

"The Province of the Geologist": Constructing Scientific Space and Space for Science in the Era of Great Surveys

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Its [the West's] extraordinary wealth can become fully understood only through a scientific exploration, ordered by the government, conducted under its authority, and its results published to the world under its sanction... such a report... would do more, it is believed, to disseminate a correct knowledge of this extraordinary portion of our public domain, and invite capital and population from foreign countries, than any other means that could be adopted.

-Joseph S. Wilson, Commissioner of the General Land Office, 1868

...while I have endeavored, as far as possible, to add to our scientific knowledge, I have always felt it to be my duty to keep constantly in view, as the primary object, the gathering of such facts and knowledge as will be of use to the public, and tend to develop the material resources of the Territories.

-F. V. Hayden, U.S. Geologist, 1874

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The letter, scrawled precisely on stationary headed by a familiar image, likely turned William Henry Holmes's thoughts from the halls of the National Art Gallery to memories of the Colorado Rockies in 1873, of a summer spent exploring the region's mountains and valleys as an artist for the Hayden Survey.¹ Perhaps, contemplating the letterhead before him, Holmes recaptured some of his past wonder at the sight of "a peak, a very giant among its fellows, a king amidst a forest of mountains, that bore aloft on its dark face a great white cross, so perfect, so grand in proportions that at a distance of sixty miles" Holmes felt himself "in its very presence."² Not content with experiencing this presence from a distance, several members of Hayden's expedition, Holmes included, seized their opportunity to climb the peak two months after first sighting it. Heavily laden with scientific instruments, the party struggled through narrow canyons and up steep, rocky slopes. They reached the summit on the fifth day of their climb, but clouds and heavy rain, frustrating attempts at observation and photography alike, forced their retreat to a timberline camp. The weather cleared during the night, the main party completed its scientific work by noon of the sixth day, and from nearby Notch Mountain, the Survey's photographer, William Henry Jackson, secured an image of the peak's most striking feature. A reproduction of Jackson's photograph adorned the Mount of the Holy Cross Association stationary that reached Holmes fifty-six years later in Washington, D.C.

¹ The above use of "exploring," and the use of "exploration" throughout this work is intended only to echo the terminology and perceptions ascribed to the work of the Great Surveys, from within and without, within the period considered, and not as an assertion that the surveys "explored" uninhabited or otherwise unknown regions. Given the emphasis Hayden Survey members placed on "scientific survey" as a new and better means of examining western landscapes, "exploration" also captures Survey members' perceptions of their efforts even when retracing the steps of earlier expeditions.

² W. H. Holmes, "First Ascent of the Mountain of the Holy Cross," *The Illustrated Christian Weekly*, May 1, 1875, 209.



The association's chairman, Reverend J. P. Carrigan, wrote to Holmes in April, 1929 after receiving a copy of his 1875 article describing the ascent of the Mount of the Holy Cross and a copy of Jackson's original photograph. Carrigan sought Holmes's confirmation that he had forwarded a copy of his article for publication, and described the Mount of the Holy Cross Association's history and mission.³ Formed in 1921 to promote pilgrimages to the Mount of the Holy Cross, the Association selected a site on Horn Silver Mountain, near Redcliff, Colorado as its headquarters, and cooperated with the U.S. Forest Service to set aside 350 acres as a "viewing shrine" on April 16, 1922.⁴ Carrigan also described, with obvious frustration, the ongoing difficulties the Association encountered in its efforts to promote highway projects facilitating greater access to the region, which the state highway commission resisted despite federal offers to fund two-thirds of the project's costs. President Herbert Hoover's designation of the peak and 1,392 acres of surrounding land as a national monument the following month doubtless alleviated some of Carrigan's frustration.

³ J. P. Carrigan to William Henry Holmes, April 9, 1929, "Random Records of a Lifetime, 1846-1931: Cullings, Largely Personal, From the Scrap Heap of Three Score Years and Ten, Devoted to Science, Literature and Art," 4, pt. 1: 51-2. Record Unit 7084, *William Henry Holmes Papers, c. 1926-1982*. Volumes 1-16 on microfilm, Smithsonian Institution Archives, Washington, DC.

⁴ Ferenc M. Sasz. "Wheeler and Holy Cross: Colorado's "Lost" National Monuments," *Journal of Forest History* 21:3 (July 1977): 142-4.

The Mount of the Holy Cross received national monument status on May 11, 1929, but erosion, a steady decline in the number of pilgrimages beginning in the 1930s, and rising maintenance costs led the federal government to withdraw monument status in 1950.

