining them for more important information. They are given, not because they show the peculiarities of Mr. Hassler as an individual, but as indicating the disposition of one who has long held one of the most important offices in the country, and who, by some unaccountable means, has produced on the minds of many the impression, not only that he is identified with the coast survey, which must cease, of necessity, if he be detached from it, but, also, that he is peculiarly fitted for the station.

The House will be able to judge whether these extracts indicate the cool, deliberate, common sense that is required in conducting an extensive operation like that intrusted to Mr. Hassler.

His disputes with the Secretary of the Treasury are not introduced to show that he desired more pay, but for the other matters that the extracts contain. (72)

In 1836, it will be seen that the President had called the "attention of Congress to the entire subject of the coast survey, as well as the weights and measures, including future as well as past compensation, and the *general supervision of their future progress.*"

In 1837, the Secretary of the Treasury (Hon. Levi Woodbury) writes a plain business communication, such as his duty required of him as a public officer. But, because he does not immediately accede to all of Mr

Hassler's demands, he is answered in such style that we might have imagined Mr. Hassler would have been immediately dismissed for disrespect to his superior. (73)

We find an "Enumeration of sacrifices which I made for the coast survey"—1836–'7, vol. 1, Doc. 13, pages 21, 22, 23, 24.

A lecture on republican government, next article.

Next article repeats his demands for higher pay, July 30, 1836.

Next article is a communication from the Secretary of the Treasury, August 2, 1836, in which he says: "But, in closing this communication, I feel bound, in frankness, to apprize you that the President will, on his return, be requested to excuse the head of this Department from the further supervision of the subject of the coast survey, and to devolve the care of it again either on the Navy Department or some board of officers with ample powers and greater leisure to supervise a work so important in itself, and so fruitful in difficulties and embarrassments." P. 40.

Page 42, Mr. H. says he cannot go out until he gets arrearages paid up, and $6,000 for future.

Page 44, Mr. Woodbury answers: "If you are not able or willing to proceed with the survey in the manner suggested, and on the terms above stated, until Congress can act on the whole subject of compensation, it is desirable the Department should be apprized of it at the earliest convenient day."

Page 46, Mr. Hassler says: "It is a curious phenomenon, that while from all the better-informed public, both of Europe and of this country equally, I receive almost daily testimonials of the interest and value put in the work in which I am engaged," &c., "the public Department under which it stands should refuse every proper means, and propose every means of destruction." Again: "Difficulties never subdued me in my life, though I can affirm that I have subdued difficulties. My means are moral and intellectual; that is, stronger than money, or money considerations."

From Mr. Hassler's remarks in relation to one of the questions put to him by the committee, (74) it appears that he draws a very broad line of distinction between the industry required of the "hirelings *by the hours*," who must do their full day's work for their dollar or fifty cents, while it is a disgrace to the scientific man, who receives his ten or his twenty dollars per day from the public Treasury, to inquire whether he does a reasonable amount of work, or whether he receives a high salary without returning an equivalent.

The conclusion drawn by Mr. Hassler is not very evident. (75)

He appears to have his own peculiar modes of doing almost every thing; whether they are *better* than the plans pursued by others, (76) we have no means of judging, unless he will inform the scientific world what his peculiar forms are.

(77) On reading this remark, we would hardly imagine that the article contained in note (19) came from the same individual, showing that nearly the whole of Europe had been triangulated.

The chairman of the committee, in consequence of the desire of Mr. Stone, the engraver, to see the chart, before he could give an estimate of the expense of engraving, (79) gave him a note to Mr. Hassler. The peculiar reception of Mr. Stone is described by himself. (80) The appended

letter was next sent in; (81) and on the next page we have a reference to the same matter. (82)

And, again, we have Mr. Hassler's remarks on the same subject, in his circular, (over his own name,) sent to the members. (83) The fact mentioned by himself, that Mr. Stone "measured it with a two-foot rule," shows that his "examination" referred entirely to the expense of engraving.

We need hardly stop to inquire whether a man of Mr. Stone's well-known abilities as an engraver, would, under any *ordinary* circumstances, allow that he could not put on copper all that Mr. Hassler can put on paper. (84)

Still Mr. Hassler asserts that his office is the same as the Treasury office, and his work open to inspection. (64) Would his superior, the Secretary of the Treasury, meet a note from the chairman of a regular committee of the House of Representatives in this manner?

Mr. Hassler reads us several extra lectures on the impropriety of our conduct. (85)

It appears, also, that Mr. Hassler finds great difficulty in agreeing with the persons respecting his operations on their land. (86) The appended note will show that "they do these things better in France." (87.)

NOTE (72.)

"This amount [$1,500 for expenses] does but scantily cover the halt of the difference between the life of a stationary home and that which I have to lead in that work, which is, of course, what is to be compensated by this allowance." [1835–6, vol. 1, Doc. 2, p. 384, *Hassler's report.*

"In consequence of a difference of views existing between the President and the superintendent, (Mr. F. R. Hassler,) in regard to an allowance of arrearages of pay claimed by him for himself and assistants, as also for an increased rate of compensation for the future, this Department was directed to bring the subject to the notice of Congress," &c. "Congress having adjourned without taking any legislative action in the matter," &c., "consequently he [the President] has, in his annual message, invited the attention of Congress to the entire subject of the coast survey, as well as of the weights and measures, including future as well as past compensations, and the general supervision of their future progress."

[1836–'37, vol. 1, Doc. 13, p. 1, *Sec. Treas.*

NOTE (73.)

Read the whole of Mr. Hassler's letter to the Secretary of the Treasury, 1836–'37, vol. 1, Doc. 13, April 30, 1836. The extracts would be too voluminous; but he complains that the Secretary refuses to propose an alteration in the amount of his extra pay for expenses, unless vouchers are produced, or the opinions of persons acquainted with such expenses are given, and calls it "inquisitorial," "as novel as it would be unbearable by any man," and hopes that the "summer's campaign may not be crippled, like the former ones have been, by difficulties which hitherto it has been the unfortunate habit to throw in the way of the work every spring."

NOTE (74.)

"5th. I was asked how many hours the assistants worked per day; I answered, as many as the day allows, (*the work cannot be made in office hours.*) This addition, I believe, has been omitted to be written down; in fact, all my assistants, like I, work from interest for the work, and not as *hirelings by the hours*, it would be a disgrace to treat the actors in a scientific work with such illiberality." [*Hassler, p.* 63.

NOTE (75.)

"Without the constant attendance to my works, at any hours that can be used for them, my task would be positively inexecutable; this is evidently the state of the establishment, and the works produced." [*Hassler, p.* 50.

NOTE (76.)

"The calculation of the triangles in my work gives in ultimate result the latitude and longitude of each point of the triangle, primary and secondary, according to my special form [corrected page 60, '*formula*'] for the work." [*Hassler, p.* 10.

"Upon the station of Weasel mountain, all the means for astronomical determinations and azimuths were united, and a regular system of these observations executed with its appropriated combinations, upon peculiar methods which I made and prescribed, and which succeeded to satisfaction." [*Hassler, p.* 49.

NOTE (77.)

"It is very natural that in this, like in every other subject of science or knowledge, the acquirements and improvements are gradual; they develop themselves as the occasion for them is given, and with a considerable and proportional consummation of time. So much so, that even in Europe this branch of science is not so much spread, as it is pretended to be, already in this country, where it has never yet been employed at all, for the detached small surveys, made so abundantly, do not come at all in comparison, nor under the principles of science, which is absolutely required for such an extensive work as the coast survey, especially in the form and in the locality of the earth in which it lies." [*Hassler, p.* 52.

NOTE (78.)

95. Question. Did the French, in the triangulation of their country, use mixed geodetical and astronomical observations?

Answer. Not in the form in which I have stated in the first part of my written explanation. [*Hassler, p.* 10.

26. Question. Has there been any difficulty in procuring suitable points for observation as far as the main triangulation has proceeded?

Answer. Yes; since we entered the valley of the Delaware.

27. Question. Where first?

Answer. At Mount Rose, near Princeton, in New Jersey; some in opening the line from Newtown; then at Willow Grove and at Stony Hill;

some difficulty in connecting Mount Holly with the point below; a good deal at Yards. These obstructions could not have occupied more than five months. [*Hassler, p.* 15.

66. Question. How long before the survey will reach Cape Hatteras?

Answer. It is impossible to say—it is too vague a guess.

67. Question. Have you any personal knowledge of the location of the Southern coast?

Answer. I have never been any further south than Norfolk.

68. Question. You have said that it was difficult to find suitable elevation on both sides of the Delaware, which cause prevented the main triangulation from keeping up with the secondary, (No. 40:) how do you propose to obviate similar difficulties on the flat coast of the South?

Answer. By care and assiduity, and by the methods used on the Jersey sea coast.

69. Question. Is that work on the Jersey sea coast a primary or a secondary triangulation?

Answer. It is secondary triangulation.

70. Question. What is the peculiarity of the methods used on the Jersey sea coast, where there is a deficiency of natural elevations?

Answer. By adapting the triangulation to any locality which may be found favorable.

71. Question. You do not specify any of the means you propose to recur to at the South, in the absence of natural elevations. Do you decline to state what they are?

Answer. No.

72. Question. What are they, then?

Answer. By mixed astronomical and geodetical observations.

73. Question. Why were not such means used to overcome the impediments to the completion of the main triangulation on the Delaware?

Answer. Because they would not apply with propriety. There are better means.

74. Question. What are those better means?

Answer. By meeting those localities by triangulation from the south side of the locality.

75. Question. You say that the peculiar methods by which you propose to overcome the difficulties on the Southern coast are mixed astronomical and geodetical observations; are not such the general means used every where in the survey?

Answer. The means of both are different in the two cases.

Hassler, pp. 8, 9.

WASHINGTON CITY, *March* 30, 1842.

I must add a more detailed answer to that question which asked me "How I would proceed in the Southern coast, where marshes, woods, &c., presented peculiar impediments?" I answered to it: "By mixed astronomical and geodetical observations." This question was followed by that: "Is that not more or less the case with all the coast survey?"

This question showed that the nature of the scientific principles to be applied and indicated by my answer were unknown. I must therefore *explain*: what is called, in mathematical practice, MIXED astronomical and geodetical observations, is, when both these elements concur in the *same individual determination*; this is the case in the application of a problem of

practical mathematics, which I have applied in Switzerland and in this country, on Weasel mountain, (to the full knowledge of my assistants,) to obtain the junctions of my works of 1817 with those of 1833, in the beginning, when I had not yet a new base line nor sufficient angles; it was equally successful in both cases.

It consists in "one goedetic line being given in position and length, the latitude of either point being known, the latitude and the angle, the line subtends from a third point, being observed, together with the azimuth of either end point, to determine the place of observation." From such a result new connexions are then opened further onwards; other similar problems may be made.

This is what I was beginning to express when I was stopped, under the denomination of entering into arguments, which Mr. Cushing refused to hear.

That I should expose it from its elementary principles, is what I am sure the committee cannot intend, because it is a problem which, joining both branches of science, would require long deductions of principles, almost an elementary work, for persons not acquainted with the science.

In triangulation, the two kinds of observations, astronomical and geodetical, are *disconnected;* each operation is *separate*, and they are only compared to draw conclusions upon one another, for a new, different result, required to place the survey in general to its proper place upon earth; therefore the astronomical parts are only made at a few properly selected places, and with *general views* for the work, *not* for *details*, like in the other case, as I have stated in my answer to question 5, article 3d, of my report of December 2, 1841.

F. R. HASSLER.

73. Question. On what part of the coast, North or South, can the work be carried on most easily?

Answer. At the North, by reason of the nature of the coast.

[*Ferguson*, p. 19.

"The direction in which the first extension of the work was, by preference, to be made," &c., was "that I might be enabled to present, at as early period as possible, an actually executed full scheme and example of the work. For these views the continuation of the work eastwardly, over Connecticut and Long Island, presented, evidently, advantages over that southerly, through Jersey," &c. [*Hassler's Report, May* 17, 1834-'35, *vol.* 1, *p.* 367.

NOTE (79.)

13. Question. How long will it take to engrave the map of the harbor of New York, and what will it cost?

Answer. I cannot answer without examining the chart.

The chairman then gave Mr. Stone a note to Mr. Hassler, of the following tenor, as near as remembered, viz: requesting Mr. Hassler to permit Mr. Stone to examine the manuscript chart of the harbor of New York.

The committee then adjourned. [*Stone, page* 42.

NOTE (80.)

15. Question. Did you, as requested by the committee, call on Mr. Hassler, and present the note of the chairman?

Answer. I did.

16. Question. What occurred?

Answer. The interview was so disagreeable, that I would rather not describe it, unless it be insisted on by the committee.

The chairman therefore propounded to the committee the following question: Shall Mr. Stone be required to state what occurred in his interview with Mr. Hassler? and it was determined in the affirmative—Mr. Mallory, Mr. Aycrigg, and Mr. Cushing, present, and voting.

The question being again propounded to Mr. Stone, he answered as follows:

I went to Mr. Hassler's office, and knocked at the door. A servant showed me into his room, and asked me to sit down, and in a minute or two Mr. Hassler came in. I then handed him Mr. Mallory's letter. Mr. H. read it, and immediately fell into a violent rage, and swore that I should not see the map, neither should the committee have it. After much rudeness and violent language, both towards the committee and me, Mr. Farley came in, and Mr. H. handed him the letter. After some further conversation, Lieutenant Page came in, and Mr. H. showed him the letter, and further conversation ensued. At length Mr. H. permitted me to examine the map, which I did; and on my departure, he handed me a letter for the chairman of the committee, which I delivered to Mr. Aycrigg. This letter is annexed, and marked C, F. Mallory. [*Stone, page* 43.

NOTE (81.)

WASHINGTON, *May* 30, 1842.

SIR: The unprovoked *insult* offered to me, by sending the engraver Stone to me to inspect the work of the coast survey in the map of New York, is too much, as well for the powers of the committee, as for the feelings of an honest man.

You know that the maps of the coast survey cannot be engraved but in the office under my own inspection. You know that the map in question is already cut up in plates, two of which are under the engraver's hands, nearly finished; two others just beginning; for two more the drawing is nearly finished; and two more are half finished drawings.

You know that the engraver Stone is in no way qualified to do such work, nor that I could be made responsible for any of his doings.

Hence you cannot otherwise but conclude that the measure you begin is destructive to the work, therefore to the execution and expenses hitherto incurred, therefore directly opposite to the aim professed by the committee to favor the coast survey work.

No man can expect that I, who am answerable for the work, could be compelled to give the final execution in the hands of a man in whom I have not the slightest reason to have any confidence whatever.

I consider the sending of Stone to *inspect my work, as he said first, as an unmerited insult*, and I am certain that every member of the committee, placed in my situation, would consider it so.

With best respects and good wishes, your obedient servant,

F. R. HASSLER.

Hon. FRANCIS MALLORY,
Chairman of the Committee on the Coast Survey.

[*Page* 47.

NOTE (82.)

