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**Profiles of Rocky Mountain Geologists – a continuing series**



*F. V. Hayden*



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# Revisiting the life and scientific reputation of Ferdinand Vandeveer Hayden

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*Hayden annoyed almost everyone he knew at one time or another; he thrived on spiteful controversy.*

—Mike Foster, 1994, p. 351

*At the period of his greatest success Hayden was always the same unpretentious and enthusiastic seeker for knowledge.*

—Edward Drinker Cope, 1888

Had Congress created the United States Geological Survey (USGS) in 1877, rather than a year later, Ferdinand Vandeveer Hayden (Fig. 1) would likely have become the first director. He was the favorite. If this had happened, Hayden's reputation and prominence today would be completely different.

By many accounts, Hayden was the most qualified of the principal candidates for the USGS directorship, a group that included Clarence King, John Wesley Powell, and George Montague Wheeler. Congressional support for Hayden's U.S. Geological and Geographical Survey of the Territories, and for Hayden as its leader, was greater than that for the Geological Exploration of the Fortieth Parallel (the King Survey), the Geographical Survey West of the 100<sup>th</sup> Meridian (under Wheeler, of the U.S. Army's Corps of Engineers), or the Geographical and Geological Survey of the Rocky Mountain Region (the Powell Survey).

At the time, from his published studies and newspaper stories, Hayden was well known and respected both in the U.S. and in Europe. He managed many people and projects, and he raised the money to keep people in the field and in offices writing their reports, the publication for which he also arranged. During the 25 years or so of his exploration in the American West—up to about 1878—Hayden's publications exceeded in number and were frequently equal to or superior in quality to those of King, Powell, and Wheeler. Hayden was the most experienced naturalist of the candidates and had served as director for the more inclusive and scientifically varied of the surveys.



**Figure 1.** F. V. Hayden, about the time of his directorship of the U.S. Geological Survey of the Territories, 1870. Courtesy of U.S. Geological Survey Photographic Library.

Neither King nor Powell had yet published their best geologic work, although Powell's Colorado River narrative (1875) was in print, and though it attracted

significant public interest and is a wondrous report, it contains little geology. Prior to 1877, Powell's most notable geologic publication was his report on the eastern part of the Uinta Mountains (1876), some of which was taken from King. Powell's, King's, and Hayden's maps of the Uintas are all quite similar. Many of the publications generated by the Powell survey concerned Native Americans, probably John Wesley Powell's principal interest (Worster, 2001).

In 1872, King's colorful account of his field and climbing adventures, *Mountaineering in the Sierra Nevada*, appeared. *Mountaineering in the Sierra Nevada* contains descriptions of many journeys and views from lofty mountain peaks; it is travel writing that informs and engages its readers. The book gave King literary standing and attention by both Congress and the press.

Wheeler was not long in the running for the directorship. He knew little about geology, and was in fact generally impatient with geologists who were prone to be too deliberate in the field to suit him. For a time, he had two excellent scientists on staff: the peerless G. K. Gilbert (three seasons (Picard, 2008)) and the vertebrate paleontologist E. D. Cope (one season). However, Wheeler's geologists were essentially assistants to his topographers.

Hayden's ebullience, his articles and book-length reports on Yellowstone (Hayden, 1872a, b, c; 1873), his appreciation of its great beauty, and the role he played in establishing Yellowstone as a national park, brought him great attention and substantial recognition throughout the U.S. and Europe. This may have been a mixed blessing, obscuring some of his less well-known but real contributions to science.

Of the four candidates for the directorship, Hayden was the oldest. He had done the most varied and largest amount of science. He enjoyed the most support in Congress and initially appeared to be the better politician. The prominent geologist J. D. Whitney of California, who was Clarence King's principal mentor and knew the most about his abilities, wanted Hayden to be the first director of the USGS instead of King (Foster, 1994, p. 317). Nevertheless, King, in what looked like an upset, prevailed, becoming director in 1878 of the newly formed Survey. Hayden made some mistakes in his efforts to reach the directorship (Foster, 1994, p. 292). Further, Hayden's style of surveying was on its way out. And Powell, who favored King, was part of

a small group of men who wanted Hayden out. There was much rivalry among the surveys and considerable jealousy of Hayden's success. Thus, Hayden's enemies, of whom there were many—among them John Wesley Powell, Clarence King, Othneil Charles Marsh, John Strong Newberry, James Hall, and George M. Wheeler—won the wounding political struggle. When King rather quickly resigned, Powell succeeded him.