Monument status drew greater national attention to the Mount of the Holy Cross and protected the area from mining and commercial exploitation. However, the designation did not impede other efforts to develop the monument. The Mount of the Holy Cross Association established a base camp near the peak to support pilgrimages, which the Colorado State Highway Department rendered accessible by road in 1932.⁵ Spurred by the Holy Cross Association and the support of regional residents and newspapers, the Civilian Conservation Corps constructed roads, trails, and guest and rest houses at the Monument in the mid 1930s.

The designation and development of the Mount of the Holy Cross as a "shrine" and national monument highlights the complex interactions of various interests, actors, and geography that shape conceptions of landscapes and their appropriate uses. That the Mount of the Holy Cross Association enlisted Jackson's photograph and Holmes's article in their efforts to promote and protect the area attests to these artifacts enduring power to shape perceptions of, and inscribe meanings upon, the western landscape, but their use also evinces the historical contingency of such perceptions and meanings.

Images of the mountain and accounts from early travelers expressing awe and wonderment at the peak's profound presence resonated within the deep cultural and religious meanings pilgrims assigned to the Mount of the Holy Cross in the 1920s, but these pilgrims' travels were not those of Holmes or Jackson, nor were the meanings they inscribed upon the landscape. The Mount of the Holy Cross National Monument, in 1929, existed as a geographically bounded area within the state of Colorado, a special place, appropriately preserved, and appropriately experienced through pilgrimage. Although Holmes's account exhibits a pilgrim-like reverence of the peak, pilgrimage was not his object. Exploring the region with the U.S. Geological and Geographical Survey of the Territories in 1873, Holmes

⁵ Sasz, "Wheeler and Holy Cross," 143.

encountered not a national monument bounded and defined by Executive order and appropriate usage, but rather he participated in the examination and mapping of the Colorado Territory that facilitated such bounding and definition. For Holmes and the other members of the Hayden Survey, the mountain's prominence and unique geological features provided a valuable landmark and opportunity for scientific study, but the peak took on meanings beyond these practical and scientific considerations as well.⁶ The Mount of the Holy Cross, a literal beacon in the wilderness, meshed with persisting notions of manifest destiny, providing a potent emblem of divine approbation for the expanding United States.⁷ In this context, a snowy cross embedded in a remote western mountainside promoted not preservation and temporary pilgrimage, but settlement and use. Holmes's article and Jackson's photograph, despite their enduring relevance to the Mount of the Holy Cross Association in 1929, represent the products of earlier labors and vestiges of an earlier era.

If Carrigan's letter evoked within Holmes fond memories of the Mount of the Holy Cross, his memories of the summer of 1873 as a whole were likely somewhat bittersweet. A "chance" meeting between parties of the Hayden and Wheeler Surveys that summer heightened concerns over the duplication of survey work, provoking a critical reappraisal of the wisdom and utility of

⁶ Holmes, "First Ascent," 205. & Ferdinand V. Hayden. *Annual Report of the United States Geological and Geographical Survey of the Territories Embracing Colorado, Being a Report of the Progress of the Exploration for the Year 1873* (Washington, D.C.: Government Printing Office, 1874), 73-74.

⁷ Kevin J. Fernlund. *William Henry Holmes and the Rediscovery of the American West* (Albuquerque: University of New Mexico Press, 2000), 34.

"Wilderness" represents a potentially problematic term, and its use here is not intended as a characterization of the Colorado Territory as an unknown or uninhabited area, or as pristine Nature, distinctly separate from humanity; rather my use of the term is intended to reflect prevailing perceptions of this landscape among members of the Hayden Survey, and among those who found in the Mount of the Holy Cross support for notions of manifest destiny. Manifest destiny, as Robert V. Hine and John Mack Faragher have argued, represents not a deeply-held American folk belief, but rather the creation of political propagandists who sought to separate the politics of westward expansion from the growing sectional divides over slavery in the antebellum era. See

Robert V. Hine and John Mack Faragher, *The American West: A New Interpretive History*, (New Haven: Yale University Press, 2000), 200. Nevertheless, persisting notions of America's manifest destiny lent images and descriptions of the Mount of the Holy Cross a significant following, prompting subsequent studies by Thomas Moran, and promoting the widespread dissemination of such images and accounts.

conducting four simultaneous surveys organized under both the War and Interior Departments, and fueling efforts to consolidate the King, Hayden, Powell, and Wheeler surveys into a single institution. The already considerable rivalries among the surveys stemming from competition over funding and territory, grew more considerable with the push for consolidation. As competition among the surveys reached a fever pitch, so too did tensions between the War and Interior Departments. Assessing the issue of consolidation in 1874, President Ulysses S. Grant concluded:

...where the object is to complete the map of the country; to determine the geographical, astronomical, geodetic, topographic, hydrographic, meteorological, geological, and mineralogical features of the country; in other words, to collect full information of the unexplored, or but partially known, portions of the country, it seems to me a matter of no importance as to which Department of the Government should have control of the work. The conditions which should control this subject are, in my judgment, first, which Department is prepared to do the work best; second, which can do it the most expeditiously and economically.⁸

In proposing conditions for resolving the consolidation controversy (1873-79), Grant succinctly captured the fundamental disputes from which the controversy stemmed. Rather than distinct considerations, however, the quality and economic utility of survey work became increasingly linked as the debate over consolidation progressed.