I suppose Mr. Stone will have made his report upon his *examination* of the manuscript map of New York, for which he has been sent to me in the name of the committee. [*Hassler, page* 48.

NOTE (83.)

12. The letter of Mr. Mallory, requesting me to give the map of New York to Mr. Stone, *to examine*, (please consult Johnson's dictionary for the real meaning of this word)—an operation which would require, of course, a good mathematician, conversant with the principles and practice of the works of the coast survey; I felt very hard to be subjected to the *examination* of a man whom I know incompetent for that task. I even told him directly "you are not capable to put this map upon copper;" he immediately answered "I know that very well."

THE MAP WAS, HOWEVER, SHOWN TO HIM IMMEDIATELY, in presence of several assistants, and he measured it with a two-foot rule, as if to order the coffin for it of proper size. Those of my assistants who were present at the time, were as much displeased with the circumstance as myself, and I found it necessary to state on that occasion, a limit which I had hoped would not be stepped over; Stone himself felt that he had overstepped his limits. [*Hassler.*

NOTE (84.)

4. Question. Is there any difficulty in procuring competent map engravers in the United States?

Answer. None.

5. Question. Do you know of any special superiority of German engravers over those of the United States?

Answer. No; I consider the American workmen better, cleaner, and more rapid. [*Stone, page* 42.

NOTE (85.)

To 37 and 38 add: These are sufficiently explained as for the fact, but it must be added here, that the speaking disreputably and inimically against the coast survey work in Congress, occasions ignorant men in the country, who read these things, to lay impediments in the way of the work, and to ill-treat us, which is a great loss to the work, and its economy. [*Hassler, page* 50.

21. The attempt to find causes for change in my arrangement, by the resolution of the last Congress session, and the present committee, has already caused a great damage. [*Hassler, page* 55.

To 94 to 98, inclusive: These answers I consider as self-evident, and entirely of the domain of the science, in one respect, and of the decision of the Goverment in another; I have said upon it what was to be said by me, in its proper place, in my report of last December. If the work is not carried on, with all the means that science dictates for its execution, *it is worse than useless, and discreditable.* I consider myself always bound to such a course, as I have hitherto pursued, and have found myself al-

ways approved in this view, by those men *best able* to judge, and by those in the *proper stations to decide upon it.* [*Hassler, page* 61.

To 120 add: But the constant persecution to which the work has been exposed, and especially *now is*, impede its progress very much; there is a damage now incurred by the propositions of the last Congress session, and the present investigations, which have been occasioned by it, of positively upwards of $50,000, in delay of the work, and accessories; besides the discouragement occasioned by it, in all those persons who are engaged in the work, by their seeing their liberal exertions rewarded by *throwing out suspicions* against them, these occasion a still greater damage. The discredit thrown out in the public occasions impediments with the people in the country, with whom we come in contact, they consider themselves equally authorized to ill-treat us, which makes the work difficult, and increases the expenses beyond reason, to no good purpose, and subject to uncertainty. [*P.* 64.] F. R. HASSLER.

NOTE (86.).

To 50 and 51 add: It must be remarked upon these articles that, the putting me in jail at Mount Holly by a warrant of Judge Dayton, of Trenton, given upon the oath of a *clergyman* of the name of Brown, who *swore* his damage was over $200, because I had refused to pay, at first presentation, instantly, a bill presented to me by a, so called, Judge Haywood, for $25 damages, because I found it overrated and asked an impartial estimate, to legitimate me to direct the payment to be made, (the accounting officer being absent;) that such a circumstance, I say, I considered as neither *decent* nor agreeable; such acts go to the direct overthrow of the work, the court concern following; it cost both sides useless, but I had to stand the disagreement, and the Treasury Department had to defend the suit, which awarded the *reverend* Mr. Brown with difficulty, as a highest extreme, the $25 claimed, most of the jury voting first for $10, $15, or $20, instead of the hundredth which he had *sworn to.* It was necessary to stand this legal transaction in self-defence—the documents upon it can be exhibited.

At Yards the same impudence is now repeated, damages asked of more than double the value, and impudent letters written upon it, &c.

Such things not only cost money, but have a tendency to give apprehensions upon the safety of our station points, and signals, to the great annoyance of the work.

To 52 add: We have been obliged to make a special agreement with the owner of the land of the station next after Yards, to avoid difficulties if possible, by a contract for the use of the land for three years.

[*Hassler, page* 51.

NOTE (87.)

"We recommend to the engineers the greatest reserve in the means to be employed to unmask the signals. If it shall become indispensable to trim or cut down certain trees, they should at first propose to treat with the proprietors by mutual agreement, and to offer to them a suitable indemnity; in case of difficulty they should refer to the local administration, and even, if it be necessary, to the superior authorities." (General orders for the con-

duct of the French triangulation, from "Memorial du Depot de la Guerre," vol. 6, page 21.)

NOTE (SS.)

4. Question. What proportion of instruments have you had made or repaired at the office in Washington?

Answer. I have seldom had any sextants or glasses repaired there; but a large part of the drawing instruments have been made there, to the value or cost of say $500 at any private establishment, that is, during the whole time I have been in the survey. [*Blake, page* 40.

For expenses of the instrument maker's shop, including the compensation of the persons employed therein, and the cost of tools and materials purchased for same - - $2,318 11

For compensation and expenses of the persons employed in engraving the chart of the harbor of New York - - 2,011 14

[*Swift, page* 28.

18. Question. What amount of work or repairs have you had done in the office here to instruments?

Answer. Nothing but the mounting of one telescope, which came from Europe without a stand. I have had no difficulty in obtaining repairs elsewhere, if needed.

19. Question. Should you think it necessary to have a mechanician with you in the field?

Answer. To measure the base line it might be desirable; not otherwise. [*Blunt, page* 23.

57. Question. Where are the instruments used by you repaired?

Answer. At different places, but generally at the office of the survey here.

58. Question. Have you had any difficulty in procuring repairs at other places?

Answer. I have scarcely ever had occasion for repairs; I should think not exceeding five dollars in amount since 1833, when I entered the survey. All my instruments are of European manufacture. They are good instruments. [*Ferguson, page* 18.

108. Question. Cannot American engravers put on copper all map engraving which can be put on paper?

Answer. No. [*Hassler, page* 11.

15. Question. What amount of repairs of instruments have you had done at the office of the coast survey?

Answer. I cannot say.

16. Question. Have you had other repairs done elsewhere; and if so, by whom, and to what amount?

Answer. I have had repairs done for our, or my, party, the last year, to the amount of forty or fifty dollars, by Mr. Montandon, and by George Blunt, of New York, it having been convenient to have this done on the spot there. [*Gedney, page* 38.

102. Question. How many plates are now in the hands of the engraver?

Answer. Of actual copperplates, two.

103. Question. Do these contain the whole map you are now getting ready for publication?

Answer. No; the map of New York harbor will cover eight such plates.

104. Question. Why are not more preparing for publication?

Answer. They are in work; in a few days we can cut off a few more.

105. Question. How many engravers have you in employ?

Answer. Two; I would have more if I had the money.

106. Question. How long have these two been employed, and at what salary?

Answer. Since last January or December; one at $1,800, and the other at $1,300, per annum.

107. Question. Where did you procure the copper for the above engraving, and where the engravers?

Answer. The copperplates used were procured from Keim, in Philadelphia; the engravers from Hamburg, because they were the best, and best recommended. [*Hassler*, *p.* 11.

A copperplate printing press has also been procured, which has been employed hitherto, and will, also, for some time yet be employed, for the necessary intermediate proof sheets, by which the gradual progress of the work is successively tried and directed, with some improvements which will be added to it, it will then also serve for the ultimate execution of the final printing of the plates.

These operations require just as much the constant attention, and the eye of the superintendent, as any other parts of the works of the survey itself, therefore the whole must necessarily be carried on in the office of the coast survey itself, by an appropriated establishment.

Proper time, care, and an adequate portion of the appropriation, must of course be devoted to it, and much attention and time is required to procure the various materials, as copperplates, paper, and others, of that superior quality, which can alone be considered as satisfactory for a work of the character which the coast survey shall, also in its outwards appearance, present to the public. [1842–'43, *Doc. No. 23*, *p.* 3.

When, in 1832, the coast survey began again, it was found necessary that an establishment should be in it: to enable to keep the instruments required in it, always in good repair, not only, but also to construct entirely new ones; for this a dividing engine was evidently required, as the necessity to recur to any mechanician, not habituated to the wants of the coast survey work, would never give results appropriated to our use, and keep the work itself back by delays, which would be out of our control, and very costly.

Therefore the acquisition of such an engine was immediately authorized by the President, and in consequence it was ordered immediately, and upon my plan of the modified construction, which I have just described.

Mr. Troughton, and Mr. Simms, whom he had in the mean time associated with himself, received the order to that effect; but Mr. Troughton died before the engine was finished, and it ultimately arrived here in the course of last summer, after a delay, which affords again a proof: that, when a work is to be done, requiring mathematical accuracy to a high degree, and to an honorable useful result, the time to be consumed for it, can impossibly be limited, as little as the extreme care and assiduity.

The engine is unique in its kind in this country, and of great value even for the general progress of the art of the mechanicians in this country, besides the services the coast survey will derive from it.

[1842–'43, *Doc. No. 23*, *p.* 4.

Since then, the works for the balances intended for the State Governments, have principally occupied the mechanical part of the establishment, the final adjustment of the dry capacity measures, of half bushels, will, as I have stated there, be begun as soon as the season will be favorable for it, their mechanical execution is complete.

[1842–'43, *Doc. No.* 23, *p.* 5.

NOTE (89.)

23. Question. Can good copper for engraving be procured in this country?
Answer. Yes.
24. Question. Have you had any practice as an engraver?
Answer. Yes.
25. Question. Can impressions be taken from a plate in an unfinished state, to show the progress of the work?
Answer. Yes.
26. Question. Can impressions be taken from the plates now engraving in the survey?
Answer. Yes, without injury to them.
27. Question. How long will it take to furnish the eight plates of the harbor of New York, with the present force, at the rate it now goes on?
Answer. I cannot state by conjecture. I should think about three years.
28. Question. Is it not possible to have the work done accurately and more rapidly than at present, if more hands were put on the work?
Answer. Yes. [*Blunt, page* 23.

NOTE (90.)

The works of the coast survey have, since my report of 2d December of last year, continued in all the different branches, with steadiness and assiduity, the same as has always been habitual, on the part of every one engaged in the work, notwithstanding the difficulties arising from the nature of the ground, and other causes, which have required increased attention, and from the intermittent fevers, which have more or less attacked every party of the work at different times. This latter difficulty being local, and well known to increase in proportion as the work proceeds southerly, will, in a year or two, oblige to change the time of the year to be used for the field works, approaching it always nearer to the winter season; this will, however, make but a slight difference in the general organization of the work, the nature of the changes that may arise from this, or any other accessary circumstances belonging to the detail administration of the work, are so much less to be detailed here, as they are only prospective, therefore, as yet, undeterminable.

The present organization of the work, being the same as since many years, is of course fully known; the grounds of it have been deduced in my numerous former propositions for the work, and the series of my yearly reports; it would therefore not be proper to dwell here again upon it.

The tasks executed by the last summer's works in the field, are as follows:

For the main triangulation: the extension of a more general scheme of larger triangles southerly on both sides of the Delaware, over those that

have been made with the view to topographical and hydrographical use, and which forms their final element and union.

For the secondary triangulation: to extend preliminary triangles over the upper part of the Chesapeake, which will lead also to the discovery of a proper locality for measuring the second principal base line, and to complete the triangles about both sides of Delaware bay, establish those up to the neighborhood of the head of the tide waters of the Delaware river, about above Philadelphia, &c.

The plane-table parties have filled up the greatest part of the ground now intended to be surveyed on both sides of the Delaware, and in other parts of New Jersey.

One of the naval parties has continued the soundings in the Delaware, parallel with the works of the topographical parties on its shores; the other has been extending the soundings out of sight of land, in the quadrangle, which is formed between the coast and the parallels and longitudes of Block island and Cape Henlopen, forming the outer approaches of both the New York harbor and the Delaware bay.

This investigation was carried out till to the Gulf stream, and in soundings till 650 fathoms depth, keeping samples of the nature of the bottom below. The officer operating in this work, expressed his full satisfaction with the methods indicated to him, the means he was provided with for that purpose, and the results obtained.

The consideration of the peculiarity of these works can alone make them appreciate, the nature of the ground over which they extend, the marshes abounding on both shores of the river, and the great multitude, and variability of the channels, shoals, and other impediments, which the Delaware presents, multiply in an equal proportion, the works and the difficulties of them, thence the necessary care, assiduity, and exertions, for both the topographical and the naval parties in that part of the work.

It was of interest to find out the exact place, where the observations of the transit of Venus over the Sun, was observed in 1769, at what was then called Cape Henlopen; therefore, on my visit to that neighborhood, I made proper inquiry, and was very kindly shown the place by the oldest inhabitant of Lewiston, Mr. Rodney, formerly Senator for the State of Delaware in Congress, who recollected it, from his having been at the tents of the observers at the time, when he was about five years old.

This place was, therefore, determined by the topographical party operating in the neighborhood, and the results for the astronomical position of the place, will become comparable with that, which will result in time from the present survey.

In a great part of the early season the weather was very much averse to the works; the fine weather in the fall, though favorable for the works, requiring no distant views, was far less so to the works of the main triangulation than its appearance would have led to expect; the constant dense fogs, particularly over the Delaware, which the greatest number of the large triangle sides, now in operation, are crossing, caused considerable loss of time. (Total description of the year's work.)—1842–'43, Doc. No. 23, pp. 1, 2, and 3.

NOTE (91.)

To 111 and 112: The principles of my action in this respect, are fully exposed already in my printed papers upon the coast survey, quoted before. The reduction, to any other measure, consists only in the addition of a constant logarithm, as for instance, that for the yards, and even for the miles, is given in my printed logarithmic and trigonometric tables. As all the scales of the maps are expressed by their fractional value, the distance upon the maps can be ascertained in any measure whatsoever, and by that means is really given in any measure whatsoever, which is widely different from the *bad method* so many miles to the inch, which has no regular comparable proportion. [*Hassler, p.* 63.

NOTE (92.)

111. Question. Are the measures in the survey taken in French metres? If so, why?

Answer. Yes, because it is the only absolute standard; but the results are given in yards and metres both.

112. Question. In what parts of yards?

Answer. In decimal parts only. [*Hassler, p.* 12.

65. Question. How are your distances measured?

Answer. In French metres. It is not the standard of the country, but it is the standard best authenticated, and best known in geodetic operations. Our standard is the English yard. The foot is the most common measure used in this country, both for scientific and practical purposes.

66. Question. Is the metre in common use in this country in any way?

Answer. No.

67. Question. Is it not as easy to convert yard measure into metres as metre measure into yards?

Answer. It is the same thing.

68. Question. In that case, what benefit is there in having the work of the survey in metres?

Answer. None but what I have given before.