The early years of Hayden's life are murky. Even when and where he was born is unclear. His principal biographer, Foster (1994, p. 12), concluded that it was in Westfield, Massachusetts, on September 7, 1828. Most other historians accept that date, though birth records have not been found. On occasion, Hayden juggled his own age, claiming he was born on September 7, 1829, an impossible date because it is too near the birth of his younger brother.

Hayden's parents, Asa Hayden and Melinda Hawley, were unmarried when he was born. His father, described as an alcoholic, died when Hayden was ten (Aldrich, 1972). Early in 1841, when Hayden was 12, his mother sent him to Rochester, Ohio, to live with an aunt and her husband on their farm. After that time, Hayden never really rejoined his mother, who had abandoned him. On May 23, 1841, Hayden's mother married a prosperous Ohio farmer (Foster, 1994, p. 15).

In September 1845, Hayden, virtually penniless and with few educational credentials, entered the preparatory department of Oberlin College, walking tens of miles to get there. He was not unlike many of his classmates. In his classes, he encountered "geography, math, English, elementary Latin and Greek, history, and the four gospels," but little science (Foster, 1994, p. 23). Probably he read more poetry than petrology. He fell in love quickly and regularly (Foster, 1994, p. 22), perhaps related to his mother's rejection of him. Five years later he graduated from Oberlin, one of only 13 of the 40 students admitted to freshman status with him in 1846. Afterward, Hayden often said that the years spent at Oberlin were the happiest of his life.

In September 1850, Hayden enrolled in Oberlin's Theological Department, but for part of that year, he

was mainly teaching in district Ohio schools. By the fall of 1851, Hayden was in Cleveland studying medicine and natural history with J. P. Kirtland and J. S. Newberry (Foster, 1994, p. 31). Through Newberry, a budding geologist, Hayden met James Hall in 1851 at Newberry's home. By then, Hall was already a well-known paleontologist and stratigrapher in New York State. Hayden visited him in Albany, gradually cultivating the relationship that eventually led to support for field studies in the South Dakota Badlands. Hayden sent plants he later collected to Newberry. Eventually, both Hall and Newberry became enemies of Hayden.

In the spring of 1853, Hall asked the superb paleontologist, F. B. Meek, to lead a field trip with Hayden up the Missouri River to the Dakota Badlands, and Meek accepted. Meek and Hayden soon formed a productive alliance, and Meek became Hayden's closest personal friend in geology. However, their friendship had its ups and downs, and it cooled after 1867 as Meek began to think Hayden was hogging the credit for their studies (Cassidy, 2000, p. 95).

During the nine-year period of 1856–1865, Meek co-authored as the senior author more than 20 articles with Hayden, beginning with Hayden's first geological paper, a short article on gastropods from the Cretaceous of Nebraska (Meek and Hayden, 1856). That year the two co-authored four other papers describing new species of mollusks from the Nebraska Territory, all in the Proceedings of the Academy of Natural Sciences of Philadelphia.

About two years earlier (January 1854), Hayden earned the M.D. from Albany Medical College, training and a degree that he believed would lead to a career in geology. He never entered the regular practice of medicine. To go from a medical degree to a career in geology—to finding opportunities for collecting specimens in the West and making new scientific discoveries—required Byzantine political maneuvering on Hayden's part, a job he managed skillfully. At this point, at age 25, Hayden knew something about nature, but very little about geology.

In June 1854, he began a 20-month trip to the Upper Missouri Basin, traveling as far as the confluence of the Bighorn and Yellowstone Rivers that first summer. He wintered at Fort Pierre in South Dakota and explored the Badlands, Black Hills, and Fox Hills (Foster, 1994, p. 65). The second summer, Hayden went on up the Missouri River to

Fort Benton. His collecting during this stage of the trip was highly successful: the first soft-shelled turtle found in America, the first dinosaur remains, pachyderms, fish-like reptiles, camel-like animals, rodents, and the mollusks he and Meek would describe in the 1856 articles.

From April 1856 to late 1860, Hayden continued exploration in the American West, first with Lieutenant Governor Kemble Warren, then with Captain William F. Reynolds. These were the best opportunities for field work he could muster, but ones in which the military's slow pace and demands were frustrating. He gathered valuable collections, however, and explored the Upper Yellowstone River. He also published his first geological map (Hayden, 1857, p. 76) and authored more than 20 papers, the majority with Meek.