Tasked with locating exploitable resources, arable lands, and suitable routes for railroads and paths of transportation and settlement, the Great Surveys that emerged after the Civil War proved inextricably attached to the economic growth of a nation that saw in western lands and resources opportunities for future prosperity. As evidenced by President Grant's message to the House of Representatives, developing this potential windfall required comprehensive mapping and specialized, accurate knowledge of western landscapes. With the profitable development of

⁸ Geographical and Geological Surveys West of the Mississippi, *Message from the President of the United States, in Answer to a Resolution of the House of April 15, 1874, Transmitting a Report from the Secretary of War, Relative to Geographical and Geological Surveys West of the Mississippi*, 1874, 43rd Cong., 1st sess., House Executive Document 240 (Washington, DC: GPO, 1874), 1.

the West thus contingent upon the verity of survey work, questions of economic utility became less a consideration of the financial cost of survey operations alone than a cost-benefit analysis that weighed such expenditures against the potential value of a survey's work. Determining the quality of that work, and those best suited to it, proved the most contentious issues negotiated amongst the Great Surveys and the federal government throughout the consolidation controversy. Indeed, beneath the disputes over funding and areas of operation evident on the surface of the controversy lay pressing questions concerning forms of knowledge and expertise that pitted Army engineers and civilian men of science against one another in a competition for the survival of individual surveys and the authority to define western landscapes. Tracing the process and outcome of this negotiation illustrates the ways in which men of science worked to cultivate perceptions of the late nineteenth-century American West as a scientific space, appropriately examined through scientific survey, in order to expand the space for science within the federal government.

The United States Geological and Geographical Survey of the Territories, directed by Ferdinand Vandever Hayden, provides a particularly fruitful perspective from which to examine these events. Trained in geology and natural history in the antebellum era, and working as a member of both independent, scientific explorations and U. S Army Corps of Topographical Engineers expeditions before the war, Hayden's training and early experiences in the West offer insights into the nature of American science and its role in western exploration at mid century. Although Hayden, and a good many others, viewed the Civil War as an unwelcome interruption, the war created new opportunities for men of science, particularly those engaged in western surveys.

As "U.S. Geologist" for the survey of Nebraska in 1867, and later as the self-proclaimed "Geologist in Charge" of the U. S. Geological and Geographical Survey of the Territories, Hayden explored, mapped, and studied large swaths of the American West, shaping both the course of American science and Americans' perceptions and understandings of landscapes and their appropriate uses.⁹ In addition to expanding opportunities for science within the federal government, the Hayden Survey conducted the first successful scientific exploration of the upper-Yellowstone watershed, playing a prominent role in the establishment of Yellowstone National Park. Throughout the postwar period, Hayden secured patronage and ensured the survival of his survey through nurturing links among science, government, industry, and the American public, and by promoting the utility of scientific surveys in serving the varied interests of these groups. Through these efforts, the Hayden Survey grew into one of the most widely known, influential, and well-funded scientific institutions of the post-Civil-War era. Examining the Survey's rise to prominence offers a means of placing the role of science within postwar, western exploration and assessing the importance of survey publications, in their various forms, in promoting the Survey and its depictions of western landscapes. Tracing the Survey's role in popularizing the Yellowstone region and supporting the creation of America's first national park reveals how such depictions, supported by claims of scientific veracity and authority, promoted perceptions of the West as a scientific space.

Finally, interrogating the confrontation between Hayden and Wheeler Survey parties that catalyzed the consolidation controversy illustrates the importance of western landscapes as objects of study and sources of promotion within the work of the Great Surveys. For survey

⁹ Although Hayden gained the position of "U. S. Geologist" while in charge of the Nebraska Survey, (see Cassidy, *Hayden*, pp. 87-8), the U. S. Geological and Geographical Survey of the Territories would not be established until April 1, 1869, (see C. Delano to President Grant, April 28, 1874, 43rd Cong., 1st sess., House Executive Document 240 (Washington, DC: GPO, 1874), 9). Hayden referred to himself as U.S. Geologist and Geologist in Charge, a title of his own devising, interchangeably while director of his survey.

directors and personnel, these landscapes proved essential in gaining the experience and knowledge vital to claims of epistemic authority and in illustrating the accuracy and value of survey work. Throughout much of the controversy, from 1873-77, the members of the Hayden Survey labored to produce the *Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory*. The cartographic embodiment of the "full information of the unexplored, or but partially known, portions of the country" that Grant and others sought from the surveys, the *Atlas* contained a landscape thoroughly examined and defined, and rendered profoundly legible.¹⁰ The *Atlas* evinced the extensive breadth of scientific explorations conducted by the Hayden Survey, and represented the culmination of that Survey's efforts to assert its members' expert knowledge of western landscapes and demonstrate the quality and utility of their labors.