69. Question. What is the standard used in the English survey?

Answer. Either the English yard or foot. [*Ferguson, p.* 18.

NOTE (93.)

The answers to questions 69 till 74 must have been highly instructive for the committee, as they offer much field for speculation without bottom. The discussion upon the Newark bay map, requested so minutely from Mr. Ferguson, shows evidently a high degree of research upon mathematical accuracy, and similar subjects, which exceeds itself again, when it comes to determine the square miles covered by triangles who have but three corners, as well explained at the end of the article. [*Hassler's critique on the examination by the committee, dated January*, 1843, *p.* 9.

The following information respecting the wearing of the coast at Cape May has been received from Colonel T. Jones Yorke, the present member of this House from New Jersey.

NOTE (94.)

HOUSE OF REPRESENTATIVES U. S.,
Washington City, D. C., February 15, 1843.

DEAR SIR: In answer to your inquiries, "of the effect of the wash of the ocean on the main land at Cape Island," I now enclose you a copy of the record kept at the Atlantic Hotel and Congress Hall, upon the island. The Atlantic Hotel was built in 1804, and you will observe the record shows the annual wear, with few exceptions. The whole amount, however, is shown for twenty-six years, which is 334 feet, being an average of $12\frac{30}{100}$ feet annually—(the house was then moved.)

In the years 1831 to 1834, inclusive, there was no record.

From 1835 to 1843, the measurement has been made from Congress Hall, (on a different site,) and embraces eight years: whole amount, 76 feet—making an average of $9\frac{25}{100}$ feet annually.

The whole amount of wash is 410 feet in 34 years, averaging $10\frac{78}{100}$ feet per year.

If the years 1831 to 1834 were included, it would make the total greater, but perhaps would vary the average very little, if any.

I am informed that the wash has changed within the last two years, and has cut off the *point* formed by the ocean and the Delaware bay; and is now working into the bay, and cutting away the main land upon which the light-house stands, (which is about one-half of a mile within the bay;) and, further, that the beach is making above the light-house.

I hope these answers will be satisfactory; if not, I shall be pleased to give any further information in my knowledge.

Very truly, &c.
T. JONES YORKE.

Hon. JOHN B. AYCRIGG,
House of Reps. United States.

Effect of the wash of the Atlantic ocean upon the main land at Cape Island, ascertained by measurement, of which a record has been kept.

Atlantic Hotel.				Congress Hall.				
Year.	Distance from the beach.	Wash.	Average.	Year.	Distance from the beach.	Wash.	Average.	Total wash.
	Feet.	Feet.	Feet.		Feet.	Feet.	Feet.	Feet.
1804 -	334			1831 to 1834	No record.			
1805								
1806 -	324	10						
1807 -	294	30		1835 -	540			
1808 -	273	21		1836 -	528	12		
1809 -	267	6		1837 -	526	2		
1810 -	266	1		1838 -	515	11		
1812 -	256	10		1839 to 1843	464	51		
1816 -	225	31						
1817 -	210	15						
1818 -	204	6						
1819 -	186	16				76	$9\frac{28}{100}$	
1820 -	180	8						
1821 -	174	6						
1827 -	64	110						
1830 -	–	64						
26 years -	–	334	$12\frac{30}{100}$	8 years -	–	334	–	410

RECAPITULATION.

Wash opposite Atlantic Hotel, from 1804 to 1830, inclusive, being 26 years - - - - - - - 334 feet.
Wash opposite Congress Hall, from 1835 to 1843, inclusive, being 8 years - - - - - - - 76 "

Total wash for 34 years - - - - 410 "

Average wash - - - - $10\frac{78}{100}$ feet per year.

The documents from which the above extracts are taken, being within reach of all the members of the House, any individual can satisfy himself (by referring to the originals) upon any point on which he may entertain a doubt.

ORIGINAL CONTRACTS

FOR

THE SURVEY OF THE COAST.

ORIGINAL CONTRACTS.

TREASURY DEPARTMENT, *June* 20, 1842.

SIR: I have the honor to transmit the following communication, in answer to the inquiries made in your letter of the 31st ultimo, in behalf of the special committee "on the coast survey."

First. Respecting "the contract between the Government and F. R. Hassler, superintendent of coast survey," of which a copy is asked by the committee, I beg leave respectfully to refer to the accompanying papers, (marked A, B, C, and D,) as containing all the information in possession of the Department, in reference to the engagement of the services and the terms on which Mr. Hassler undertook to perform the work, in the year 1816, and on its revival in 1832.

Second. In reference to the inquiry, "under what authority was Mr. F. R. Hassler employed to make a set of measures for the United States?" I would respectfully refer the committee to the copy of a communication, herewith sent, from Mr. Secretary Ingham, under date of the 30th of April, 1831, (marked C,) by which it appears he was employed by the Treasury Department, with the sanction of the President, to superintend the manufacture of weights and measures for all the custom-houses of the United States.

Third. In regard to the inquiry, "when was the work commenced, and how much has been expended, yearly, from its commencement up to the present time, specifying the sums, to whom paid, and for what purpose?" it is to be remarked, in answer to the first branch of this inquiry, that on the 29th of May, 1830, the Senate of the United States adopted a resolution directing the Secretary of the Treasury "to cause a comparison to be made of the standards of weight and measure now used at the principal custom-houses in the United States, and report to the Senate at the next session of Congress." To comply with the requirements of this resolution, it appears Mr. Secretary Ingham deemed it expedient to engage the services of Mr. Hassler to make the necessary comparisons, as shown by the accompanying copy of his letter to that gentleman, dated 12th June, 1830, (marked B,) and inviting him to come on to Washington to perform that duty. To institute the comparisons mentioned, it became necessary to require the collectors of the principal ports to forward their standards to Washington, which occasioned some unavoidable delay in the commencement of the work. The proper tests and comparisons were accordingly made by Mr. Hassler, and the determined results were submitted to the Senate, in reports from the Department, under dates of the 3d of March, 1831, and 20th June, 1832, which will be found in Senate documents, 2d session of 21st Congress, 2d volume, document 74, and Executive documents, 1st session 22d Congress, volume 6, document 299.

As the results of these comparisons exhibited serious discrepancies between the standards used at the respective ports, the Department gave directions to Mr. Hassler to superintend, in this city, the manufacture of standard weights and measures for all the custom-houses. These directions were given in April, 1831, but, as many arrangements had to be made before the work of fabricating these standards could be properly entered upon, such as the collection of materials and the preparation of re-

quisite machinery, some time elapsed before it went into complete operation. There is no data in the Department by which the precise time when the work was commenced can be fixed.

In reply to so much of the second branch of the inquiry under consideration as relates to the amount "expended yearly, from its commencement," I beg leave to refer to the statement prepared by the Register of the Treasury, and transmitted to the committee on the 15th instant, in compliance with the request of Mr. Aycrigg, a member of the committee.

Fourth. As to the inquiry, "from what source or sources have the funds thus used been derived?" I have to state that the funds have been derived from the accruing revenue, under the authority believed to be given in the 21st section of the general collection act of the 2d of March, 1799, requiring surveyors of the customs, from time to time, and particularly on the first Mondays in January and July, in each year, to examine and try the weights, measures, and other instruments, used in ascertaining the duties on imports, with standards, "to be provided by each collector, at the public expense, for that purpose." The construction given by the Department to this provision of law seems to have been sanctioned by a special committee of the House of Representatives, of which the Hon. Horace Binney, of Pennsylvania, was chairman, as shown by their report, No. 132, vol. 1, second session of the 23d Congress, which closes with the following resolution, which was adopted by the House:

"*Resolved*, That it is highly expedient that the Treasury Department should complete, with as little delay as practicable, the fabrication of standards of weights and measures, for the supply of the different custom-houses of the United States, upon the principles set forth in the reports of the Secretary of the Treasury to the Senate on the 3d of March, 1831, and 20th June, 1832."

Both Houses of Congress subsequently sanctioned the source from which the expenditures were made, by a joint resolution of the 14th June, 1836, directing the Secretary of the Treasury to finish a complete set of all the weights and measures adopted as standards, for the respective States; and by the 7th section of the act "for the support of the military academy," &c., passed the 7th July, 1838, the Secretary of the Treasury is directed to cause to be made, under the superintendence of Mr. Hassler, one standard balance for each State, and, when completed, to be delivered to the respective Governors, for the use of each of the States.

Fifth. In regard to the inquiry, "how many complete sets of weights and measures have been delivered to the Treasury Department, and how have they been disposed of?" I beg leave, in answer, to refer the committee to the statement herewith sent, (marked D,) by which it will be found that two hundred and seven sets of large weights, forty-four sets of ounce weights, and forty-one yard measures, have been delivered by Mr. Hassler to the Department; that, of the former, there have been distributed to custom-houses and States, &c., one hundred and nineteen, of the second twenty-three, and of the latter thirty-four.

Sixth. In respect to the inquiry, "when is it probable the work will be finished?" I would remark, that the Department is not possessed of such information as to enable it to fix any precise time when the work will be finished; but, as it is informed that the capacity measures, and the balance of the ounce weights and yards, have been fabricated, and are now undergoing their final comparison, it is not supposed that much time will elapse

before their final completion. It is understood that the balances designed for the States are also in a state of forwardness. It is deemed proper to observe, in conclusion, that it is not contemplated to furnish the respective custom-houses with balances or ounce weights, they being designed for the respective States alone.

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

W. FORWARD,
Secretary of the Treasury.

Hon. F. MALLORY,
Chairman of Select Committee on Coast Survey.

WASHINGTON, *July* 12, 1816.

SIR: Herewith I have the honor to deliver the more detailed articles of the agreement between the Treasury Department and myself, relative to the survey of the coast, as desired by the letter of the Secretary of the Treasury, under the 5th instant.

You will judge if I have expressed myself clearly upon the subjects under consideration, or not, and dispose, in consequence, as you find most proper.

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

F. R. HASSLER.

——— JONES, Esq.,
Treasury Department, Washington City.

Articles of engagement between the Treasury Department of the United States and F. R. Hassler, relative to the survey of the coast of the United States.

A. Mr. Hassler engages to bestow all his time, labor, and attention, to the work of the survey; as well to make, himself, the principal part of the general large triangulation, and the consequent calculations, as to superintend and direct the establishment of the observatories, and the officers of engineers, or naval officers, who will be engaged under his orders, in the detail parts of the work, and give them proper instructions to that effect, according to the plan proposed by him, under the 15th May, 1816.

B. He will, to that purpose, have the use of such instruments and books of the collection he has procured, or which are yet to be procured, for the use in this work, as he may find necessary for his objects, and give directions relative to those which are to be used by the officers under his direction.

C. He will be provided from the corps of engineers, on his application to the general of said corps, with the following assistance to his own works, or such part of the same as he may deem necessary, according to circumstances, viz:

1. Two officers of engineers, topographical or others.
2. Some cadets of said corps, in number according to the circumstances.
3. Twelve men of said corps, for the most part artificers, with corporal or sergeant.
4. One large baggage wagon, with four horses, or two smaller ones, as he may require, with the necessary drivers to them.

5. Two saddle horses.

6. Tents for the accommodation of himself, the above-mentioned officers, cadets, and men, and the shelter of the instruments.

7. The necessary field utensils, as well for the personal accommodation of the company as for the works occurring, not comprehending Mr. Hassler's private equipment.

D. Under Mr. Hassler's orders, the officer first in rank accompanying him will have the chief command of the above military assistance, and act as treasurer upon the funds, which will be given to said officer to defray all the expenses of a public nature occurring or ordered by Mr. Hassler; and said officer will render account upon these funds to the Treasury Department.

E. The following are to be considered expenses of a public nature, viz:

1. The keeping in order and securing from injury of the instruments belonging to the Government, their stands and boxes, and the fitting them up for use.

2. Such additions to the collection of instruments and books as may be found necessary by Mr. Hassler in the progress of the work, as well to complete the collection from time to time as to furnish a sufficient number of them for the use of the detail surveyors.

3. The construction of the signals and signal lamps, and their attendance and protection

4. The preparations of the stations, for the convenience of observations, and the securing of them for future utility.

5. The transport of the instruments and the baggage of the company.

6. All expenses consequent or relating to the keeping in order and maintenance of the military assistance stated in article E.

7. All expenses for the establishment of the permanent or temporary observatories, to be erected according to Mr. Hassler's plans.

8. The printing of blank formulas of journals and calculations, for the detail surveyors, if such are found advantageous, as it is probable.

F. Mr. Hassler will receive, as compensation for his personal work in the survey, his superintendence and direction of the whole, and all his personal expenses consequent thereof, the sum of five thousand dollars annually, to be paid quarterly, on his drafts upon the Treasury Department, or otherwise.

G. It is understood that the work shall not be carried on in the form of a bureau or office; but that Mr. Hassler himself, as well as the officers under his direction, shall execute such work as devolves upon them, or are ordered to them in the field, by defraying their own personal expenses, and at home in their private quarters. Therefore, no accounts will be admitted upon room hire, fire wood, stationery, or smaller drawing implements, not provided by the collection of the Government. The above-mentioned compensation is to be considered compensating all his personal expenses, in his absence from home, in the work of the survey, and the items here mentioned, required for his personal use in this work, exclusive only of the expenses stated as of a public nature in article E.

H. The appointments to be made in future, to officers undertaking separate parts of the work, will be fixed so as to comprehend the same articles, and to follow the same principles.

I. If, therefore, Mr. Hassler shall at any time require officers to work under his direction in his quarters, it will be at his option, and entirely a

matter of his private arrangement; otherwise, every officer is to be understood to execute his house work in his own quarters.

K. From these regulations are excepted:

1. All expenditures relating to the use of vessels or shipping, for soundings and the nautical part of the survey, for which proper arrangements will be made in time by the Treasury Department, upon propositions to this effect.

2. The clear executed copies of the maps and charts, either general or special, which will be required by the proper authorities, or prepared for publishing; for which proper draughtsmen will be appointed, and paid according to separate arrangements, to be made with men who may have applied to such works with particular success.

3. All expenses and consequences of engraving, printing, publishing, or executing such number of copies of the maps or charts as may be required for this purpose, or desired by the Government, or the officers to whom it may belong.

F. R. HASSLER.

WASHINGTON, *July* 12, 1816.

TREASURY DEPARTMENT, *August* 3, 1816.

SIR: The correspondence and documents relative to your being employed as superintendent of the survey of the coast, under the act of Congress respecting that object, have been submitted to the President, and your services are engaged, on the following terms:

1. The whole of your time, labor, talents, and attention, shall be given to the work, as well in relation to the superintendence of the duties to be performed by military or naval officers and assistants, or by draughtsmen and engineers, as in relation to the parts of the work which are to be executed by yourself.

2. You will be provided with competent assistance of officers and men, from the corps of engineers and from the navy, with tents and field equipage, with baggage wagons and horses; and you will have the free use of the public instruments and books, for the purposes of the survey.

3. The party of officers, men, and assistants, accompanying you, will be ordered to conform to your instructions; and all the incidental expenses of the survey, which are of a public nature, will be defrayed by the Government; but your own personal expenses are to be defrayed by you, whether you are employed at home or abroad.

