

GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

L E T T E R

FROM THE

SECRETARY OF THE INTERIOR,

RELATIVE TO

The estimate of appropriations heretofore submitted to the House for the continuance of the geological survey.

JANUARY 13, 1875.—Referred to the Committee on Appropriations and ordered to be printed.

DEPARTMENT OF THE INTERIOR,
Washington, D. C., December 23, 1874.

SIR: My attention having been called to the fact that the estimates of appropriations, submitted by this Department through the Secretary of the Treasury, for the continuation of the geological and geographical survey of the Territories of the United States, during the ensuing fiscal year, involve a sum largely exceeding that appropriated for the same service during the current fiscal year, I have the honor to submit to Congress the following statement explanatory of the circumstances under which the increase was inadvertently asked for.

In explanation of the estimate of \$100,000 for the continuance of said survey, as contained in the annual estimates of this Department, I have the honor to state that those estimates were prepared at a time, during the past summer, when I was absent from the city.

A letter had been received from Mr. J. W. Powell, submitting an estimate of \$100,000 for the continuation of said survey during the fiscal year ending June 30, 1876, and for the illustration of the reports thereof. The subject was brought to the attention of the Acting Secretary of the Interior, who, in the absence of any estimate from Dr. F. V. Hayden, deemed it advisable to fix the entire estimate for the continuation of both divisions of the survey at \$100,000, that sum to be divided between Dr. Hayden and Mr. Powell, *pro rata*, on the basis of the appropriation of \$90,000 made for the current fiscal year, and the estimate was accordingly prepared with that intent, and forwarded to the Treasury Department. In this connection, I have the honor to state that the words "by the second division," which are contained in the estimate as shown by the Book of Estimates, do not appear in the copy submitted by me to the Secretary of the Treasury. This interpolation, which would confine the whole sum asked for to the exclusive use of Mr. Powell, obviously destroys the intent of the estimate as originally prepared by this Department.

Subsequently to the transmission of said estimate to the Treasury Department, Dr. Hayden returned from his field of survey and submitted an estimate, amounting to the sum of \$100,000, for the continuation of the survey during the ensuing fiscal year, the illustration of reports, &c., and, without duly considering the action already taken, or intending to increase the original estimate, I forwarded Dr. Hayden's estimate to the Secretary of the Treasury for insertion in the regular estimates of this Department.

In view of the fact that the whole matter has assumed a different shape from that which was intended, and as Dr. Hayden and Mr. Powell have indicated to me their intention to revise their estimates, I have the honor to withdraw my original estimate for \$100,000, and to submit, in lieu thereof, the inclosed estimates, amounting to the sum of \$125,000, or exactly the same amount that was appropriated for the same service during the current fiscal year.

It will be observed that, of the whole amount estimated for, the sum of \$35,000 is for the illustration of the reports of the survey, no provision for which was made in the original estimate, and that the remainder, \$90,000, is for the field-work of the survey, the latter sum being apportioned between the two divisions thereof on the basis of last year's appropriation. If it shall be the pleasure of Congress to grant a larger appropriation than \$90,000 for the field-work aforesaid, it would seem proper, in my judgment, that whatever sum may be appropriated should be more equally divided between the two divisions of the survey than is contemplated in the inclosed estimate. I have already, in the last annual report of this Department, expressed the opinion that this survey deserves encouragement from the Government, and therefore submit the whole subject for favorable consideration by Congress.

As soon as the letters from Dr. Hayden and Mr. Powell, containing their revised estimates, shall have been received, copies thereof will be duly forwarded to Congress.

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

C. DELANO,
Secretary.

HON. JAMES G. BLAINE,
Speaker of the House of Representatives.

Estimate of appropriations required for illustrating the reports of the geological survey of the Territories, during the fiscal year ending June 30, 1876.

For the preparation and publication of the maps, charts, geological sections, and other engraving necessary to illustrate the reports of the United States geological surveys of the Territories, during the fiscal year ending June thirtieth, eighteen hundred and seventy-six, thirty-five thousand dollars, to be expended under the direction of the Secretary of the Interior.

Estimate of appropriations required for the continuation of the geological survey of the Territories during the fiscal year ending June 30, 1876.

For the continuation of the geological and geographical surveys of the Territories of the United States by F. V. Hayden, seventy-five thousand dollars, and by J. W. Powell fifteen thousand dollars, during the fiscal year ending June thirtieth, eighteen hundred and seventy-six; in all ninety thousand dollars, to be expended under the direction of the Secretary of the Interior.

GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

LETTER

FROM

THE SECRETARY OF THE INTERIOR,

SUBMITTING

Revised estimates for the continuation of the geological and geographical survey of the Territories of the United States.

JANUARY 13, 1875.—Referred to the Committee on Appropriations and ordered to be printed.