Despite the Survey's prominence, and the concerted efforts by Survey members to assert themselves as the preeminent explorers of western lands and resources, the resolution of the consolidation controversy, in 1879, found the Great Surveys combined under the newly formed United States Geological Survey, directed not by Hayden, but by Clarence King. Hayden's diminished role in western exploration, as one of six principle geologists of the USGS, reflects, in part, the bitter hostility his relentless ambition and often polemical assertions of claims on the scientific exploration of western lands engendered among army engineers and civilian men of science alike. Yet, in the civilian-directed USGS, organized under the Department of the Interior, the men of science associated with western surveys, though divided, received a powerful reification of scientific investigations as adroit means of exploring and interpreting western landscapes, due in no small part to Hayden's concerted efforts.

¹⁰ Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge: Harvard University Press, 1987), 227-8. I draw here on Latour's concept of "immutable mobiles," representations collected at scientific and governmental centers that simplify objects, areas, etc., that exist at a scale or distance which precludes actual observation by those at these centers. Immutable Mobiles render the objects of description legible and controllable by those at the "center."

The State of the Field

As "Geologist in Charge" of the U. S. Geological and Geographical Survey of the Territories, Hayden drew upon growing perceptions of science as a credible and definitively accurate means of examining and explaining the natural world to promote both his survey and his view of western landscapes.¹¹ The growth of industry following the Civil War fueled increased demand for the resources and raw materials of the West. In this context, men of science, particularly geologists, found new opportunities for employment and the advancement of scientific study. Geology, as carried out in the United States following the Civil War, existed as the specialized pursuit of the geologist. The geologists conducting western surveys drew much of their support from government patrons, who expected the surveys to yield the practical information regarding lands and resources necessary for their successful settlement and development. The utilitarian requirements of survey work compelled survey geologists to balance their prosecution of "purely scientific" investigations, those undertaken with the goal of advancing scientific knowledge or addressing open questions, with their pursuit of the "practical" tasks of examining, describing, and mapping western lands and resources. The men of science who turned their attentions westward after the war took advantage of new opportunities provided by a resurgence of interest in western lands and resources. Yet, they built on established patterns as well. The heightened emphasis on scientific survey and examination that followed the Civil War grew from the long-standing courtship of federal patronage and cultivation of perceptions of

¹¹ Robert Bruce has argued that by the mid-nineteenth century American science had grown into a recognized profession among men of science and the public alike. While recent scholarship has rendered classifications of nineteenth-century American science as a profession problematic, (Paul Lucier has most recently drawn on actor's categories employed by American men of science of the period to show that even those men of science who viewed themselves as "scientists" did not regard themselves as "professionals.), sufficient evidence exists to demonstrate that science, and those who pursued scientific study were increasingly and widely perceived as authoritative and credible interpreters of the natural world in the mid-nineteenth-century United States.

Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (Ithaca: Cornell University Press, 1987), 4. & Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis* 100:4 (December 2009), 699-732.

scientific expeditions as efficient means of gathering accurate and practical knowledge of lands and resources by men of science.

While relatively few individuals sought out science as a means of employment in the antebellum era, the majority of those who did earned their livings from their work.¹² American science thus required extensive networks of funding and support. Some gained employment and support by offering their services to those who hoped to benefit from their specialized knowledge. Geology, for example, emerged as “the science of the day” by the 1830s, as geologists found work searching for resources with state surveys, and locating suitable canal and railroad routes for transportation companies.¹³ Such practices of securing support through appealing to the interests of potential patrons promoted the advancement of scientific disciplines that offered practical or economically beneficial results, and lent a utilitarian disposition to much of American science. Private philanthropy and teaching positions at colleges and universities offered men of science other opportunities for funding and employment, but such opportunities entailed the difficulties of “get[ting] at men’s pockets,” and limited research according to teaching demands.¹⁴ The scientific institutions that emerged during the nineteenth century helped to organize the American scientific community and mitigate the difficulties of securing patronage.¹⁵ Through coordinating networks of collaboration and communication, and providing funding and research opportunities, the directors of such institutions hoped to advance the status of American science. Through promoting the practical benefits of scientific work, these directors won popular support for their efforts, and expanded opportunities for government patronage, increasing the scale of scientific projects, and institutionalizing the practical focus of

¹² Bruce, *Launching*, 81, 135.