Next, Hayden spent most of two years in Washington, D.C., finishing his manuscripts *On the Geology and Natural History of the Upper Missouri* (1862a) and *Contributions to the Ethnography and Philology of the Indian Tribes of the Missouri Valley* (1862b), two book-length efforts. The work on the Upper Missouri (1862a), though a collage, some of which had been previously published, is still interesting. The seven years from 1856 through 1862 were for Hayden a solid period of field work, research, and publication.

During October 1862, when many others were dodging military service, Hayden enlisted in the Union army (Fig. 2). In November he passed a three-day examination and became a "surgeon of volunteers" (Foster, 1994, p. 143). By the time Hayden enlisted, he had authored or coauthored 36 papers and notes related to his geological investigations (Cassidy, 2000, p. 76).

A year after enlisting in the army, Hayden was put in charge of two small hospitals (50 beds) at Beaufort, South Carolina (Foster, 1994, p. 144). Later, he became the Post Surgeon. In 1864, he was successively appointed assistant medical inspector, Department of Washington, and Chief Medical Officer, Army of the Shenandoah. A month after Lee surrendered to Grant (April 9, 1865), Hayden resigned his commission, leaving the army as a Lieutenant Colonel by brevet, a higher nominal rank than that for which he received pay.

What to do next? The end of the war and his discharge from the army posed problems for Hayden,



**Figure 2.** F. V. Hayden in Union Army uniform during the Civil War, apparently the only time he actually practiced medicine, 1865. Courtesy of U.S. Geological Survey Photographic Library.

as for most other veterans of the Civil War. He surmised correctly that there would be few funds for exploration in the American West for some time following the war. Through his friends in Philadelphia and Washington, D.C., he lined up enough support to become an Auxiliary Professor of Geology and Mineralogy in the Department of Medicine, University of Pennsylvania. If such existed then, no formal course evaluations of Hayden's teaching survive. Colleagues and students suggested that he was successful, presenting carefully prepared lectures, showing numerous minerals, rocks and fossils, and having an open-door policy (Foster, 1994, p. 152).

In the fall of 1866, Hayden was back in the field, collecting in the Badlands and in other parts of South Dakota. He also traveled across Nebraska and explored in Colorado and southern Wyoming. His principal area of survey in 1867 was Nebraska;

in 1868, it was southern Wyoming; and in 1869, it was Colorado. During 1869, Hayden's appropriation doubled. That Survey then became the U.S. Geological Survey of the Territories.

The printing in 1870 of the dramatic landscapes in Hayden's bestseller, *Sun Pictures of Rocky Mountain Scenery*, marked a leap forward for him. It was a good year: he turned 42, and he was engaged to marry Emma Woodruff, whom he had met in 1867 in Philadelphia. The *Sun* book became a model for other naturalists working in the American West. Displaying signs of Hayden's characteristic excitement and enthusiasm for nature, it pleased a growing popular taste for combining science and scenery, and it offered substantial original research. He capitalized on the burgeoning appeal of photography combined with writing, which continues to the present. Hayden enshrined the Rocky Mountains like a relic, said Foster (1994, p. 197).

With \$40,000 obtained from Congress in 1871, Hayden put together his largest team to that date for exploration in the Yellowstone area of Wyoming. During early June, he led 34 men and seven wagons east, then north from Ogden, Utah (USGS, 1980, p. 8). Within the conterminous U.S., the Yellowstone region was almost the last unexplored area in western North America.

In 1870, the famous Washburn-Doane expedition provided a startling account of the Upper Yellowstone (Keefer, 1971). Members of that survey, while camped near the Gibbon River crossing about 15 miles northwest of Old Faithful, discussed the need to preserve the area. Thus, according to Smith and Siegel (2000, p. 189) the idea for a national park was born.

Particularly important to the success of Hayden's Yellowstone exploration were the artists H. W. Elliot and Thomas Moran, together with William H. Jackson, the foremost photographer of the American West. Later on these artists' documentation and sensitive capture of Yellowstone's wonders were critical in introducing members of Congress to its animal life, wildness, and extraordinary beauty. In 1873, Moran produced the beautiful impressionist work, *The Grand Canyon of the Yellowstone*, a large oil painting on canvas, which was soon put on display in Washington, D.C.