DEPARTMENT OF THE INTERIOR,
Washington, D. C., January 4, 1875.

SIR: Since my letter of the 23d ultimo, relating to the estimates of appropriations for the continuation of the geological and geographical survey of the Territories of the United States, was written, communications have been received from Dr. F. V. Hayden and Mr. J. W. Powell, submitting revised estimates for their respective divisions of said survey.

Copies of said communications and estimates are herewith transmitted, consisting of—

1st. Letter from Dr. F. V. Hayden, dated December 24, 1874, submitting revised estimate for the continuation of his division of the survey during the ensuing fiscal year, amounting to \$75,000;

2d. Letter from Dr. Hayden of the same date, submitting revised estimate for the illustration of the annual and final reports of his survey during the ensuing fiscal year, amounting to \$20,000;

3d. Letter from Mr. J. W. Powell, dated December 30, 1874, submitting revised estimates for the continuation of his division of the survey during the ensuing fiscal year, amounting to \$25,000; and for the illustration of his reports during said year, amounting to \$25,000;

4th. Map of the Territories of the United States, which accompanied letter of Mr. Powell; and

5th. Letter from Dr. Hayden, dated December 31, 1874, in further explanation of his estimates.

The foregoing estimates aggregate for field-work, \$100,000, and for illustration of reports, \$45,000; in all \$145,000; a sum exceeding by \$20,000 the appropriations made for both branches of the survey during the current fiscal year. I am fully convinced of the importance of con-

tinuing this survey, but do not feel at liberty to state what amount should, in my opinion, be appropriated for the purpose. The whole subject is therefore respectfully submitted for favorable consideration by Congress, and, if it shall be the pleasure of that body to grant the increased amount asked for, I have the honor to suggest that items similar to the inclosed estimates be inserted in the pending sundry civil appropriation bill.

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

C. DELANO,
Secretary.

Hon. JAMES G. BLAINE,
Speaker of the House of Representatives.

For the continuation of the geological and geographical survey of the Territories of the United States, under the direction of the Secretary of the Interior, during the fiscal year ending June thirtieth, eighteen hundred and seventy-six; by the first division, under F. V. Hayden, in Colorado and such adjacent portions of Utah and New Mexico as were explored the preceding year, seventy-five thousand dollars; and by the second division, under J. W. Powell, in Utah, twenty-five thousand dollars; in all, one hundred thousand dollars.

For the preparation and publication of the maps, charts, geological sections, and other engravings necessary to illustrate the reports of the United States geological and geographical survey of the Territories; by the first division, twenty thousand dollars, and by the second division, twenty-five thousand dollars; in all, forty-five thousand dollars, to be expended under the direction of the Secretary of the Interior.

DEPARTMENT OF THE INTERIOR,
Washington D. C., December 24, 1874.

SIR: I would respectfully request the sanction of the Secretary of the Interior to the following annual estimate for the continuation of the geological and geographical survey of the Territories of the United States for the fiscal year ending June 30, 1876.

During the season of 1874 the survey continued its labors in the mountainous districts of Colorado, in an almost unknown area of our continent. With a portion of the force in the field the coming season, the area marked out for six sheets of the physical atlas will be completed. The portion of this district, however, that remains to be surveyed is very far from our base of supplies, and the work will therefore be performed at an increased expense.

The short session of Congress will enable the party to commence early in the season, and this, also, will add much to the expense, though it will increase the value of the results.

Most of the assistants connected with the survey have spent several years in this special work, and their facility for producing results has proportionately increased. It becomes necessary, therefore, in order to retain them in the service, to increase their salaries somewhat commensurate with their value.

Therefore, on account of the greater length of time to be spent in the field the coming season, and the greater distance of the area to be surveyed from our base of supplies, as well as to render the corps more

efficient for its duties, I would respectfully beg the sanction of the Secretary of the Interior to the usual estimate of \$75,000, for the field-work of the fiscal year ending June 30, 1876.

Very respectfully,

F. V. HAYDEN,
United States Geologist.

Hon. C. DELANO,
Secretary of the Interior.

For the continuation of the geological and geographical surveys of the Territories of the United States by Prof. F. V. Hayden, under the direction of the Secretary of the Interior, during the fiscal year ending June 30, 1876, seventy-five thousand dollars.

DEPARTMENT OF THE INTERIOR,
Washington, D. C., December 24, 1874.

SIR: I would respectfully ask your sanction to the following estimate of \$20,000 for the preparation and publication of the maps, charts, geological sections, and other engravings necessary to illustrate the annual and final reports of the geological and geographical survey of the Territories of the United States, for the fiscal year ending June 30, 1876.