¹³ Cassidy, *Hayden*, 7-8.

¹⁴ Bruce, *Launching*, 136-8.

¹⁵ *Ibid.*, 3-4.

American science. Two institutions, the U.S. Coast Survey established in 1807, and the Smithsonian Institution founded in 1846, proved particularly effective in these efforts.

Congress established the U.S. Coast Survey to map the nation's coastline.¹⁶ The Survey's first director, Ferdinand Hassler, drew on the expertise of "scientifically trained personnel" ensure accuracy and precision, and hoped to advance American science by supporting a wide range of scientific activities. Hassler's efforts met with limited success, but his emphasis on scientifically trained personnel enlisted the federal government as a patron of American science. The government employed almost one third of America's leading men of science by the antebellum period.¹⁷ The centralized organization and substantial financial backing offered by government positions elevated the influence of many of these individuals within the scientific community. Government patronage offered extensive but conditional support. Institutions such as the Coast Survey demanded practical, utilitarian results, requiring a balance between the advancement of "pure" science and the fulfillment of government interests. Perhaps no other man of science employed by the federal government in the antebellum era balanced these interests as effectively as Hassler's successor, Alexander Dallas Bache.

Assuming control of the Coast Survey after Hassler's death in 1843, Bache immediately set to work on his twin goals of advancing both his survey and American science. He expanded and restructured mapping efforts, secured larger appropriations, and demonstrated the utility of the Survey by rapidly publishing the results of its work.¹⁸ These publications emphasized the accuracy and efficiency of the Survey's scientific practices, illustrated the scientific and commercial value of the work, and courted popular and Congressional support. Bache further promoted the Survey through cultivating relationships with those in positions to aide his

¹⁶ Slotten, *Patronage*, 1-3.

¹⁷ Bruce, *Launching*, 166.

¹⁸ Slotten, *Patronage*, 80-83.

efforts.¹⁹ The Survey supported a wide variety of scientific pursuits and offered patronage to large numbers of men of science through direct employment, positions as consultants, or collaboration in research ventures. Bache's concerted efforts transformed the Coast Survey into the largest and most influential scientific institution in the antebellum United States. As the Survey's director, Bache established himself as one of the foremost patrons of American science as well.

Bache, acting the part of the patron, secured the directorship of the Smithsonian Institution for his long-time friend, Joseph Henry. Henry grudgingly accepted.²⁰ Henry and Bache coordinated their efforts to advance American science. Both men hoped to establish the Smithsonian as a "seedbed of science," advancing knowledge through rewards for research papers and supplementary support of short-term projects, and diffusing scientific knowledge through periodic reports.²¹ As directors of the two most prominent scientific institutions in the antebellum United States and members of the American Association for the Advancement of Science, Henry and Bache drew upon networks of political and scientific support to defend their institutions, and proved instrumental in shaping the course of American science.²²

Joseph Henry's appointment as director of the newly established Smithsonian Institution offered Bache and the Coast Survey a potent ally in promoting a particular course for American science by further strengthening links between science and the federal government, and advancing the position of Washington, D.C. as a scientific center. The Smithsonian's "first major scientific undertaking," a meteorological project begun in 1848, solidified this central role of the Institution and Washington, D.C., by placing Henry at the head of an extensive network of

¹⁹ *Ibid.*, 1.

²⁰ Bruce, *Launching*, 188., , Henry feared that the position offered an abundance of administrative duties and little time or opportunity for research.

²¹ *Ibid.*, 193.

²² Slotten, *Patronage*, 89-93. & Bruce, *Launching*, 256-7.

volunteer observers who kept standardized weather journals and submitted monthly reports.²³

The project's practical task of mapping the movement of storms across the continent drew Henry's attention to the West. The West also drew the attention of the Smithsonian's new assistant secretary, Spencer Fullerton Baird, although for a different reason.

²³ James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore: Johns Hopkins University Press, 1990), 75.

"A Curious Self-Made Man of Science"

Despite Henry's avowed opposition to assembling natural history collections at the Smithsonian, the Board of Regents appointed Baird, a naturalist specializing in ornithology, Assistant Secretary in 1850, for just that purpose.²⁴ Eager to capitalize on the potential natural history bonanza provided by the new lands of the Mexican Cession, Baird lost little time enlisting "Great Reconnaissance" expeditions in his collecting efforts. Baird collected collectors nearly as quickly as they collected specimens. He cultivated talent, offered advice, and gave supplies to those who lacked proper knowledge or equipment.²⁵ His collectors repaid his assistance with a flood of specimens, providing a sufficient abundance to justify the establishment of a national museum at the Smithsonian in 1858. Baird proved a good patron to his collectors, using his position at the Smithsonian as a means of sponsoring those who showed particular promise. A young collector named Ferdinand Vanderveer Hayden perfectly fit that description.