4. Funds will be placed, from time to time, upon your requisition, in the hands of the chief officer accompanying you, to be disbursed, upon your order, in the payment of the expenses of a public nature, and to be accounted for by him at the Treasury once at least in every three months.

5. You will receive, in full for all your services, a compensation at the rate of $3,000 per annum, and for your personal expenses an allowance at the rate of $2,000 per annum, to commence on the 18th day of June, 1816, and to be paid quarterly at the Treasury, upon your drafts.

6. You will make frequent reports of your progress to this Department, and deposite here all the surveys, drafts, notes, charts, maps, journals, and documents, in any wise belonging to the survey of the coast; and you will return the public instruments and books to such place as shall be directed, when they are no longer required for the business of the survey.

7. If at any time it should be necessary to explain the nature and extent of your employment and engagement, your communications to this Department, and particularly the articles submitted by you on the 12th July, 1816, will be resorted to.

It only remains to repeat the President's solicitude for a successful and speedy execution of the great national work which is thus confided to you, and to assure you of the esteem with which I am, sir, your most obedient servant,

A. J. DALLAS.

Mr. F. R. HASSLER,
[*To the care of Robert Patterson, Esq., Director of the Mint, Phila.*]

Copy certified conformable to the original.

F. R. HASSLER.

Upon the articles of agreement between the Treasury Department of the United States and F. R. Hassler, relative to the survey of the coast of the United States.

1. Mr. Hassler engages to undertake the direction of the survey of the coast of the United States, according to the law to that effect of 1807, and the act to put the same in activity, passed in 1832, as well by performing such of the principal parts of the same as will require his own personal work, as by directing and superintending the work of such officers of the army and navy, and also civil engineers, as will be appointed, upon his recommendation, in the other parts, and the detail surveys, the determination of soundings, and such like.

2. He will, for that purpose, have the use and disposition, for himself or his assistants, of the instruments and all other necessary implements, books, &c., that have been procured in time for that purpose, and such others as will be procured successively for the same use.

3. He will also be provided with the proper means of safe conveyance of these instruments and other objects, either by land or by water, according to the arrangements which he will make at proper times for that purpose.

4. He will receive the assistance of such officers, cadets, midshipmen, or other men of the military or naval service, as will be appointed upon his request, and who will be provided with all their necessary field equipments, &c.

5. All the assistants and men, military, naval, or civil, that will be appointed for this service, will be ordered to conform to his instructions and directions, and, in case of their refusal, he will have the liberty to order them to report for other services, or dismiss them.

6. He will have the sole and free disposition of the carriages or other means of conveyance, and other objects or implements appertaining to the equipments for this work.

7. He will be provided with tents for the instruments and for the accommodation of himself and his assistants, with the necessary tools for preparing stations, placing signals, and the other necessary works for the encampment on the stations, and mending implements, &c., that might be in

need of it, the necessary means for signals, and for the preservation of the stations of the survey.

8. One of the assistants will act as accountant for all public expenses made upon the orders of Mr. Hassler, and will receive from the appropriations made for the survey such sums, at different times, as shall be agreed upon. He will account for them, at stated times, to the Treasury Department, for which service he will receive a compensation.

9. All drawing, plotting, execution of maps, or such like, will be done by the assistants, upon Mr. Hassler's orders, either in their private quarters or in an office, as may be judged best adapted to the case; the office expenses will be paid by the accounting officer, on public account.

10. All the stationery needed in the work, as well for Mr. Hassler as for any of the assistants, will be provided by the accounting officer, at public expense, in the field or at home.

11. Officers or engineers, detailed out by Mr. Hassler for separate works, of detail parts or others, will conform to the instructions which they will receive from him upon their work; they will be furnished with such instruments, implements, and assistance, as he will direct; and their expenses of a public nature will be accounted with the accountant above stated. They will report to Mr. Hassler, as he will direct; for such works they will receive adequate compensation.

12. Mr. Hassler will receive, for compensation of his services, $3,000 per annum, and in lieu of his private personal expenses $2,000 per annum, to be paid together quarterly, upon his draft, bill, or otherwise, unless, in the progress of the work, he should be obliged to make voyages at greater distances, when an allowance, by the way of mileage, will be determined.

13. Mr. Hassler will be provided with an ostensible public paper, stating his employment, and the nature and object of the same, to support him in his actions and transactions in any part of the country he may have to go for the purpose of his work, to serve equally for his assistants and the persons employed under him.

F. R. HASSLER.

WASHINGTON CITY, *August* 6, 1832.

Instruments, implements, and assistance required.

1st. These cannot be very essentially different from what they were in 1817. In the present state of the instruments and their accessories, it will be best to give them under detailed inventory, as stated in its place, to the disposition of the chief of the work, to take the best advantage of them that they will afford, to have them put in as good order as possible, and to allow him to replace the missing accessories as best he can.

2d. The carriage made purposely for the transportation of the principal instruments was sold, but is yet on hand, and can be made serviceable until a new one may be constructed, which would most likely delay too long at present. For the other parts of the transportation it will be easy to get a Jersey wagon, as has been used before.

3d. Horses and harness it will be necessary to purchase—the first strong and sure; the second simple, but strong. The mode of transportation of the instruments by a proper carriage, made of a size exactly to serve as a box

for them, and upon springs and thorough-braces, has been found more secure and economical for this country than the transportation by hand. It admits, therefore, also, to reduce the number of laboring hands for the work of the triangulation.

4th. The whole party in the work must be supplied with the necessary tents for their encampment in the field, and other necessary field equipments, besides axes, pickaxes, spades, and other tools, required for the placing of signals, preparing stations, and keeping every thing in good order. (I have even always such tools with me as are proper for keeping the instruments in good order, and repairing lighter accidental damages.)

5th. It must be observed, that the proper provision and arrangement of the accessories, and even the ease of an observer, are essential elements of accurate observation, as well as attentive and intelligent assistants; both favor the unimpeded and proper progress of the work, and are therefore essentially economical. A defective state of these parts is very detrimental.

6th. It is expected that none of the chronometers will be in a serviceable state; that defect may be supplied by the loan of a second-pendulum clock at West Point, (of Troughton's arrangement,) made expressly for transportation, which is not expected to be in use there; even a circular instrument of Troughton's, which is there, most likely in the same predicament, might be borrowed with advantage for the secondary triangles mentioned in the proper place.

7th. The selection of the assistants, in officers or other able men, must of course belong to the chief of the work, who will recommend them, and they will receive their appointments from the Department, but, if necessary, removed upon the proposition of the chief of the work. For the present first beginning, to execute the part stated for the immediate work, three such persons will only be required, whom I wish to name, besides what accidental help I shall have to call my son in for, on account of his acquaintance with the former work.

8th. The number of laboring men will vary at different times. When the base lines are measured, fifteen to twenty will be required for the simple triangulations, particularly that proposed at present in completion and extension of the triangulation made in 1817. Six or seven may be sufficient, besides the drivers for the carriages and what may be needed for detail triangulations, if they are undertaken simultaneously.

9th. The best manner of getting this part of the assistance in laboring men is to take them from the military, where they may be easily spared from some garrison or other. Their habit and regulation of discipline, and their being placed under the order of an officer, introduces much easier the necessary regularity, and they stand for their conduct under proper regulation.

10th. The pay and maintenance, in every respect, of the officers and men taken from the army and navy, is in all cases to be provided for and paid by the army corps to which they belong, or the navy in general, according to the regulations in which they otherwise stand; so, also, they will receive all their equipments. They must, in general, be considered as coming to this service in the same manner as to any other in their line to which they might be ordered.

F. R. HASSLER.

WASHINGTON CITY, *August* 6, 1832

TREASURY DEPARTMENT, *August* 9, 1832.

SIR: With the President's approbation, you have been appointed to make, under the superintendence of this Department, the survey of the coast of the United States, directed by the acts of the 10th February, 1817, and 10th July, 1832.

The act last mentioned having authorized the employment of other persons as well as those in the land and naval service, such assistants, of either description, as may be necessary in the work, will be provided at your request.

Funds will be placed, from time to time, upon your requisition, in the hands of one of your assistants, to be disbursed for such expenses of a public nature as may be properly chargeable to the appropriation for the survey of the coast, and he will render his accounts, approved by you, quarterly, to the First Auditor.

Those expenses of the persons in the military and naval service employed in the survey, which are chargeable to military and naval appropriations, will be defrayed by the officers of the respective Departments, and accounted for under the direction of those Departments.

You will receive, in full for all your services, a compensation at the rate of $3,000 per annum, and, for all your personal expenses, an allowance at the rate of $1,500 per annum, payable quarterly, to commence on the 2d of August, 1832, you having been employed since that time in the necessary arrangements of the instruments and other preparatory works. It is to be understood, however, that you will still continue your services in the construction of weights and measures for the custom-houses, as far as may be compatible with your duties in the coast survey, without any other compensation than what is allowed for the coast survey.

In all other respects than those indicated by this letter, the terms and nature of your employment will be the same as were fixed by the letter addressed to you by this Department on the 3d of August, 1816.

The plan of operations and methods formerly adopted by you in the coast survey having been approved of, you will recommence and continue the work in conformity with them, including such modifications as are suggested in your report of the 6th instant.

I am, respectfully, your obedient servant,

LOUIS McLANE,
Secretary of the Treasury.

F. R. HASSLER, Esq.

WASHINGTON CITY, *August* 12, 1832.

MOST HONORED SIR: I have the honor to acknowledge the receipt of your favor of the 9th instant, by which you are pleased, with the authorization of the President, to give into my charge and direction the important national work of the survey of the coast of the United States, with a compensation of $3,000 annually for my services, and an annual allowance of $1,500 for my personal expenses, to begin from the 2d instant.

I am too well aware of the great importance of the work, its exigencies and nature, and the magnitude of the task, not to appreciate duly the value of the confidence you place in me by this trust. I shall call up all my exertions to prove these feelings, by conducting the work in a manner as

honorable as permanently useful to the country; for which it presents so valuable means, that I feel highly honored by the occasion thus given to me to contribute my exertions toward such an aim.

The diminution of the allowance for my personal expenses, from what they had been rated at in my first appointment in 1816, is not such that within the limits of such estimations, made beforehand, its effects could be distinctly foreseen; I could only say, that while I was in activity in this work in 1817, my annual expenses in my absence from home amounted to about $2,000. What effect the now somewhat changed prices of things may have in this respect is of course impossible to foretell; therefore this is so much less an objection with me, as in any case I am certain it is not the intention of the Government to put me to pecuniary loss, and that, therefore, in case it should be found appropriate, this part may easily be modified to the exigency of unforeseen circumstances.

I shall also attend to the standarding of weights and measures, in which I have hitherto been engaged. I have taken such arrangements as will enable my assistant in it, Mr. Schmid, to prepare the works to the last stage of their adjustment, which I shall then make myself next winter, after my return from this year's field work in the survey. His acquaintance with the subject, and his practice in that part during his presence in all my former operations, render him fully capable to the task; and his work will abridge mine so as to bring the necessity of my personal attendance within such limits of time as will be compatible with my work in the survey.

With thanks for the honor of your confidence, I remain, with perfect respect and esteem, most honored sir, your most obedient servant,

F. R. HASSLER.

Hon. LOUIS MCLANE,
Secretary of the Treasury of the United States.

ORIGIN AND HISTORY OF THE ATTACK OF MR. CUSHING UPON THE COAST SURVEY, AND OF THE SELECT COMMITTEE OF INVESTIGATION, OR EXAMINATION, UPON THE WORK.

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1. The first *occasion* to the inimical move in Congress, was taken from the proposition of Mr. King, from Georgia, to order the printing of some maps by the Navy Department, of some southern harbors, surveyed (so said) by Lieut. Glynn, which the Navy Department did doubt of being worth it.

2. Lieut. Glynn had at that time, as before and since, visited about the members of Congress and the libraries, to preach up his merits, and a plan of chronometric surveying, which had already in 1832 been tried to be put up, in opposition to my plan, (I have the copies) but which is actually incapable of giving a result in the case, as well known in science; chronometers are good seamen's tools, but incapable of surveying, because they give no determination of distances, &c.

3. Lieut. Glynn's intermixture is proved by himself, by the anecdote, that, Mr. Everett having said in the course of his opinion, "he could attribute the course of Mr. Cushing, only to a want of information of what had been done, and to the promptings of some discontented lieutenant of the navy."

Lieut. Glynn went to Mr. Everett, telling him that his statement must have meant him; to which Mr. Everett answered, "that he had not known him, nor heard him mentioned before that time;" this of course unveiled Lieut. Glynn's co-operation, by his own conscience.

4. The whole attack of Mr. Cushing was directed against me, personally; his other discussions betrayed the most complete ignorance of mathematical science, and of the work to which it was to be applied. He used unbecoming expressions, against which many members of Congress were so kind as to take my defence in a generous way. He betrayed it in a very low manner, by saying, after repeating a call for a committee; "if it should be found that *no one but a Swiss*

could do the duty, he would waive his objection, *and not till then.*" This is evidently too distinctly stating, that I should be ejected, *if it could be done*, to leave the slightest doubt upon the case, that *private interested intention*, without regard to public good, lay in his motives.

5. In general, all the low and bad language which Mr. Cushing used on the occasion, is the fullest proof of his complete want of decency, and respect for the assembly whom he addressed, and of the fullest absence of all self-respect.

6. How Mr. Mallory could let himself be induced to be the cat's-paw of Mr. Cushing, who was himself already a mere cat's-paw, is only explainable by his not in the least understanding the subject, and being made to believe that he could earn glory by helping Mr. Cushing to pull down that public work, under his control or guidance.

7. In the examinations of the committee, all the above proved itself still fuller, by the conduct of Mr. Cushing, who at that time very soon was seconded by Mr. Aycrigg; Mr. Mallory, as chairman, forgetting the dignity of his situation, to keep up decency in the examination, to which I was subjected, in a form worse than criminal, (for at least I, as attorney-general of the higher and supreme courts in Swisserland, did positively and strongly reprove the inferior courts, when an examination of a criminal was not conducted with propriety and decorum, though none ever went so low down in language as Mr. Cushing came with me in the committee, with the sufferance of Mr. Mallory.)

8. The following is the history, and some facts of my examination.

At the first meeting, Mr. Mallory began by saying to me: "We know the respect due to age; we know that you are very industrious." I augured well from that; he and Mr. Aycrigg both said then, they were friendly to the work. Mr. Wise was present also, who had already spoken friendly in Congress, and otherwise; a few questions only passed as such, otherwise only conversation, which, if persisted in friendly, instead of what occurred after, would have been able to give all proper information upon any part of the work, that might have been desired.

9. But, next day, were present Mr. Mallory and Mr. Aycrigg only; when Mr. Cushing entered furiously, stretching his arms over the table, around which we were all three sitting, loudly exclaiming, "You know, gentlemen, we have agreed that, unless publications be made, we would vote for keeping back the appropriation." This at once unveiled to me, that no objection to the

appropriation was intended, as there was evidently no time lost to change any thing.

