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**Preliminary field report of the United States geological survey of  
Colorado and New Mexico**

**Hayden, Ferdinand V.**

**Washington, 1869**

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Letter to the secretary.

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## LETTER TO THE SECRETARY.

DENVER, COLORADO TERRITORY,  
October 15, 1869.

SIR: In accordance with your instructions dated Washington, April 1, 1869, I have the honor to transmit my preliminary field report of the United States geological survey of Colorado and New Mexico, conducted by me, under your direction, during the past season. A portion of your instructions are as follows:

"You will proceed to the field of your labors as soon as the necessary arrangements can be made and the season will permit, and your attention will be especially directed to the geological, mineralogical and agricultural resources of the Territories herein designated; you will be required to ascertain the age, order of succession, relative position, dip, and comparative thickness of the different strata and geological formations, and examine with care all the beds, veins, and other deposits, of ores, coals, clays, marls, peat, and other mineral substances, as well as the fossil remains of the different formations; and you will also make full collections in geology, mineralogy, and paleontology, to illustrate your notes taken in the field."

In accordance with the above instructions I proceeded to Cheyenne, Wyoming Territory, where my preparations and outfit were made.

My assistants were selected as follows:

1. James Stevenson, managing director and general assistant.
2. Henry W. Elliott, artist.
3. Rev. Cyrus Thomas, entomologist and botanist.
4. Persifer Frazer, jr., mining engineer and metallurgist.
5. E. C. Carrington, jr., zoologist.
6. B. H. Cheever, jr., general assistant.

Five men were also employed, three of them as teamsters, one as laborer, and the other one as cook.

As soon as my preparations were completed, my field labors commenced, June 29, at Cheyenne. Limited somewhat as to time and means, I arranged my plans so as to cover as much ground as possible and secure the greatest amount of geological information. On the plains the geological structure is very simple, and frequently over large areas the basis rocks are concealed by superficial deposits. It seemed best, therefore, to make my examinations southward along the eastern base of the Rocky Mountains for the purpose of studying the upheaved ridges, or "hog backs," as they are called in this country. These ridges afford peculiar facilities for working out the geological structure of the country. Indeed, they are like the pages of an open book upon which the geologist can read what the Creator has written upon each formation known in the country from the granite mass that forms the nucleus of the loftiest mountain range to the most recent tertiary formation inclusive. Often in a little belt, from half a mile to four or five in width, one may travel over the upturned edges of nearly all the formations in the geological scale, and the opportunity was presented, in this way, for tracing



out their relations by studying the junction of the changed with the unchanged rocks.

From Cheyenne to Denver we examined with some care the mines about the sources of the Cache à la Poudre River and the coal mines at South Boulder. From Denver we visited the silver mines at Georgetown, and the gold mines of Central City, thence to the Middle Park, where we found much of interest geologically. We then returned to Denver and pursued our way southward, passed the "divide" to Colorado City, Soda Springs, Cañon City, Spanish Peaks, Raton Hills, Fort Union, Mora Valley, Santa Fé, Placiere Mountains, &c. Along this route the scenery was grand beyond description. At Colorado City there is an area of about ten miles square that contains more material of geological interest than any other area of equal extent that I have seen in the west.

The coal formation along the base of the mountains was studied with great interest. With these coal beds are associated valuable deposits of brown iron ore. The coal and iron deposits of the Raton Hills extend from the Spanish Peaks to Maxwell's, and the supply of both is quite inexhaustible and of excellent quality. The future influence of these two important minerals at this locality, on the success of a Pacific railroad, cannot be over-estimated. It is believed that the coal and iron mines of the Raton Hills will be of far more value to the country than all the mines of precious metals in that district.

The next locality for coal was at the Placiere Mountains. In one locality here, the coal has been changed into anthracite by the eruption of a basaltic dike, the igneous material of which had poured over the coal strata. Vast quantities of brown iron ore are associated with this coal, and magnetic iron ore is found in the gneissoid rocks of the mountain. The gold mines here are very rich and are now wrought upon a true scientific plan.

From Santa Fé we proceeded up the Rio Grande through the San Luis Valley, Poncho Pass, Arkansas Valley, through the South Park to Denver again. We could only give a glance at the salt springs and gold mines of the South Park, but we gathered much valuable information in regard to this interesting region. To the geologist Colorado is almost encyclopedic in its character, containing within its borders nearly every variety of geological formation. The portion of the country examined by me this summer, comprises a belt about five hundred and fifty miles in length from north to south, and almost two hundred in width from east to west.

The collections in all departments are very extensive and valuable, comprising geological specimens, fossils, minerals, plants, birds, quadrupeds, reptiles, and insects, all of which are to be arranged and classified in the museum of the Smithsonian Institution according to a law of Congress.

My report, herewith transmitted, has been written under circumstances of great pressure at odd moments, in traveling from point to point, or in camp after the labors of the day were completed, far away from books or any opportunities for careful elaboration. It may therefore be regarded as little more than a transcript of my field-notes.

Accompanying my own report will be found those of my assistants. Mr. Persifer Frazer, jr., on the mining resources of the route passed over, and Mr. Cyrus Thomas on the agricultural resources. I regard these reports as of great practical value to the country.

I take this opportunity of tendering my thanks to all of my assistants for their cordial co-operation throughout the entire survey. The reports of Messrs. Thomas and Frazer will speak for themselves. Mr. Elliott,



the artist, has labored with untiring zeal, and has made more than four hundred outlines of sketches, and about seventy finished ones for the final reports. Each one of these sketches illustrates some thought or principle in geology, and, if properly engraved, will be invaluable. My principal assistant, Mr. James Stevenson, who has been associated with me in my western explorations for many years, has rendered me indispensable services throughout the entire trip.

I beg permission to state here that my appropriation was so limited that had it not been for the kindness and generosity of the military authorities of the country, I could have accomplished but a small portion of the work that I have performed during the present season, and I take this opportunity to say that the West is very largely indebted to them for whatever benefit my labors have been or may be to the country.

Before leaving Washington, I made application by letter to General Sherman, commanding the armies of the United States, for such assistance from the military authorities of the West as could be afforded to me without manifest injury to the public service. On my letter of application, General Sherman placed the following indorsement:

"This application is referred to the commanding officers of the departments, districts, and posts, who will extend to Professor Hayden's party the usual courtesies, and the privilege of purchasing a limited quantity of provisions on the same terms as officers."

Similar indorsements were made by Generals Sheridan, Schofield, and Augur. The greater part of my outfit was supplied to me by Colonel E. B. Carling, United States army, depot quartermaster at Fort D. A. Russell, Wyoming Territory; and I cannot express too cordially my grateful acknowledgments to him for his generous aid, not only for this season, but also for two previous campaigns. I am also under equal obligation to General William Myers, United States Army, chief quartermaster department of the Platte, at Omaha, for invaluable aid in several past years. When we came in the vicinity of a military post, at Fort Union, Santa Fé, or Fort Garland, we received all the aid we needed.

I would also extend my grateful acknowledgments to the press and the citizens of Colorado and New Mexico, but more especially to Colorado for their cordial aid and sympathy in all my explorations.

If my labors have added anything to the sum of human knowledge and the honor of our country, I shall be content.

I remain very respectfully, your obedient servant,

F. V. HAYDEN,  
*United States Geologist.*

Hon. J. D. Cox,  
*Secretary of the Interior.*

REPORT OF E. V. LAYDEN