A "curious self-made man of science," Hayden took full advantage of the opportunities science afforded for employment and social advancement.²⁶ Likely born on September 7, 1828, in Westfield, Massachusetts, Hayden hardly enjoyed a genteel background. His parents, Asa Hayden and Melinda Hawley, supposedly married on November 26, 1826, in Enfield, Connecticut, though no record exists. Asa Hayden had difficulty maintaining steady employment, and the family moved frequently as he searched for work. Hayden's parents separated in 1838, and Melinda Hawley filed for divorce in 1841. A Berkshire, Massachusetts

²⁴ Bruce, *Launching*, 196-7. & Cassidy, *Hayden*, 20.

²⁵ Bruce, *Launching*, 198.

²⁶ Goetzmann, *Exploration and Empire*, 490.

court dismissed the divorce claim, but Hayden's mother remarried nonetheless, sending Hayden to live with relatives in Rochester, Ohio.²⁷

In 1845, determined “either to learn a trade, and become a master in it, or to study a profession,” Hayden, “without a cent in his pocket,” walked the fifteen miles from his uncle's farm to Oberlin Collegiate Institute and secured President Charles Grandison Finney's permission to begin his course of study.²⁸ A driven and enthusiastic student, thoroughly devoted to reading when not working to pay his expenses, Hayden quickly developed a love of geology and natural history. He graduated in 1850, spending an indecisive next year-and-a-half studying theology at Oberlin and working as a teacher. In the summer of 1851, Hayden enrolled at Cleveland Medical School.

Like Hayden, many would-be men of science of the antebellum period received their advanced scientific education while pursuing medical degrees. Hayden excelled in the study of geology while at Cleveland Medical School, aided by the guidance of George Nelson Allen and John Strong Newberry, and made the acquaintance of the famous New York geologist James Hall through his contacts there. Hayden's avarice for collecting impressed Hall, who offered him a position in Albany at the conclusion of his studies. The appeal of Hall's offer proved too great, however, prompting Hayden to seek employment in Albany in January of 1853, two months shy of completing his education. Hall offered Hayden the opportunity to complete his studies in New York, and, perhaps more importantly, extended him the opportunity to serve as an assistant to Fielding Bradford Meek, an invertebrate paleontologist, on an expedition to the Dakota Badlands that season.²⁹

²⁷ Cassidy, *Hayden*, 34-5.

²⁸ John Wesley Powell, “Ferdinand Vandever Hayden,” *Ninth Annual Report of the United States Geological Survey to the Secretary of the Interior 1887-88* (Washington, DC: GPO, 1889), 31-8.

²⁹ Cassidy, *Hayden*, 37-41.

Working as a collector often served as a starting point for those interested in pursuing scientific work, and in that sense the expedition presented Hayden with a signal opportunity; however, the undertaking presented substantial difficulties as well. The American Fur Company, closely linked with competing expeditions, provided Hayden and Meek with transportation and assistance, but at inflated rates that quickly drove their expenses higher than expected.³⁰ The men also found their work cut short when fears of attack or the robbery of their precious specimens by local bands of Sioux forced them from the field.³¹ Despite these difficulties, Hayden and Meek collected hundreds of botanical specimens and invertebrate fossils, a few specimens of fossilized plants, and more than a hundred vertebrate heads. Their extensive collections impressed not only Hall, but also Baird and Joseph Leidy, the sponsors of a competing expedition, as well. The expedition ultimately proved a success, but the difficulties it entailed impressed upon Hayden the importance of securing patrons who could provide logistical support in addition to funding. The expedition's encounters with the American Fur Company and the Sioux inhabiting the region also reveal that conducting scientific work in the West depended crucially upon accessing territory. After disputes with Hall over the amount of credit he received for the expedition's work, and nearly a year of wrangling for a new position, Hayden finally succeeded in gaining Baird's patronage.

Hayden spent the remainder of the antebellum period exploring and collecting in the upper-Missouri region, gaining valuable experience and making a name for himself as a geologist and naturalist. In 1854, residents, speculators, and politicians in the newly formed Nebraska Territory began calling for a survey of the territory's resources as a means of promoting development. Spying an opportunity to expand his scientific endeavors beyond

³⁰ *Ibid.*, 42-45.