10. Then, Mr. Cushing, *turning his back to me*, as he did *during the whole three days'* examination, began in a vociferating tone, to address me the questions in my examination up to about No. 50 or 60.

The questions being set mixed, or unclear, I, of course, began sometimes by wishing to separate them, clear them up, and explaining, but Mr. Cushing, turning round to me in an angry tone, said most generally, "that is argument, I will not that—I want '*yes* or *no*,'" which could of course convey no information to a man ignorant of the first elements of the subject he inquired into.

Often, when I began only to speak, at the first word he exclaimed to his colleagues, "Always evasive answers, you see," or other offensive provocations.

11. I pass various questions, placed evidently only as catches, as upon danger of fire, of falsifications, &c.; most of them are contained in the 120 questions, which are recorded, and to which I have since extended the answers.

This unbecoming turn of the examination occasioned me to write a letter to Messrs. Holmes and Wise, complaining of the unbecoming conduct towards me, and desiring their presence, as a check; both came the third day of my examination, but staid only a short time, Mr. Cushing always pushing his rough language, and impeaching my answers. I stated to them at last, "Gentlemen, I will answer you any question, but do not impeach my answers, that I do not admit." Then, Mr. Mallory said to me, "take it easy"—while, however, he left full sway to Mr. Cushing's angry and unbecoming language to me; it appeared, however, Mr. Cushing gave a little in, though his conduct was never what I could call decent.

12. In the first meeting I was alone; in the two others Captain Swift, the accounting officer of the Coast Survey, was present; he, after both examinations, on the return, acknowledged to all the other assistants, accidentally present, that the examination, questions, &c., were *evidently inimical*, and they found it the same, as every man who has seen them.

13. After me, Captain Swift, Messrs. Ferguson, Blunt, Blake and Page were examined, and, as I had expected, all treated with more kindness; for it seemed to be intended to hide the manner in which I had been treated, and to gain their good will against me, if possible; this I had expected, *and told beforehand to my assistants*, that it would be the case; for Mr. Mallory giving me in the first

meeting the occasion to mention, that the trial of making me appear a man difficult to live with, was idle, as every man whoever dealt with me could state the contrary, he said, "it must not be so bad, for all your assistants like you." Their examination I know nothing of.

14. The trial evidently made, repeatedly, to frighten or provoke and irritate me, was a foolery, as I have no fear in my character. That the appropriation would not be withheld, I said to my assistants, because I said, it is not the question of *saving money*, but *to get* the very money for the *favorites of Mr. Cushing, and those concerned.* This proved itself fully by the fact, well known and recorded for the public, in Mr. Cushing's rising for it, and by the very words he used.

15. I might have asked the questions to be given to me in writing, to answer them more leisurely; but under the distrust which Mr. Cushing showed, by the whole proceeding, I was willing to leave him all the advantages which he might collect from ready answers, which I was just as able to give, provided he would consider the truth, that he was only master of the questions, and that I was so of the answers, as it is undeniable, but which he so completely disregarded.

A member of Congress may claim the immunity to *scrutinize* a subject freely in the house, but he *has no right to abuse*, if he has any thing to investigate.

16. The puerile questions, of how much time the Weight and Measure work took of me, show evidently that they were prompted by the desire of putting somebody for that alone, to *distribute offices* in greater number, &c. It shows, that the task which I undertook, to perform two works for one income, was considered as introducing a bad habit, and not consonant with the genius which I have heard advocated: to make room for as many as possible, to give incomes, without regard to the work to be done.

17. Mr. Mallory once took up my last report, upon which the Committee was established, to go regularly in the order of its articles, but Mr. Cushing immediately broke through, continued his disconnected random questions, and Mr. Mallory gave way to him. Upon my answer to question 38, Mr. Cushing said, "Such reports as you make, we make in an evening." This was hardly worth the smile of ridicule which I gave to it.

18. Upon my answer to question 56, Mr. Cushing bursted forth with outstretched arms, "I know 500 men who can do it full as well as you, that I can lay my hand upon at once." A smile at this would have followed, if the next question had not made me lift the

shoulders, as it showed that with all the French, and other publications, which Mr. Cushing quoted in Congress, as on hand *to be learnt from*, the knowing to read, and the understanding the subject read upon, were so very far away from one another.

19. The object of question 58, is one of the complaints put up in the most unjust manner; I am obliged to remark upon that: I am promised in my contract with government, *assistants;* these to select I have the proper liberty, by my second agreement of 1832. But with the best wishes, and selections, as was naturally to be expected for a work so entirely new in the country, I must instruct them always, so as I answered, "as much as they will admit;" but the less instructed being also those who are the least prone to ask for information, and to learn, it appears as if some one had complained, that I did not act enough the schoolmaster with him, to get ultimately after much trouble the answer, habitual in that case; "Oh, that I knew long ago!" when he even did not understand it yet, as any man who has, as I have, been engaged in teaching, may know, as well as I. In short, the accusation *is false.*

20. Still, I might add, that I contracted with the government for my *work*, the capacity to which is one of the results of *my* knowledge, *acquired at my father's and my expense, and assiduous study of many years;* to this my knowledge itself, the government has *no right*, having not paid for it, nor has any of my assistants, it is my *private property;* whatever of it I may be willing to give, is my liberal gift, which should be exercised only towards the *deserving*, and which such a man will duly acknowledge, as actually some of my assistants do. The right of the government goes, strictly speaking, only upon my work, as *results* of my knowledge in that branch; so it is considered all over Europe; thus Mr. Bessel expressed himself in his review of my Coast Survey papers—"Mr. Hassler *gives us* also *his means*," as a distinction from others.

21. The most of the questions testify by themselves to the incapacity of the questioner, and to his desire to (what was called) "stump me:" see questions 63, 64, 66—76. All that relates in any way to the actual work, I had explained in full at other places; the most remarkable defeat of their questions was, when thinking to find me not able to answer, exactly, the time of my going to the field work, and returning here, every year, since 1832. I could indicate the hour, and half hour, of my departure and arrival in every year; upon which Mr. Mallory was himself *obliged to laugh* at Mr. Aycrigg, who had proposed the question, in high hopes of a catch, if it was in any way reflected.

When, by mere conversation at the beginning with Mr. Aycrigg,

I stated to him, that I had even to reduce the zinc from the ore in the beginning, Mr. Cushing bursted out at once, "You might just as well have an iron mine, too." What reproach should that convey? What reasonable aim could there be in it?

22. When the three members present appeared to consider nothing as work of mine, except my part of the work in the field, I observed, that the administration of the whole business, ordering and distributing of the works, &c., gave considerable work, Mr. Cushing turned round to me, speaking violently in my face, "What administration have you?" Nearer to enter into the subject with a man, who could not see that a work requiring scientific and mechanical operations of all kinds, and the guidance of a considerable number of men, of very different qualifications and dispositions, must necessarily have even a considerable administration concern, was altogether useless, therefore, this was not answered in any way. Of the amount of this administration, the 17 or 18 volumes of my manuscript Documents give fully sufficient proofs.

23. Let it be enough of samples of politeness, good manners, and sagacious, wise investigation, with only the remark, that my assistants were all highly scandalized at it. Upon me it made a painful effect, which has now vanished.

When I, therefore, was dismissed and my assistants also, it should have been hoped, that the three inquisitive members of the Committee had become wise, and over wise in the subject, but mistaken!!

24. Mr. Mallory directed to me an undertaker in engraving, Mr. Stone, to *examine* (consult the dictionary upon the meaning of the word and its sequels,) my map of New York in MS. This man I and my assistants knew too well, to be inimical to my engraving arrangement; however to him, of course, the map was shown; but I told him directly he was *not able to put this map of mine upon copper*, to which he had to confess—"*I know that very well*;" he measured the map with a foot rule, like an undertaker, to make a coffin for a dead body; while there is upon one square foot of it positively more work than upon two square yards of the most full map ever given out under his name, and I have not any confidence in him; he is, in fact, no actual engraver; besides that, there is much of the map done, and in a far superior style. It would be as uneconomical, as improper and unreasonable, that an intermediate *engraving undertaker* should be between me and the man *who must work* always positively under my instruction.

25. This occasioned me to write to Mr. Mallory, that the sending of *such a man*, to *examine my work*, is an unprovoked *insult*,

stating my reason, which would certainly be considered so by any member of the committee, if it had been done to him.

Mr. Mallory, to whom I sent shortly after the first sketch of the questions of my examination, sent me word by the messenger who returned them, that this my letter spoiled all, &c.; if they choose to step out in the public with that, I am ready to meet them, but they and Stone both do best to let it rest.

26. As the wish of the committee, to show him the map, was executed, notwithstanding *he had seen it before already*, all the committee *could claim was done;* and I had, as a private honest man, the right to complain, when a man was sent to me whom, in my opinion, I did not find admissible under circumstances so highly obnoxious.

27. It appears evidently, that the harvest of faults desired to be found with me, was not satisfactory in the Coast Survey researches; therefore, the committee took hold of my works, for the establishment of uniform Standards of Weight and Measure for the Union. Mr. Mallory sent me word not to go away, that I would be called to be examined upon that work also!

28. As Mr. Mallory left for Norfolk, Mr. Ayerigg wrote to me under the 9th of June, a letter, calling me up, *forthwith* to give a *concise account* of my works in that line, *without referring to any of my former reports;* the style of it being too far from what, in old free Switzerland, would be considered becoming in public business, it presented a sample of style new to me; but I answered it by a full, still very abridged report, dated 29th June last.

29. Nobody will doubt, that if those members of the committee, who proposed to themselves to fight to destroy the work, had, instead of the blind passions and interested action, actually intended to make themselves acquainted with the subject, they would have begun, as Mr. Woodbury did when the Coast Survey came under him in the Navy Department, that is, by reading first all that was printed upon it; he, therefore, then also took the right and just course at once.

On the contrary, Mr. Cushing positively declined all reference to documents, as did after also Mr. Ayerigg; even when Mr. Mallory tried to lead the questions of Mr. Cushing, by those proposed to me by *his resolution*, as answered in my report of 3d December last. Mr. Cushing rejected it.

31. Messrs. Wise and Holmes, evidently disproving the course taken by Messrs. Cushing and Ayerigg, to whom Mr. Mallory gave way, kept away from the committee, expecting that the part of the committee which aimed at the majority, by involving Mr. Mallory,

should some day or other make an exposition of what conclusion they would come to; but nothing yet came out from them; I hope they abandon further persecution.

32. However, every part of my work being grounded upon laws, and my positive contract with the government, they cannot propose *insinuations* to any actual effect, &c.; if a law should be proposed, the sense of Congress will have to discuss it, and truth will come out.

33. Accounts were called in from the Treasury Department for every penny since 1807, which have occupied and confused a clerk in the Treasury Department, to take out of the Documents, since last January, and will still more confuse the Committee, which is not in any way in the case of drawing correct conclusions from them.

34. This whole attack of Mr. Cushing with its consequences has, taking all together, cost one whole year of my work in the Coast Survey, and disturbed all the other works very much; the cost of this move is, therefore, of considerable consequences in respect to money; but that is trifling in comparison to the harm it has done to the work in general, which to discuss is not here the place. But it may be observed, that this Survey work can never be, for the chief, a money concern of any moment, nor that the pushing to making the work, with a view to making money, can possibly give an honorable result.

35. The Committee was evidently in the position of a coroner's jury, which ought to have inquired into its subject, by direct personal inspection of the office, in which the work is established; I requested this repeatedly in writing, and verbally, but could never obtain it; so, *no actual investigation* was ever made there. Mr. Holmes made a short visit, Mr. Wise came several times; both in a friendly way, but the other three principally *active members paid no attention to the office, where every thing could have been shown and easily explained.*

36. It must strike any observer, that these ways of interrupting the Coast Survey, occasion a great deal of writing, that might well be spared, and which unfortunately takes *away my own personal* time, which is so much required for every branch of the work. Therefrom has arisen, that the primary triangulation has remained behind the secondary, by which this becomes a preliminary or reconnoitering work, which, by the nature of it, must be subject to change of form in its application, by which there is a damage done, even prospective, by doubling the calculations in future. There is

no remedying to that consequence, because mathematical principles decide peremptorily, and without appeal or cavil.

37. It cannot escape the most superficial observation, that these interruptions are very costly, because, during the time which the subjects are discussed, the compensations and the current expenses of the whole establishment go on, as well as if the time were employed in the work, which of course cannot possibly go on with equal success, during the time that these impediments last, and engross the attention, and absorb to a great degree the labor of all the persons engaged in the work.

F. R. HASSLER.

Pinehill, 21*st December*, 1842.

Notice of the Impediments and Delays which the Survey of the Coast has encountered previous to 1842.

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1. When, in 1816, I had agreed with Mr. Dallas, Secretary of the Treasury, about arrangements for the funds to be given to Major Abert, the then accounting officer for the Coast Survey, Mr. Dallas resigned immediately after, and Mr. Crawford, succeeding in the Treasury Department, refused the funds; this occasioned that I had to wait, to move the instruments from Philadelphia to Newark, New Jersey, where they were to be used, until I had money of my own to pay the expenses myself.

2. In the spring of 1817, a similar occurrence made again, that I had to start upon my own means. Mr. Crawford all that year answered none of my letters requiring dispositions, by which arrangements were lost which would have helped the work a great deal.

3. In the Senate, session 1817, '18, a proposition was made, and passed both houses, *the representative unobserved* even, limiting the law to the sole employment of naval and military officers, which, by abolishing my connection with the work, broke up the work! The attempt then made by the Navy Department, under the direction of four divisions of the navy, occasioned the expenditure of several hundred thousand dollars, but produced no work that dared to be shown or honorably exhibited. Witness, and other proofs, to these facts are yet producible.

4. When the law for the Coast Survey was renewed in 1832, the influence of navy officers, who had joined to advocate a so called chronometric survey plan, occasioned such circumstances as were expected to break up the agreement with me, directed by the President, which delayed the agreement; when it was concluded it was set up, that no advance of money could be given to me, without the special permission of the President, just then absent.

I vanquished that by asking only the proper papers, and with them, as proof of my position, I got personal credit in the Bank of the United States, in Philadelphia, for $3000, with which I began

the work again at my expense; after two months, upon sending in accounts, I got a check upon the United States Bank at New York.

5. In 1838, a proposition was started to establish a committee to regulate the work, to be composed of a Naval Commodore, the chief of the Topographical Department, and the under Secretary of the Treasury. I said immediately that I could not work under such circumstances, because the committee could not possibly direct me in the work, and I had no time to lead the committee. A trial, by my meeting the naval and engineer officers who were to be the members of the committee, which lasted but about an hour, showed by their disagreeing in principles, the inapplicability of the committee, and it was of course dropped.

6. In the mean time I could never get either a hearing or an answer upon my letters from Mr. Taney, then Secretary of the Treasury, and the Coast Survey was transferred to the Navy Department, where I knew it could not prosper, and said so immediately to the President, who promised me his protection, when I informed him of that, but the sequel proved me in the right.