In confirmation of this request, I beg to say that a portion of the six sheets of the geological and geographical map of Colorado are now in the hands of the engraver, and two hundred quarto plates of fossils are ready to be engraved, besides a very large number of sections, small maps, and other illustrations for the annual reports. In view of the necessity of this great amount of very important work being given to the public at an early date, I trust this estimate will receive your approval.

Very respectfully, your obedient servant,

F. V. HAYDEN,
United States Geologist.

Hon. C. DELANO,
Secretary of the Interior.

For the preparation and publication of the maps, charts, geological sections, and other engravings necessary to illustrate the annual and final reports of the geological and geographical survey of the Territories of the United States, for the fiscal year ending June 30, 1876, twenty thousand dollars, to be expended under the direction of the Secretary of the Interior.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL AND GEOGRAPHICAL
SURVEY OF THE TERRITORIES, SECOND DIVISION,
Washington, D. C., December 30, 1874.

SIR: In compliance with your verbal request, I have the honor to submit the following revised estimates for appropriations to continue the geological and geographical survey of the Territories by the second division, under my charge.

4 GEOLOGICAL AND GEOGRAPHICAL SURVEY OF TERRITORIES.

For the continuation of the geological and geographical survey of the Territories by J. W. Powell, \$25,000.

For the preparation of maps, charts, geological sections, ethnographic and other illustrations, and for special studies connected with said survey, \$25,000.

In explanation of the above estimates I beg leave to submit the following statement:

The work originally commenced as the "exploration of the Colorado River of the West." After the unknown portion of the river (being a distance along its course of 1,053 miles) had been explored, the work was changed to a survey. The area surveyed is a belt of country along and on both sides of the river, varying from 50 to 250 miles in width and embracing an area of 59,400 square miles. In addition to this, a preliminary reconnaissance has been made over an area of 9,000 square miles. During the first two years of the progress of the work the survey rested on base-lines, determined by astronomical methods, with the triangulation on points which were topographic features. After two years' experience it was decided that this method was not sufficiently accurate for scientific or economic purposes, and another system was adopted, that of measuring base-lines by methods sufficiently refined for that purpose, and projecting therefrom a series of triangles to artificial points or flag-stations.

By the latter method about 40,000 square miles have been surveyed; by the former, nearly 20,000 square miles. The reconnaissance mentioned above, made over an area of 9,000 square miles, was for the purpose of preparing a plan of triangulation for the beginning of another year's work.

The appropriations which have been made for the above work are as follows:

For the fiscal year ending June 30, 1871.....	\$12,000
For the fiscal year ending June 30, 1872.....	12,000
For the fiscal year ending June 30, 1873.....	20,000
For the fiscal year ending June 30, 1874.....	10,000
For the fiscal year ending June 30, 1875.....	30,000
Total.....	84,000

In addition to these appropriations, my parties have received rations from the Commissary Department of the Army during a part of the time, but the value of such subsistence-stores would not equal the amount expended in the exploration of the river previous to the commencement of the survey, so that it is proper to say that the survey of the area mentioned—40,000 square miles from measured base-lines, and 19,400 square miles from astronomical bases, and the reconnaissance of 9,000 square miles—has cost a total of \$84,000 up to the present time. To complete the office-work, engrave the maps, geological sections, ethnographic and other illustrations, and for special studies, it will require, in addition to the balance now on hand, an appropriation of \$30,000; so that the work when completed will have cost \$114,000, or \$1.91 $\frac{9}{10}$ per square mile, not including the area embraced in the reconnaissance.

It is proper for me to state that prior to the present year the rail roads over which my parties were compelled to travel in the performance of their duties have generously extended to us the courtesy of free transportation both for men and materials, so that no expense has been incurred on the part of the Government for railroad transportation. The railroad officials having met in general convention and decided no longer to issue passes, such saving cannot be made during the present year nor in the future. During the same time the expenses of the photographic department were borne by myself, as I did not deem that the amount of the appropriations was sufficient to warrant

me in adding this department to the survey at the expense of the Government. It is found that photography is a great assistance, and even a necessary means to be used in such survey, and the expense hereafter should be borne by the Government.

Experience has shown that the cost of these surveys with accurately measured base-lines is about \$2.50 per square mile. Adding to this the cost of railroad transportation and photography, the cost will be about \$3 per square mile—that is, if the work is carried on with parties organized as they have been in the past; but it is believed that by a somewhat different organization the survey can be carried on without increasing its cost beyond \$2.50 per square mile.