³¹ Mike Foster, *Strange Genius: The Life of Ferdinand Vandeveer Hayden* (Niwot, Colorado: Roberts Rinehart Publishers, 1994), 51.

collecting, Hayden eagerly campaigned for the position of survey director. He sought Baird's assistance in promoting his cause in Washington, championed the idea in articles written for local newspapers, provided specimens for a new territorial museum, and presented Senator Stephen A. Douglas, chairman of the Senate Committee on the Territories, with a small selection of collected specimens.³² Determinedly ambitious, Hayden, even as a young collector in 1854, exhibited a knack for keenly seeking out those particularly well situated to assist him, and understood the importance of building support at both the local and national level. Although a publicly funded survey failed to materialize, the vigorous efforts of Hayden and his supporters won sufficient private support for an independent natural history survey of the region. Baird arranged for Alfred J. Vaughn, the Indian agent at Ft. Pierre, to sponsor Hayden on a two-year expedition to the upper Missouri, beginning in 1854, in exchange for a portion of Hayden's collections.³³ Vaughn paid the cost of shipping the collections that Hayden assembled, and, drawing on contacts made the previous summer, Hayden secured transportation and assistance from the American Fur Company as well.³⁴ Over the next two years, working closely with Baird, Meek, Henry Engelmann, John Strong Newberry, Joseph Leidy, and the St. Louis Academy of Sciences, Hayden learned the value that collections offered for securing patronage. After his exhibition of specimens at St. Louis drew a reminder from Meek to guard his collections until they received proper study, Hayden learned the importance of assuring priority and credit for his finds through rapid publication as well.³⁵

Hayden's extensive collecting efforts won him high regard as a collector and naturalist, connected him with essential patronage networks, and ingratiated him to those eager for the

³² Cassidy, *Hayden*, 58-9.

³³ *Ibid.*, 55-7.

³⁴ Charles A. White, "Biographical Memoir of Ferdinand Vandiveer Hayden. 1839-1887" (Read before the National Academy of Sciences, November, 1894), 399.

³⁵ Cassidy, *Hayden*, 59-60.

research opportunities his collected materials afforded. However, it was Hayden's own insightful study and description of the western landscape, not merely others' analyses of his collections, that advanced his position as a man of science. Hayden's burgeoning reputation won him a position as geologist and naturalist for Lieutenant G. K. Warren's Army Corps of Topographical Engineers expedition to Dakota in 1856. Again working closely with F. B. Meek, who offered guidance to the young geologist and evaluated his collected specimens and observations, Hayden eagerly availed himself of the opportunities that the expedition's official report offered for publishing work on the geology and natural history of the upper-Missouri region.

Drawing on their extensive observations and knowledge of the upper Missouri's geology and fossil record, Hayden and Meek constructed a stratigraphic column for the region. The column ordered the vertical structure of nine geological systems from the Azoic to Quarternary periods, revealed the existence of Potsdam Sandstone formations in the American West, and identified a discrepancy in the stratigraphic position of Permian layers between the American West and "Old World" as "the most interesting feature in American geology at the present time."³⁶ The first standard stratigraphic model for the West, the column served as a reference point for subsequent geological explorations by J. S. Newberry and Henry Engelmann.³⁷ Hayden and Meek also described five distinct layers within the Cretaceous stratum, and, despite persisting bitterness over Hayden's earlier break with James Hall, they followed their former instructor's practice of naming formations for the location of their discovery rather than in accordance with established terminologies and analogies employed in Europe. When other

³⁶ F. V. Hayden. "Catalogue of the Collections made in Geology and Natural History, Obtained by the Expedition under Command of Lieut. G. K. Warren, Topographical Engineers," in *Preliminary Report of Explorations in Nebraska and Dakota in the Years 1855-'56-'57 by Lieut. G. K. Warren* (Washington, DC: Engineer Department, United States Army, GPO, 1875), 63-4.

³⁷ Goetzman, *Exploration and Empire*, 492-3.

geologists, including Jules Marcou, challenged this five-layer model, Hayden enlisted for support Newberry's assessment that the fossil flora from the formations placed all five layers within the Cretaceous Period, and asserted the careful, personal examination of paleontological and geological evidence conducted by Meek and himself as proof of the model's accuracy.³⁸ In abandoning practices and terminology that related formations to a standardized, global geological framework, Hayden and Meek offered "a simple picture of American reality as they saw it."³⁹ In citing their personal knowledge and expertise as proof of their model's accuracy, Hayden asserted that his and Meek's view of "American reality" was correct, and claimed an authority as a competent interpreter of western landscapes as well.