7. In 1834, a violent attack was made against the accounts of the Coast Survey, my competence in doing what was required for the work, &c., and I was charged *unjustly* with payments of expenses of coming from the field work to Washington.

This was carried on under the name of Amos Kendall, Auditor, who having before already passed the account, turned upon his heels, and served as *cat's-paw in the trial* to subvert the work.

8. By wrong application of the funds of the Coast Survey in the Navy Department, the amount of appropriation had been reduced below the necessary means to go out to the field work in 1835; it took some time to obtain the return; besides that Mr. Dickerson, the then Secretary of the Navy, took a decidedly inimical turn; in direct change of the very fine manner in which he had defended the work in 1818.

9. The documents of 1835 show how much of my exertions of this year was still wasted upon the discussion of the difficulties raised, until I obtained from the President the re-transfer of the work under the Treasury Department, then in the hands of Mr. Woodbury, at the same time the works upon the Weight and Measure Standards were discussed, planned and begun.

10. Through 1836 shows itself the influence of all the preceding state of disturbance; the inability to pursue certain parts of the work, on that account, occasioned to pursue that year only the means of junction of the Maryland Survey, with the Coast Survey.

11. The little bickerings in journals, newspapers and insinua-

tions from various sides, that always go on, produced only disagreeable feelings, but the former experiences had of course occasioned precautions to be taken, in all measures and arrangements, which had a bad effect upon the celerity of the progress, which would otherwise have been possible.

12. It appears that the credit acquired by the work in this interval of half peace, was not to be suffered unmolested. Mr. Cushing rose as champion of a new tournament, which is now playing.

13. This constant persecution, and the groundless reproaches, heaped upon a work of science, and public utility for the country, which is universally acknowledged to go on in the best manner possible, to the complete success of the results aimed at, becomes ultimately discreditable. It would be a bad and painful result, if the ignorance and jealousy of a private few should be able to produce a national harm and disgrace, by Congress being once more misled to espouse them.

F. R. HASSLER.

Station, Pinehill, N. J., 21st December, 1842.

HOUSE OF REPRESENTATIVES,
Committee on Naval Affairs, Feb. 25, 1828.

SIR: The House has directed the Committee on Naval Affairs to inquire into the expediency of carrying into effect the provisions of the act to provide for surveying the coasts of the United States, approved February 10, 1807.

I am instructed by the committee to ask of your Department information on the following points:

1. What maps and charts of the coast of the United States the Government possesses; by whom and when the surveys were made, so far as these and other facts connected with these maps, charts, and surveys, can be given without injury to the public service; and what progress has been made in or toward the survey contemplated by the act referred to?

2. Whether, in the opinion of the Department, such survey ought to be made; and if so, what further, if any, powers are deemed necessary to its due execution?

3. The best plan of making it; the instruments on hand to make it; the instruments, and their cost, necessary to be procured; and the appropriations deemed necessary to the work, in the whole, and for the current year.

I would add, that the committee, in calling your attention to these particulars, do not desire to limit you to them, but solicit the fullest information on the whole subject referred to them.

With perfect esteem, I am, sir, your humble servant,

MICHAEL HOFFMAN.

Hon. SAMUEL L. SOUTHARD,
Secretary of the Navy.

NAVY DEPARTMENT, *April* 14, 1828.

SIR: I have had the honor to receive your letter, making certain inquiries respecting "the expediency of carrying into effect the provisions of the law to provide for surveying the coasts of the United States, approved 10th February, 1807," and respectfully submit my answers, in the order in which the questions are propounded.

1. "What maps and charts of the coasts of the United States the Government possesses; by whom and when the surveys were made, so far as these and other facts connected with these maps, charts, and surveys, can be given without injury to the public service?"

The enclosed papers, A and B, furnish lists of the maps and charts in the offices of Navy Commissioners and Engineer department. In addition to these, there have been made, within the last three years, surveys of the harbors of Baltimore, Charleston, Savannah, Brunswick, and Beaufort, under the direction of the Navy Department, and by authority of resolutions and laws of Congress. They furnish the materials for charts and maps of those harbors, which will exhibit the depth of water, particularly on the bars at their entrances, and their fitness for naval purposes.

Of the whole of the maps and charts in possession of the Government,

it may be remarked, that they 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 govered 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.

2d. "What progress has been made in or towards the survey contemplated by the act referred to?"

The law was passed on the 10th February, 1807, under the auspices of the then President Jefferson. Immediately after its passage, he directed Mr. Gallatin, the Secretary of the Treasury, to make the proper inquiries into the best mode of executing it. Communications were made by him to several of our most scientific citizens; and their views having been obtained, and submitted to a commission of scientific men, a plan was adopted in July, 1807.

To execute this plan, it was necessary to procure from Europe a variety of mathematical instruments, especially those which were required for one or more observatories, which formed one of its leading and prominent objects. An agent, Mr. Hassler, whose views upon the subject had been adopted by Mr. Jefferson and Mr. Gallatin, was sent to Europe by President Madison, in 1811, and he procured the instruments, a list of which is enclosed, marked C. You will perceive that a portion of these instruments was designed for use in the observatories, and are without value for any other purpose; their cost was about $17,167 61. But little use has been made of them, and they are now chiefly in good order, under the care and in the office of the Engineers, attached to the War Department.

The sum of $29,720 57, of the original appropriation, was carried to the surplus fund on the 31st December, 1814, and reappropriated on the 16th April, 1816, (vol. 6, page 57,) which enabled the Executive to direct the survey to be commenced. It was accordingly commenced in the fall of 1816, under contract with Mr. Hassler, and was terminated by the act of 14th April, 1818. For both the plan, and extent of the work done under it, I beg to refer you to reports of Mr. Hassler. It would not be practicable to condense them to any useful extent, nor could it be profitable to attempt it. It may be sufficient to remark, that the time during which he was employed, and the speedy repeal of the law, did not permit him to exhibit practical results in such a way as to enable the public to test the fitness of his plan *by them;* nor to execute any part of the work, so as to present a complete survey or chart of any portion of the coast.

It is believed, however, that he accomplished all that was possible, within a short period, and that his observations and work will be useful when the survey shall be resumed. I would respectfully refer you to papers published by him in 1824, "on various subjects connected with the survey of the coast of the United States," to be found in the 2d volume of the American Philosophical Transactions, and also, it is presumed, in the library of Congress.

3d. "Whether, in the opinion of the Department, such survey ought to be made?"

Upon this point, no doubt is entertained. It is called for by regard to our commercial and naval interests, and to our means of national defence. I do not understand that you require a statement, in detail, of the reasons for this opinion. They will readily suggest themselves to every mind.

4th. "What further, if any, powers are deemed necessary to its due execution?"

I do not suppose that any further or other powers are necessary, than those given by the law of 1807, with an appropriation adequate to the object. The work being authorized, it will be the duty of the Executive to see that it is executed in the best manner which the pecuniary and scientific means within the control of the Government will permit.

5th. "The best plan for making it."

The plan under which the survey was commenced, in 1816, was adopted, after prudent deliberation, and by intelligent men, perfectly acquainted with the state of science in this country at the time. Since that period, much has been added to the acquirements and skill of many of our citizens, but especially of our officers, to whom duties of this kind would be properly assigned. Several other plans have been proposed, but I am not prepared to express a decided opinion which should be adopted; and beg to suggest to you, that a decision on this point should be the result of deliberate investigation by the Executive, to whom the execution of the law would be intrusted. In the performance of the work, under any plan, officers of the army and navy would afford assistance, and thus diminish the expense. But it is proper to add my conviction, that it never can be perfectly and satisfactorily done, without the aid of an observatory.

6th. "The instruments on hand to execute it."

Paper D furnishes an answer to this inquiry.

7th. "The instruments, and their cost, necessary to be procured."

These must necessarily depend upon the plan which shall be adopted; and, therefore, a safe list cannot, at this time, be furnished. It is probable that their cost, and the expense of procuring them, will not be less than four or five thousand dollars. Should you still wish lists under the different plans which have been suggested, I will attempt to furnish them in a few days.

8th. "The appropriations deemed necessary for the work, in the whole, and for the current year."

It is a work of great labor, and of long continuance. In attempting to estimate its cost, with the present lights upon the subject, there would be much more danger of misleading than of directing the judgment.

The cost of an observatory, of the necessary instruments, and the pay of the officers employed, would be the principal items. For the first, I would respectfully refer you to an estimate furnished by the Department of War, in a communication to Congress, on the 6th of March, 1826; and would only remark, that I believe the expenditure, both for its erection and support, may be made somewhat less than the estimate. The pay of the officers employed will create a comparatively small burden on the Treasury, as they are already in the service, and will be detached from other duties to execute this.

An appropriation of thirty thousand dollars, for this year, would be amply sufficient.

I am, very respectfully, &c.

SAMUEL L. SOUTHARD

Hon. MICHAEL HOFFMAN,
Chairman of the Committee on Naval Affairs,
House of Representatives.

[From the North American Review of April, 1842, p. 446 *et seq.*]

ART. VIII.—*Letter from the Secretary of the Treasury, transmitting a report of F. R. Hassler, Superintendent of the Coast Survey, showing the progress made therein up to the present time. (Doc. No. 28, House of Representatives, (Treasury Department,) 27th Congress, 2d session.*

By this valuable communication, as well as by information, reaching us from various sources, we are warned that the great public work of the survey of the coast is in danger of being again abandoned, or, what we should regard as still more unfortunate, of being superseded by some other plan of operations.

In a former number * we presented a concise view of the nature of geodesical operations, and of the principles upon which they are based. The remarks there made upon the subject we conceived were sufficient to show the futility of any scheme for arriving at the perfect knowledge of any extensive portion of the earth's surface, for constructing a map, or correctly determining and connecting a number of distant situations, by any other rules of procedure than those which the science of geodesia prescribes. They also afforded some data for a comparison between the American survey, as far as it had then proceeded, and similar works in Europe; such as, whether applied to the progress or the character of the work, might well gratify national pride. Our present purpose is to submit a few remarks, not of a character to interest the scientific reader, but designed rather to arrest the attention of men, who being necessarily uninformed upon matters of strict science, are nevertheless called upon in their high places to exercise judgment, and exert authority, upon questions in which the highest science is involved. It is our present aim to secure a clear and impartial investigation; to correct misrepresentations; to counteract the designs of scheming speculators; to defeat, if necessary, the instigations of ill will; and to uphold the scientific reputation of the country, which is in some measure dependent upon the successful prosecution of this great national undertaking.

The question first in importance with regard to the coast survey is, whether any other mode can be adopted—this mode having for its object the greatest amount of useful information, in the shortest time, and at the least expense. In discussing this question, so much has been said, and is still urged, concerning the use of chronometers, and the substitution of them for the present system of triangulation, that it seems worth while to say a word upon this subject, premising, that the serious consideration we here give to it does not arise from any idea of the value attached to such a suggestion in the minds of scientific men.

The chronometer in the hands of modern artists has, it is true, attained a degree of excellence which admirably adapts it to the general purposes

* See North American Review, vol. XLII, p. 75 *et seq.*

of navigation, and supplies to seamen the most useful means of solving the problem of longitude. Still it is far too imperfect an instrument to be relied on implicitly. It possesses an inherent and constant liability to error; and although its accuracy may be preserved through any short period, this liability is so multiplied by time, and the chances of accident, as to deprive even those which are most carefully constructed of all claim to perfect confidence. In cases where their use is indispensable, as in detached and local surveys, in the cursory examination of distant and inhospitable regions, or in carrying a chain of longitudes around the globe, and generally where strict and careful measurement is for any reason forbidden, their imperfection is in some measure remedied by numbers. Acting as checks upon each other, the amount of error is reduced, and the observer is enabled to fix, with a degree of precision sufficient for the security of ordinary navigation, the simple position of certain points and headlands. This, however, is regarded only as the palliation of an evil; the evil itself is fundamental, and admits of no complete remedy.

In determining differences of time between meridians widely separated, chronometers have sometimes proved remarkably successful, and have exhibited results of surprising accuracy. The reverse of this proves to be the case in the adjustment of minor differences, where the essential defects of the instrument are particularly displayed. There is no space, however small, of perceptible magnitude, which may not be submitted to trigonometrical measurement; but it will be readily understood, that there are points, at minute distances asunder, between which no difference of local time can be estimated. If it be asserted, which we are by no means prepared to admit, that such distances are unimportant in a geographical view, it will appear that they are of the highest topographical value when we come to consider the character of our Southern coast.

If chronometers, however, could be implicitly relied on, and the determination of longitudes by means of them admitted of greater exactness, still it is to be borne in mind that their use, in connexion with the sextant, goes so far only as to decide a certain number of fixed points.

This cannot in any strictness of language be called a *survey*. It still remains to fill up the intermediate spaces by some sort of measurement, and the mode and result of this operation are questions of serious importance. We need not enter into any detail to show that a survey of this kind must content itself with the bare outline of coast, harbors, islands, &c., neglecting all the valuable details belonging to physical and statistical geography, differences of level, and the distribution, limits, and peculiarities of the country under inspection, all of which are included in the operations of a geodesical survey.

We are told that despatch is one of the recommendations of the chronometric plan. Numerous parties will probably, therefore, be immediately employed, and it will remain afterwards to harmonize their labors by joining the distant points of observation. To do this, will, we conceive, be no easy task; and, if such a plan be adopted, we shall not be astonished to learn hereafter that the attempted meeting of these unconnected operations is likely to break up in the most admired disorder.

We do not mean, in any thing we have said, to underrate the value of chronometers in their legitimate sphere. They might, undoubtedly, be advantageously employed in the preliminary determination of important points on the coast, which are known to be erroneously laid down.

Their accuracy may be depended upon within a mile, and even this imperfect knowledge will be in some degree a relief to navigators, where errors of alarming and uncertain magnitude are known to exist in their charts. Mr. Hassler has, in his letter to Mr. Gallatin, given to this proposition all the consideration it merits.* If such occasional use should be made of them, and the present system of survey should be continued, subsequent comparisons will abundantly prove, that even the simple determination of geographical positions by chronometers (omitting all question of a connected survey,) however skilfully and expensively conducted, is unavoidably defective.

In a matter that may be subjected to rigid mathematical investigation, results are anticipated, and conclusions distinctly enunciated. But perhaps it will enforce our argument to exhibit some facts that have immediate relation to the present inquiry. We select such as are nearest at hand. An attempt was made to determine the place of the Capitol, by means of chronometers, by Mr. Paine, of Massachusetts, a gentleman distinguished for his zeal and ability in these calculations. He carried three chronometers from Boston to Washington, through Philadelphia, and back, observing the difference of meridians of the three cities, both going and returning. The results of these are spoken of as important. The difference of his two longitudes of Washington, by Philadelphia and by Boston, is 14."25. The difference between the mean of his observations and the adopted longitude of Washington is 12."9; whilst Mr. Paine's longitude of Washington differs from the mean of seven results of astronomical observations, solar eclipses, and occultations, by 41."4.†

In the trigonometrical survey of the State of Massachusetts, begun in 1831, and concluded about a year since, embracing a territory of 8,290 square miles, we find an exemplification of our argument at once pertinent and conclusive.