Permit me to briefly explain this. For the most thorough and economic work the parties should be somewhat enlarged so as to admit of a more thorough division of labor, and thus permit the several parts to go on co-ordinately and simultaneously. As my parties have been organized heretofore, the principal scientific labor has been divided between Professor Thompson, my chief assistant, and myself, and this has compelled us to frequently change from one field of investigation to another, and this has resulted in a delay of the work, as one part was compelled to wait for another. As chief of the expedition I have had general direction and taken the especial work of geology and ethnography on my hands. I ought to have an assistant geologist competent to do field-work in geology and take general charge of the paleontological investigations. Professor Thompson has had the immediate direction of the geographic department. Besides taking charge of that general department in the field, he has been compelled to make the geodetic and hypsometric computations and to supervise all the topographic work. He should have an assistant competent to take charge of the hypsometric and topographic work, allowing him to use his time in the general direction of the work, and, as a specialist, to take charge of the geodesy—*i. e.*, the determination of latitudes and longitudes, and geodetic points by triangulation. He should also have constantly employed in the work a skilled draughtsman.

With such an organization and the more thorough division of labor which it would permit, the expense of the survey would be kept within the figures which I have stated—*i. e.*, \$250 per square mile.

The annual appropriation necessary to support such an organization would be \$50,000. I have reached this estimate after a very careful examination founded on an experience of five years. The estimate covers all the expenses of the work; that is, 20,000 square miles can be surveyed by the better method indicated above for \$50,000, including the field-work, computations, special studies, preparing and engraving maps, illustrations, and all expenses of the reports ready for the public printer.

A statement should be made of the character of the work which it is proposed to execute under these estimates.

The honorable the Secretary of the Interior has issued instructions to the parties engaged in geological and geographical surveys which embrace a general plan for the construction of a physical atlas of the arid and mountainous region of the West. By this plan the region is divided provisionally into districts of $2\frac{1}{2}$ degrees of longitude by $1\frac{1}{4}$ degrees of latitude; each district is to be represented on a single sheet of the atlas on a scale of four miles to the inch linear, or sixteen square miles to the square inch.

For the production of accurate maps on this scale it is necessary to employ carefully-measured base-lines and a system of triangulation for

the geodetic groundwork such as I have described above as being used in the better method, and it is believed that the work can be done with all the accuracy and detail that can be represented on maps of this scale by the methods proposed. Should the scale be increased or diminished, the expense of collecting and preparing the data would be correspondingly increased or diminished.

In preparing this statement I have contemplated the representation of certain facts in the physical atlas.

First. The general topographic features of the country, such as mountains, water-courses, and bodies of water;

Second. The amount and distribution of arable lands, or those which can be redeemed by irrigation;

Third. The amount and distribution of pasture-lands;

Fourth. The amount and distribution of timber-lands;

Fifth. The amount and distribution of mineral-lands;

Sixth. The structural geology and distribution of geological formations; and

Seventh. The distribution of the aboriginal tribes of the country.

I have not estimated for elaborate and refined geological, ethnographic, and natural history surveys, but only for preliminary surveys such as seem to be immediately demanded. Two-thirds of the amount named would be used in topographic surveys, and one-third in all others.

Many other lines of investigation might be pursued, all of great interest, especially to that large and increasing number of American citizens who are interested in scientific investigation; but it is believed that the studies enumerated are those demanding the most immediate attention both for economic and scientific purposes. Should it be thought best to enter other fields of investigation, increased appropriations would be necessary.

In the specific estimates made above, the first amount of \$25,000 is for the continuation of the field-work. The second amount of \$25,000 is for the publication of the work already accomplished. Any smaller appropriation than the latter for that purpose would result in withholding from the public the results of the surveys which have already been made.

I transmit herewith a copy of the "Map of the United States and Territories" compiled in the General Land-Office, on which I have platted the area surveyed as reported as above.

By reference thereto it will be seen that the field-work of certain of the atlas-sheet districts is complete, of others incomplete. During the coming season it is proposed to extend the surveys over the unfinished districts.

I am, with great respect, your obedient servant,

J. W. POWELL,

In charge 2d Div. Geol. and Geog. Survey.

Hon. COLUMBUS DELANO,

Secretary of the Interior, Washington, D. C.

WASHINGTON, D. C., December 31, 1874.

SIR: In further explanation of the sum requested by me for the continuation of the United States geological and geographical survey of the Territories for the coming fiscal year, I would state that it is my purpose to continue the exploration in the Territory of Colorado, collecting such geological and topographical data as is required to com-

plete the six sheets of our physical atlas of Colorado. It only remains to survey the following portions of country to finish the map:

There remains unfinished of sheet 77, in the western half, 6,400 square miles; of sheet 78, in the northeastern half, 1,000 square miles; of sheet 84, in the western half, 5,600 square miles; of sheet 97, in the western and southern parts, 7,000 square miles; of sheet 98, in the southern part, 6,800 square miles.

Very respectfully, your obedient servant,

F. V. HAYDEN,
United States Geologist.

Hon. C. DELANO,
Secretary of the Interior.