From June into September of 1872—his appropriation shooting up to \$85,000 (Cassidy, 2000,

p. 120)—Hayden led a second campaign to the Yellowstone region (Hayden, 1873, p. 228). In July of 1872, he had resigned his professorship at the University of Pennsylvania. About Yellowstone he wrote the first descriptions of the mountain ranges, and he identified the basic volcanic character of the rocks, now called the “plateau rhyolites” and the “Absaroka sequences,” mostly andesites (Keefer, 1971). On March 1, 1872, President U.S. Grant, beginning his second term, signed into law a bill approved by Congress that established Yellowstone as our first national park.

The establishment of Yellowstone National Park was a major conservation precedent. According to the U.S. Geological Survey (1980, p. 31), Hayden’s leadership of the two expeditions and his written contributions were the high point of “his long and distinguished career in public service.” Certainly, he is best remembered for the Yellowstone studies, on which he formally reported 138 years ago (Hayden, 1872a). Though mountain men and Native Americans knew about Yellowstone and saw and talked about geysers, boiling springs, mud volcanoes nearby, quaking land and the drifting vapors from springs and geysers—telling tales and constructing legends—their stories were mostly scoffed at by the public. To his immense credit, Hayden recognized the giant crater of the Yellowstone caldera, a remarkably acute observation considering all that had transpired since its formation: the subsequent lava eruptions, the smoothing of the land by enormous glaciers, and erosion and deposition. Neither Iceland nor New Zealand match the extent, variety, and grandeur of Yellowstone. Nothing on Earth does. Yellowstone made Hayden a national celebrity, our most famous explorer (Fernlund, 2000, p. 11).

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Following the Yellowstone expeditions, Hayden decided to move his survey to Colorado. Expenses had become high for Yellowstone research, and there was no railroad and only limited trails. Further, the Sioux were “in a state of hostility over the greater portion of the country which remains to be explored,” said Hayden in an 1873 letter to the Secretary of the Interior, Columbus Delano (Hayden, 1994, p. 240). In 1872, the Sioux attacked one of Hayden’s divisions working in Wyoming. Congress approved the new plans; from 1874–1876 he was with the survey in

Colorado. The masterful *Atlas of Colorado* appeared in 1877 (Hayden, 1877b), and within it, almost all of the high country in Colorado is shown. Hayden reported on surface features of the Front Range, on the Lignite Group of Colorado and portions of Wyoming, and on ore-bearing rocks in Colorado (Foster, 1994, p. 412).

The rock sequence called the “Great Lignite,” renamed the Laramie Formation in 1877, was an obsession of Hayden’s. It was one of the principal research questions of his career. He traced the layers across the Upper Missouri, “and assumed its equivalency in all the coal-bearing rocks near the eastern slope of the Rockies from Montana to New Mexico” (Foster, 1994, p. 185). Hayden’s interpretation was that the lignite-bearing strata were at the base of the Tertiary, underlain by Mesozoic layers. Other geologists had found invertebrates in coal-bearing rocks that were apparently Cretaceous in age, sufficient evidence for some geologists that the lignites were not all one enormous formation. During 1868, Hayden himself discovered beds in northeastern Utah that contained lignites and were undoubtedly Cretaceous (Hayden, 1869; Foster, 1994, p. 186). Nevertheless, he considered the Great Lignite *one* formation, so-called transitional beds between the “true Cretaceous and the Tertiary.” He used the term “Fort Union Group,” saying it had both Cretaceous and Tertiary characteristics.

In general, the uppermost Cretaceous beds in Wyoming are assigned to the Lance Formation, the lowermost Tertiary strata to the Fort Union Formation. Both sequences contain coal beds. The Lance-equivalent sequence in southeastern Wyoming, some 6,300 ft (1,920 m) thick, is called the Medicine Bow Formation. The use of the term “Medicine Bow Formation” for Lance-equivalent strata comes from a stratigraphic debate referred to as the “Laramie problem,” a debate of Hayden’s time (mid to late 1800s) and of the early 1900s (Steidtmann, 1993, p. 265). Hayden’s ruling passion was bound to falter when additional rocks were examined by others, and it did, but he never changed his mind about the question.