A letter from Mr. Simeon Borden, the superintendent of this survey, to the American Philosophical Society, in addition to an account of the work, gives a "comparison of his own results with those obtained by Robert Treat Paine, Esquire, from observations with a Troughton's sextant and mercurial horizon, and chronometers transported to different stations."

In the longitude of Pittsfield the chronometers exhibit a difference of 28."98, nearly one half of a mile; yet thirty-nine chronometers were used in thirteen journeys. The meridians of Cambridge and Dedham are 3.'30."43 apart by trigonometrical measurement; the chronometers give the difference of longitude 3.'11."10, making an error of 19."33. In the case of Cambridge, twenty chronometers were used in six journeys, and in that of Dedham twenty-three chronometers in seven journeys Gloucester and Plymouth, both seaport towns, which ought therefore to be known correctly, coincide in longitude within 2."10. The chronometers have increased that difference to 8."55. This instance illustrates what we have before said of the incapacity of chronometers to note minute differences of local time with the requisite accuracy.

Williamstown, where twenty-eight chronometers were employed in ten journeys, is placed 19."24 to the west of its true position. We have al-

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* *American Philosophical Transactions*, new series, vol. II, pp. 238, 239.

† *Determination of the longitude of several stations*, &c., reported by Sears C. Walker. See *American Philosophical Transactions*, vol. VI, p. 265, *note*.

ready remarked, that Pittsfield is 28."98 in error. The sum of these two variations is 48."22, or eight-tenths of a mile, and one-third nearly of the difference of longitude of the two places.

The longitudes of Williamstown and Dedham, as decided by the chronometric method, present a discrepancy of 29."32, or one-half a mile nearly. Fifty-one chronometers, in seventeen journeys, were used to fix the position of these two towns. Other instances might be added to this list, but the table of comparative *latitudes* demands a passing notice.

The determination of this element, as is well known, is much less liable to error. A combined difference of 9."86, or one-sixth of a mile, appears in the latitudes of Boston and Squam light; and here the industry of Mr. Paine accumulated no less than four hundred and eighty altitudes for the determination of these two places. Three hundred and ten altitudes place Amherst 8."70 south of Cambridge; but an error of 4."80, more than one-half the difference of latitude, is proved in these observations, by Mr. Borden's measurement.

The two greatest errors in this table are 7."30 and 7."81, the sum of which makes the possibility of error amount to 15."11, or one-quarter of a mile.

We will add one more case. Mr. W. C. Bond, the distinguished astronomer of Harvard College, whose remarkable accuracy and skill in the use of instruments place him by the side of the best European observers, says, in a paper now before us: "In June, 1839, I had observations with a transit circle, the illuminated end of the axis east and west, on the 16th, 17th, 20th, 21st, 23d, 24th, and 25th. These observations gave for the latitude of the instrument, 42°.19.'16."9." Reduced by the measurement of Mr. Borden, they determine the latitude of the State House, in Boston, to be 42°.21.'30."3'". Mr. Paine's observations with the sextant and artificial horizon give 42°.21.'22."7'". Four hundred and forty-two altitudes were taken by Mr. Paine, yet these insufficient instruments, in the hands of one perfectly skilled in their use, and guarded as far as possible against error by multiplied observations, fall short of the truth 7."6. Mr. Borden's latitude of the State House differs three-tenths of a second from that of Mr. Bond's.* The comparison of the precision of the two methods afforded by the Massachusetts survey is highly favorable to sextants and chronometers. It would be too tedious and expensive to apply to a great extent of territory, including a large and indented sea coast, the reiterated and laborious processes of Mr Paine.

The survey of a portion of the earth's surface is a work which comes within the domain of the mathematics. It may safely be said that any determination of a place, in which the mathematical theory is disregarded, must be fundamentally defective. A reference to this theory brings us to an argument which, we trust, no misapprehended views of science, and no preconceived notions of utility or expediency, will overlook.

The system of triangulation, conducted upon the principles in physics which direct this department of science, takes into consideration the spheroidal form of the earth, and enables the surveyor to construct such a map of that portion of the spheroid which is comprised in his labors, as will be an exact representation of its real figure. This mode of surveying, and this only, regards the earth as it actually is, in its irregularly elliptical form,

* *Proceedings of the American Philosophical Society*, May and June, 1841.

delineates its surface correctly, and treats of the true measure and configuration of the planet on which we live. Topography, and many of the details of physical geography, come within its province; as the courses of rivers, the direction and elevation of mountain ridges, the nature of the land, &c.—knowledge which is essential to the defence of the coast, to the construction of fortifications, and to all the duties of the military engineer. It furnishes the most accurate and convenient bases, from which a network of triangles may be thrown over any of the States through which it has passed. Some of them have already united their local operations with the general survey, to their great advantage. We may add, finally, in relation to this topic, that, when we are called upon hereafter to make our contributions to the common treasury of similar knowledge, this work will supply the requisite data for the measurement of degrees on the earth's surface, and for the "accurate determination of the elements of the terrestrial spheroid."

It promises also to be of especial value in giving future security to the intricate navigation of the Southern shores, a part of the coast of the United States rendered particularly dangerous by numberless reefs, shoals, and sandspits. It is well known that these are variable in their limits and condition, gradually forming in some places, and in others changing their extent and direction, under the influence of violent winds and strong currents. In order to acquire a permanent and useful knowledge of their character, and to provide an accumulation of facts that will lead to an understanding of their probable formations, dispersions, and changes, a certain knowledge of their present state is indispensable, beyond that which can be reached by sextants and chronometers. Rigorous observations upon these and similar subjects in Europe, by geologists and other men of science, have resulted in great benefits to navigation.

The increasing commerce at the South, the future establishment of naval stations there, and the close and hazardous sailing that must be pursued, both by merchant-vessels and men of war, in the event of foreign aggression, make it desirable that the *in-shore* navigation of the Southern coast should be well understood.

We have already shown what degree of reliance may be placed upon the chronometer under favorable circumstances and in skilful hands. We are justified, we believe, in saying, that longitudes by chronometers cannot generally be relied upon as correct within less than one mile. But shoals of light and unstable sand, beaches widening and narrowing, and downs accumulating and dispersing, under the action of local and general causes, demand accurate measurements of feet and inches, by means of which the operations of nature may be carefully studied, future obstructions be prevented, present ones be removed, if possible, and an effectual security be given to the pilotage of the Southern coast. A trigonometrical survey, made with all the fidelity that the improved state of the science ensures, is the only method adapted to the attainment of all these desirable objects.

Some complaint has been made against the superintendent of the coast survey, because its results have not been published, from time to time, as they have been determined. The power and duty to direct both the manner and the time of their publication rests with Congress, and to that body such a complaint may be appropriately referred. A full and sufficient reply to this charge is contained in the report. We may add here, however, for general information, that engravers are now employed upon the first sheets, which will probably be issued in the course of the coming summer; and,

if the work is continued, the publication will hereafter take place regularly, as the plates come from the hands of the engravers. When these charts, executed with precision and elegance, under the sanction of public authority, are produced, we shall, for the first time, be able to look upon similar works, contributed by the English and French Governments to the safety of commerce and navigation, without envy and shame.

Much is said of the expense of the survey as at present conducted. In this matter we are not particularly careful to answer. An honest and prudent appropriation of the public money we are willing to leave in the hands of those to whom it is legally intrusted. In this case, at least, we may be contented to confide in their integrity. Economy, it is true, is a virtue; but mere saving is not always economy—it may be the most imprudent waste; and, being satisfied of the paramount importance of this work, both to the public interest and to the national honor, we might say, without further comment, that it should not be interrupted. It is in accordance, however, with our previous remarks, to add, that this is one of those cases in which economy is not identical with retrenchment. If chronometers possess in themselves an insurmountable tendency to error, the survey undertaken by their means, and dependent on their results, is not likely to be ever completed. What is certain to-day may be doubtful to-morrow. Subsequent observations may bring discredit upon those which have gone before; and it is to be apprehended, that, however multiplied they may be, so far from ultimately removing the difficulty, they will only serve to strengthen doubt and increase perplexity.

Besides this, experience will prove that the repeated transportation of numerous chronometers will be attended with but little less expense than a regular and scientific survey. As some ground for this opinion, we shall refer again to the high authority of Mr. Paine. In a letter to the *Bureau des Longitudes* at Paris, he gives the longitudes of several towns in Massachusetts, the results of his own observations, and adds:

"These longitudes have been generally determined by the transportation of time repeated several times with numerous chronometers. Thus, between Northampton and Boston, I have carried seventy-four chronometers in twenty-four journeys; between Amherst (the college) and Boston, or Northampton, twenty-seven chronometers in nine journeys; between Barnstable and Boston, fifty-nine chronometers in sixteen journeys; and between Gloucester and Boston, sixty chronometers in sixteen journeys."*

We have here an example of the manner in which chronometers are employed in the hands of a skilful observer. In estimating their use for a survey of the coast, the additional risk of transportation by sea is to be added to this account.

The financial department of the coast survey does not, however, present any thing so startling as to render these statements necessary for its defence. They are in themselves valuable facts and considerations, tending immediately to elucidate the subject, and weighing heavily against the proposed change; but they are not, we imagine, essential to vindicate the present plan of operations from a suspicion of waste and extravagance.

Since the year 1832, sixhundred and twenty thousand dollars have been appropriated to this service, one hundred and twenty thousand dollars of

* *Connaissance des Temps*, 1843. Additions, p. 96. The *Additions et Corrections sur les Tables des Positions Géographiques*, by Mr. Daussy, will repay a critical examination.

which remains on hand, in the form of vessels, instruments, and other property, leaving a balance of five hundred thousand dollars to be charged to the survey. When we consider that this expenditure extends through a period of ten years, that it has been bestowed upon a great national work, of the highest importance to the commerce and defence of the country, that it is a contribution to knowledge, and that its investment in this way has gone further than any thing yet done to establish the character of the country abroad for a liberal patronage of science, we are not disposed to regard it as an expense which the strictest economist may not approve.

As to the amount of money and probable length of time required to complete the survey, we cannot do better than to say, that these questions are ably and properly treated in the documents before us. "With the advancement of the mathematical and physical sciences, the means of acceleration of any work grounded upon them also increase. All that is needed is, that the whole work be carried on in the most economical manner." (p. 11.) We are satisfied that its progress will compare favorably with that of any similar work in Europe; and we are not willing to be behind the old world in accuracy, and in honorable and permanently useful results.

The course pursued has already met the approbation of men abroad eminent in science, and practised in such works, whilst at home the survey has more than repaid the sums drawn from the Treasury by the benefits it has conferred upon two of the largest commercial cities, New York and Philadelphia. It ought to be a sufficient argument for its continuance, that it has discovered what other operations, though often repeated, failed to find out; and its success here was owing to strict conformity to the principles of surveying, which alone a severe science recognises. It is needless to say, that the duration of the work is indefinitely protracted by the frequent interruptions to which it has been subjected. If it were permitted to enjoy the friendly and intelligent patronage of Congress and the Government, the greatest number admissible of assistants would be employed, and all the rapidity of execution consistent with accuracy would be secured. Mr. Hassler has given a list of similar works which have been executed, and are now in progress, in Europe; from which it appears that not only flourishing kingdoms, but even petty principalities, have made their triangulations. When we contemplate the wealth, extent, and dignity of this vast empire, we feel that the hope is not unreasonable which looks for enterprises suited to its condition. But science, which knows no limits either of power or national boundary, finds a home among the thrones and insignificant dominations of Italy and Germany; and, if it be rejected from the councils of this nation, will confer upon their humble princes a distinction before which we must be content to bow. The abandonment of this work will not fail to be regarded in Europe both as a calamity and a dishonor. The impress of instability, which seems to be stamped upon every public measure, might at least be removed from this, in which all parties and all prejudices may unite and harmonize. The survey of the coast has already created a distinguished school of topographical and hydrographical engineers, thus overcoming one of the early difficulties in the undertaking; it will further contribute to erect a standard of science, the practical value of which we cannot now discuss. Should some other mode be adopted for the time, there can be small doubt that the present method, the only one which strict science approves, will be hereafter resumed; and "the chances

of an accumulation of errors upon such a long extent of sea coast as that of the United States, particularly in the direction in which it lies, will be too great, and the consequences of a want of system and care too glaring, not to bring discredit and shame upon a less accurate operation."*

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* *Papers relating to the Survey of the Coast. American Philosophical Transactions*, new series, vol. II, p. 400.

REMARKS

UPON THE

Survey of the Coast of the United States.

1. The law authorizing the survey of the coast was passed February 10, 1807.

2. Circular letters were addressed by the Treasury Department to various scientific men in the United States, asking for a plan of operations. Thirteen such were received, and submitted to a committee of learned men in Philadelphia, with the late Professor Patterson at their head. After full consideration, the plan proposed by Mr. Hassler was adopted.

3. From the passage of the law until 1811, no active steps were taken, in consequence, principally, of the unsettled state of the country.

4. In August, 1811, Mr. Hassler was sent to England to procure instruments, in accordance with the plan proposed by him in 1807. These instruments had all to be *constructed;* and, for the purpose of superintending the same, he remained in England until 1815, at which time he returned to the United States, with all the instruments and appendages requisite for the work. The war, want of remittances for payment of the instruments purchased, the difficulty of procuring suitable artists to construct the same, &c., conspired to protract his stay in England nearly two years beyond the time which he had allotted to this part of his labor.

5. In August, 1816, Mr. Hassler was appointed, to superintend the survey of the coast, under the law of 1807. The necessary preparations for the work, including reconnoitring, &c., consumed the time between August, 1816, and April, 1817. At that period a proper locality for a base line was discovered in New Jersey, and in July of the same year the actual triangulation was commenced.

6. April 14, 1818, that part of the law which authorized the employment of persons other than those belonging to the army and navy was *repealed*, and thus was Mr. Hassler's connexion with the coast survey closed.

7. Up to this period, the whole amount expended for the work was $55,634; of this amount, $37,549 had been expended for instruments and the expenses of procuring the same, leaving about $18,000 for the cost of the survey, equipment for the field, &c.

8. In 1819, Mr. Hassler presented to the American Philosophical Society of Philadelphia his papers upon the coast survey, describing the method and means by which it had been designed to conduct the work, together with full descriptions of the instruments, with drawings of same, examples of the journals of observations, &c. These papers were published by the Society, in their volume of Transactions for 1825, and are now in the Library of Congress; they contain much valuable and interesting information upon the subject. They were reviewed by the principal astronomers of Europe—Bessel, Struve, Schumacher, Ferrusac, Francoeur, Krusenstern, &c.—all uniting in the opinion that the plan of Mr. Hassler was of the first order, and that the instruments were in every manner adapted to the purpose for which they were designed. In 1832, a distinguished astronomer

of France, now employed by the Government of the United States, declared that the instruments planned by Mr. Hassler for the coast survey, and executed under his eye, were, when constructed, *twenty years in advance of the science of Europe.*

9. In 1827, the survey of the coast, after a lapse of ten years, again excited public attention. The Secretary of the Navy, (Mr. Southard,) in describing certain surveys which had been made by naval officers for an especial purpose, stated in his annual report that "the time within which it was supposed desirable to make them, [the surveys,] and the means granted by the appropriation, did not permit them to be so made as to furnish perfect surveys and charts of those harbors; *nor can such surveys be made without the aid of the means contemplated by the act of 10th February, 1807, to provide for surveying the coast of the United States.*"

In 1828, the Committee on Naval Affairs addressed a letter to the Secretary of the Navy, (Mr. Southard,) asking information in reference to the survey of the coast, to wit: whether it ought to be made; the best plan for making it; what progress had heretofore been made, &c. In reply, he proceeds to say, after referring to a list of maps and charts, "of the whole of the maps and charts in possession of the Government, it may be remarked that they 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 shore, 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.*"

10. In answer to the question, "Whether, in the opinion of the Department, such survey ought to be made?" the Secretary replies: "Upon this point no doubt is entertained. It is called for by regard to our commercial and naval interests, and to our means of national defence. I do not understand that you require a statement in detail of the reasons for this opinion; they will readily suggest themselves to every mind."

11. July 10, 1832, the law of 1807 was revived, and the employment of such "astronomers and other persons" as the President should deem proper was again authorized.

12. At the request of the Treasury Department, Mr. Hassler submitted a plan of operations for the work, being, in fact, the same which he had proposed in 1816. On the 9th August, of same year, he was again appointed to the survey, and to carry into effect the law of July 10. Prior to this period he had been employed by the Treasury Department in making comparisons of the various weights and measures in use at the several custom-houses, with a view to the construction of uniform standards of the same for the Union.

13. The two works, of the coast survey and that of the construction of standard weights and measures, being, by their nature, intimately connected, and the means of accomplishing each being in many instances the same, Mr. Hassler was charged by the Treasury Department with the

execution of both; and, since the period referred to, the two works have received his whole attention.

14. Since 1832 the survey of the coast has been diligently prosecuted. The remainder of the season, between August and December of that year, was employed in reconnoitring and other preparations; and early in the following year, 1833, the triangulation was recommenced, and has been making steady progress from that time to the present. In 1834 a new base line was measured on Long Island, and the secondary triangulation, hydrographical work, and plane-table surveys, have also been in active progress, *pari passu*.

15. By the official statement of the Secretary of the Treasury, (Doc. 57, H. R., Jan. 31, 1842,) it will be seen that the aggregate amount expended from 1808 to 30th June, 1841, is $512,731 68; of this sum, by the same statement,* $33,723 05 has been expended for the purchase of "instruments, books, and repairs of instruments." This, with various sums expended for 5 surveying vessels, 20 boats, with all the requisite accompaniments, and the necessary equipment for the several parties engaged in the secondary triangulation and plane-table work, makes a gross sum which exceeds $120,000, for objects of a *permanent* nature, now the property of the coast survey. This would reduce the amount expended upon the work itself to $392,731 68; if to this sum be added the whole amount of the estimate of the Secretary of the Navy, for difference between shore pay and sea pay of the officers, and for pay and rations of the crews of the several vessels, from 1834 to 1841, ($114,584,) we shall have a total sum expended of $507,315 68, for about 11 years of actual work, or about $46,000 per annum.

16. When the operations of the coast survey, under Mr. Hassler, were suspended in 1818, by the repeal of a portion of the law, the system which he had adopted was also suspended, and thenceforward detached portions of the coast were assigned for survey to naval officers, from time to time. Indeed, this same system, which was condemned so thoroughly by Mr. Southard in 1828, and for which the sound reasons quoted from his report, at the 4th page of this paper, were given, is still pursued—at what expense exactly we have not the means of stating. An approximate estimate may be formed, however, from the following facts: The direct expenditures, as exhibited by the printed statements in the office of the Register of the Treasury, from 1818 to 1841, are $63,520 20; the incidental or indirect expenditures do not appear, but perhaps an idea of the extent of the same may be formed upon the following data: In 1832 $5,000 were appropriated for the survey of Narragansett bay, in Rhode Island. There were employed in this work, 1 post captain, 3 lieutenants, 5 passed midshipmen, and 18 seamen, for one season, say six months. This appropriation of $5,000 is nearly $\frac{1}{13}$th of the whole amount of *direct* expenditures. Adopting the same principles in computing the cost of the work chargeable to the naval establishment, which the Secretary of the Navy adopted in stating $114,584 as the amount properly chargeable to the coast survey, for difference between sea and shore pay, and subsistence of officers, and pay and rations of seamen, we shall have a gross sum, for six months, of upwards of $4,000. Therefore, for every $5,000 expended directly for the work, we should add $4,000; and this, for the $63,520 20, amounts to

* There is an error in this part of the Register's statement; for the *original* collection of instruments cost $37,549, and additional instruments have since been procured.

$50,800. I infer, also, that nothing is included in the above $63,520 20 for purchase or repairs of vessels, equipment, &c., these being provided, as usual, in the general expenses of the naval establishment; on the contrary, both purchases and repairs of vessels, boats, furniture, &c., is chargeable upon the coast survey fund, for all which now belongs to the work. Here, then, we have a sum of $114,320 as the cost of some detached surveys of portions of the coast. Surveys of this nature, and those which are executed upon proper principles, are so unlike in character that they do not admit of comparison.

We proceed now to state briefly the principles upon which the survey of the coast is conducted.

The principle upon which the survey of the coast is conducted is, essentially, that which is known as the trigonometric method. By the relations which subsist between the sides and angles of a triangle, we are enabled, from certain known data, previously determined by actual measurement, to compute certain other parts which are unknown. For example: in a given triangle, by measuring one of the sides and the angles, the two remaining sides can be determined by computation. These computed sides then serve as bases for other triangles, and, subsequently, by measuring the angles *alone* in the triangles thus formed, the work is extended *ad libitum*. This is called a triangulation, and may be made upon any part of the earth's surface upon which a line of a given extent can be measured.

A triangulation may be complete in itself, and, when the necessary corrections have been made for the figure of the earth, the actual distance between two points can be accurately determined. But this, alone, is not all that is required; it is necessary to ascertain the true position of the district or country triangulated upon the earth's surface—that is to say, its latitude and its longitude. The first of these is independent, it being simply its distance from the equator; while the second is not independent, but refers to the position of some other point on the earth's surface, and under another meridian. This latter place or meridian may be assumed at will; and the question then to be determined is simply the difference *in time* between the two places of observation; and this, being converted into degrees, constitutes the longitude, or rather the difference of longitude, between two places.

For these determinations, observations upon the heavenly bodies must be resorted to. It is not necessary, however, that celestial observations should be made at every point determined by the triangulation; on the contrary, a few well-determined positions, ascertained by a long series of observations, often repeated, are sufficient, the connexion between the same being determined by the triangulation; hence the survey of the coast, as now conducted, is made by combined or mixed geodetic and astronomical observations.

Here, then, is the essential difference between a survey by triangulation and astronomical determinations, or even the so-called "chronometric survey," (a misnomer, by the way, for it is not a *survey*.) One consists in a *connected* work, carried on upon the earth's surface, and made by means of an uninterrupted series of triangles; while the other is composed of a collection of observations upon the celestial bodies, made at detached points, each place of observation being independent of the other. In the first method the connexion is complete, while in the others there is no connexion whatever.

To the question, whether the mode of making the survey of the coast by triangulation is better than any other, it may be said to be the *only* truly correct method which can be pursued. It is the only method by which a *connexion* in the work can be preserved. Of its accuracy the proofs are continually before the observer, and an error need not be extended beyond a single triangle. The three angles are measured in every principal triangle of the work; and, as this is all the *measurement* which takes place after the base is determined, it is obvious that the observer has his proofs of correctness continually at hand. There can be no *cooking* of observations, as is sometimes practised in astronomical determinations.

An idea of the exceeding accuracy attainable in works of the nature referred to may be formed by referring to the account of the measurement made by the French astronomers of the arc of the meridian between Dunkirk and Cabrera, for the determination of the figure of the earth, being 12 degrees of latitude in extent. After a great number of triangles had been measured, and an extent of about 500 miles upon the meridian determined, (between Melun and Perpignan,) a base of *verification*, as it is denominated, was measured at Perpignan. This verification consisted in *measuring* with the greatest accuracy one of the sides of a triangle in the series which had been previously determined by computation from the original base. The difference between this computed side and the actual measurement was less than 2 feet.*

In the work of the survey of the coast, the *secondary* triangulation now encompasses the southern part of the State of New Jersey, from Staten island to Cape May; one series of triangles was carried around on the east or coast side, while a second was carried down the Delaware river and bay, uniting near the southern point of the State. The length of the side of the triangle which was common to both series was, of course, determined by each chain of triangles—one by the coast, and the other by the Delaware bay; the difference between the two determinations was two metres, or about six feet. In the primary triangles this difference will, from present appearances, be less than one foot.

Surveys of all the countries of Europe have been or are being made by the system of triangulation, to wit: Austria, Russia, Sweden, Denmark, Hanover, Prussia, Swabia, Bohemia, and the States of Germany generally, Italy, Naples and Sicily, Switzerland, France, England, the British possessions in India, and the French colony in Algiers.

"Europe is covered with well-connected series of triangulations—from the south of Sicily to the polar circle; from Ireland, through England, France, Germany, to the interior of Russia; from Bordeaux to the frontier of Turkey, and in all the intermediate parts."

Some of the practical benefits which have resulted from the coast survey are already apparent. The discovery of the ship channel into the harbor of New York, the better determinations of the channels into Delaware bay, and the detection of the grossest errors in the existing charts of that bay, constitute a portion of the advantages which have already been derived from this work.

The engraving of the chart of the bay and harbor of New York, with the country adjacent to the same, within a circuit of twenty miles, is now

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* La Place.

in progress; two sheets, embracing the entrance to the harbor, with the channel delineated thereon, are already in a state of great forwardness, and, in all probability, will be completed by the 1st of June, 1842.

To the question, "Whether no other mode exists by which accurate results can be obtained within less time than they can be furnished by a trigonometrical survey," the answer is, *No.* There is no *short* method by which these results are attainable. It is not the "quantity" of triangles alone which determines the industry or skill of the observer, but the quality. To make the triangulation of a given district of country with the least possible number of well-conditioned triangles, is one of the important problems to be solved; quality, again, and not quantity, is the essential requisite.

Usually, the experience of the world is justly considered when any great object is to be attempted or effected. Why should it be excluded from the category, in judging the merits of this magnificent work? We have the combined testimony of all the science of Europe in favor of making surveys by triangulations, and, in fact, the positive assertion that it is the *only* proper method. Why should we not adopt the conclusions of nations which, to say the least, are older in these matters than we ourselves are, rather than to resort to methods which are a century behind the age we live in?

Why, with the great advantages which the "chronometric system" is said to possess, is it not adopted by those who are best capable of judging it by its merits? Rather let the whole work be destroyed, than to suffer it to be done discreditably. If we cannot make it in a manner which shall bear the scrutiny of the scientific world, let it rest for another fifteen years. Sextants and chronometers are invaluable instruments in their proper sphere, but they certainly do not furnish the means by which triangulations are to be made, or corrected, or superseded, as some would seem to desire.

Organization of the work.

1. The main or *primary triangulation,* upon which all the work depends, is made up of triangles having sides of from 10 to 50 miles in extent. The angles in these triangles are all measured by Mr. Hassler.

2. Within these main triangles, smaller triangles are formed; this constitutes the *secondary triangulation;* the sides of these vary in length from 2 to 10 miles. The angles of these triangles are measured by the assistants of Mr. Hassler; two and sometimes three parties are engaged in this part of the work; usually they enter the field in March and April, and leave the same for the calculations, &c., in the office in December.

3. The secondary triangulation, in turn, forms the basis of the plane-table or topographical surveys; these include all the details of the ground, outline of the coast or shore, courses of bays, rivers, roads, &c. This portion of the work is distributed among 5 or 6 parties, each having a district of country allotted to it. A party consists of 1 assistant and 5 or 7 hands, according to the nature of the country to be surveyed. These parties usually take the field in April and May, and return to the office, to make up their plottings and maps of the work of the season, in November.

4. The hydrographic determinations are made entirely by the naval assistants of Mr. Hassler. Points on shore are furnished by the triangulation, both main and secondary, together with the coast or shore line from the plane-table surveys. By this means the sounding parties are enabled to

determine the true position of their soundings, by measuring the angles subtended between stations previously established upon the shore. Two parties are engaged in the hydrographic part of the work, each being furnished with the necessary assistants from the navy, and with vessels, boats, &c., belonging to the coast survey. These parties are engaged in their labors upon the coast from April or May to November, according to the character of the weather; in the winter months they are employed in laying down upon their charts the results of the work of the season.

The triangulation now extends from Narragansett bay, Rhode Island, to Cape Henlopen, Delaware, on the coast, and from the neighborhood of New York to the head of Chesapeake bay, covering an area of about 11,000 square miles. The hydrographic surveys cover 5,600 square miles, and the topographical or plane-table surveys 4,200 square miles. This work is represented upon upwards of 200 maps and charts, of various scales, according to the nature of the work, from $\frac{1}{5000}$ to $\frac{1}{100000}$; that is to say, one foot in extent upon the map will represent, according to the scale used, 5,000 feet or 100,000 feet upon the earth's surface.

The actual length of coast line, (including Long Island,) already determined and laid down upon the map, is - - - 631 miles
Do. of the larger bays, rivers, and islands - - - 697 "

Total of shore line, coast, bay, &c. - - - - 1,328 "

Classification of the expenses.

The whole amount expended for the survey of the coast from the *appropriation* therefor, for the year 1841, was $96,174 98.

1. Of this sum, the general expenses of the work, including the main triangulation, compensation of all persons employed therein, instruments and books, and all expenses not enumerated in the items below, amounted to - -	$32,671 09
2. The secondary triangulation, including compensation of persons therein employed, 3 parties - - -	19,352 06
3. The hydrographic surveys, including the cost of repairs of the vessels, boats, &c., and allowances to officers for expenses, 2 parties and 4 vessels - - - -	25,459 16
4. Plane-table or topographical surveys, including compensation of all persons employed therein, 6 parties - -	18,692 67
	96,174 98

The conclusions which are deducible from the preceding remarks may be summarily stated thus:

1. Availing ourselves of the experience and practice of all European nations, it is just to conclude that the survey of the coast can only be made (if it shall be accurately executed) by a triangulation.

2. Conceding the ground that it is by a triangulation alone that exact results can be obtained, it may be shown, by a reference to the history of similar works, that the methods pursued in executing the survey of the coast of the United States are, in principle and in details, in accordance with the best of those adopted by other nations.

WASHINGTON, *February* 25, 1842.