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During April 1879, the Senate confirmed President Rutherford B. Hayes’ nomination of Clarence King to become the first director of the

U.S. Geological Survey. The battle was over, and Hayden believed he had been unjustly denied the directorship. Hayden initially fought hard, but near the end he inexplicably faltered and faded away. As Foster wrote (1994, p. 321), “Marsh and Powell and their coterie had done a good job of blocking Hayden’s appointment to the position nearly everyone expected him to win.” It was a vicious campaign. King and many of the protagonists saw it as a personal war, pleased that it was fought as it was, and that they had crushed Hayden, ending the personal surveys. An editorialist for *Nature* (May 8, 1879) wrote: “We fear that personal interests have had more weight in bringing about the new state of things than the interests of science.”

Unfortunately for Hayden’s reputation, little attention is paid to what he accomplished in the last nine years of his life, during which time he was recurrently sick (Nelson et al., 1981). He was dismissed by many. Aldrich (1972, p. 186) claimed that after 1879, Hayden “did little of direct benefit to science.” This is probably unfair, for although Hayden did produce fewer publications, he helped others with their reports and prepared a geologic map of the area studied by his survey between 1869 and 1880, a mammoth task. No quitter, Hayden also returned to fieldwork. Clarence King and Interior Secretary Carl Schurz appointed Hayden “fourth principal geologist” on July 8, 1879, the first three being S. F. Emmons, Arnold Hague, and G. K. Gilbert.

When Powell became director he continued to employ Hayden. With other authors, Hayden put together *The Great West: Its Attractions and Resources*, published for a general audience in 1880 by Charles R. Brodix. The book emphasized the enormous reserves of Cretaceous and Tertiary coal in the West and, in typical Hayden prose, posited “an almost unlimited future.”

With further financial support and encouragement from Powell, Hayden worked in the field (1883–1884) with A. C. Peale, a former member of his survey. The two worked well together (Nelson et al., 1981). Significantly, they discovered Devonian beds and fossils, identified by Charles D. Walcott, northeast of the Gallatin River (Peale, 1885) in Wyoming and southern Montana. From July through September of 1885, Hayden embarked on a railroad tour of Colorado, Utah, and Montana with his wife and the Peales, continuing fieldwork in the

fall with Peale in Montana. The next summer he once again was in Montana with Peale and George Merrill, one of those who had loudly proclaimed that Hayden laid the foundations for the USGS and should have been its first director. Hayden’s health continued to deteriorate, and by late 1886, he was largely confined to bed (Cassidy, 2000, p. 324). He resigned from the USGS in December 1886 and on December 22, 1887, Hayden passed on.

For almost three decades, Hayden had applied his exceptional enthusiasm and genius for raising money to his survey of the Territories. He secured excellent people for the research, edited many large and varied volumes, reached the general public with his speaking and writing, and wrote numerous excellent articles and several books on geology. Early on, he believed glaciers were a major force in nature. Through his field studies, he developed a detailed stratigraphy for the Cretaceous and Tertiary of the West, and many of his names are still in use. Hayden’s contributions have been greatly undervalued, especially his role in getting science within the federal bureaucracy. During Hayden’s government service, from which he left a poor man, he was one of the greatest collectors of natural history specimens we have ever seen in the U.S. Unlike Gilbert (Picard, 2008), Hayden left no seminal studies or even a single geological masterpiece, which has lessened his reputation among scientists and historians. However, among mid- to late-19<sup>th</sup> century Earth scientists, other than Gilbert and Clarence Dutton, Hayden contributed more than anyone to geology and natural history and the advance of science in the American West.

From an early age, Hayden sought public recognition. More insecure than many of his peers, he looked to honors and prizes for validation. At age 45 he was elected to membership in the National Academy of Sciences, coincident with his Yellowstone exploration. Rochester University awarded him an honorary Doctor of Laws in 1878. Almost a decade later, shortly before his death, the University of Pennsylvania also bestowed on Hayden an Honorary Doctor of Laws. There were numerous other prizes and awards honoring him and his survey. Perhaps more lasting than academic honors, Hayden’s name has been given to more than 40 topographic features in six states: five peaks, one mountain, three towns, many creeks, gulches, lakes, passes, and strangely,

a cemetery (Foster, 1994, p. 391). Colleagues and admirers named 45 species or genera for him. Hayden was a man who, though often maligned, was sustained by a vision of himself as an explorer following and opening uncharted trails such as Lewis and Clark once did.

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