The independent spirit and driving ambition evident in Hayden's contribution to the expedition report proved a source of tension between him and Warren upon the expedition's return to Washington, where Hayden lost little time claiming responsibility for the expedition's success and contributions to natural history.⁴⁰ With tensions high, and discouraged by what he considered the slow pace and overly rigid structure of Army expeditions, Hayden sought an alternative appointment the following season. He found none. Enlisting Baird's assistance to smooth ruffled feathers, Hayden rejoined Warren for a second expedition in 1857, receiving a greater degree of freedom in conducting geological explorations, and taking care to properly credit Warren in articles and reports. Apparently convinced that the opportunities provided by Army expeditions outweighed the drawbacks of their pace and structure, Hayden joined another Corps of Topographical Engineers expedition for the 1859 season.

In the summer of 1859, Captain William F. Reynolds of the U.S Army Corps of Topographical Engineers commanded an expedition to the upper Yellowstone and Powder River

³⁸ Hayden, "Catalogue of Collections," (1875), 68-9.

³⁹ Goetzmann, *Exploration and Empire*, 493.

⁴⁰ Cassidy, *Hayden*, 61-66.

basins. Led by the “trapper-turned-guide,” Jim Bridger, the party explored throughout the summer and fall, until a drunken mutiny by Lt. Caleb B. Smith and the expedition’s 30-soldier escort forced Captain Reynolds and his remaining command to establish winter quarters at an abandoned Mormon settlement near the Upper Platte Indian Agency.⁴¹ Much as they had on the 1856 Warren expedition, Bridger’s seemingly incredulous yarns about the wonders of the upper Yellowstone captivated Hayden.⁴² Turning northward in the spring, the party pushed into the Wind River Range, attempting to access the Yellowstone’s headwaters from the south. Heavy snows forced the expedition’s retreat, frustrating Hayden’s hopes to satisfy his curiosity, at least for the time being.

The Reynolds Expedition reveals much about the dynamic relationships among men of science, explorers, and the federal government in the antebellum American West. A renowned former trapper, Bridger drew on his extensive knowledge of western landscapes, gained through years of experience in the far West of the early nineteenth-century fur trade, to sell his services as a guide to the settlers and "Great Reconnaissance" expeditions that flocked westward following the Mexican Cession. The 1859-60 expedition, tasked with gathering intelligence on the Sioux inhabiting the region, assessing the area’s climate and resources, and exploring possible wagon routes, fit squarely within the characteristic framework of "Great Reconnaissance" expeditions of the period.⁴³ However, as “the last major exploration conducted by the Topographical Engineers in the West,” the expedition marked the end of an era in which

⁴¹ William H. Goetzmann, *Army Exploration in the American West, 1803-1863* (New Haven: Yale University Press, 1959), 417-21. &

Marlene Deahl Merrill, ed., *Yellowstone and the Great West: Journals, Letters and Images from the 1871 Hayden Expedition* (Lincoln: University of Nebraska Press, 1999), 11.

⁴² F. V. Hayden. *Preliminary Report of the United States Geological Survey of Montana and Portions of Adjacent Territory Being a Fifth Annual Report of Progress* (Washington DC: GPO, 1872), 7.

⁴³ Goetzmann, *Army*, 418.

Army topographical engineers dominated government explorations of western lands.⁴⁴ Through his participation in these explorations, and his extensive work in the upper-Missouri region, Hayden tapped into crucial networks of patronage, gained influential connections, and grew into “an observant and competent collector as familiar with the region as any naturalist in the nation.”⁴⁵ Although the outbreak of war interrupted Hayden’s advancing development as a competent man of science, the knowledge and experience he and other men of science gained from their antebellum examinations of western lands enabled them to assert their own claims on government explorations following the war.

By October of 1862, Hayden enlisted as an Army surgeon and was assigned to Beaufort South Carolina. He received rapid promotion to post surgeon, and eventually served as Chief Medical Officer of the Army in the Shenandoah Valley.⁴⁶ His duties in South Carolina afforded him some opportunities to supplement the Smithsonian’s paltry collections from the region, but out of touch with the scientific community for much of the war and saddled with other duties, Hayden viewed the war as an unwelcome interruption. Many members of the American scientific community shared this view.

The Civil War tore scientists from their work and catastrophically disrupted scientific networks, sending efforts like Henry’s meteorological project into marked decline.⁴⁷ The war also diminished opportunities for funding, suspended the activities of many scientific societies,

⁴⁴ *Ibid.*, 417. & Goetzmann, *Exploration and Empire*, xiii. Goetzmann characterizes the nineteenth-century exploration of the West as a process of rediscovery by subsequent generations of explorers, and divides this exploration into three distinct periods, characterized by central themes. The first period, from the Lewis and Clark expedition to 1845, Goetzmann characterizes as “an era of imperial rivalry in which even the mountain men and fur traders were self-conscious pawns in an international competition for the West.”⁴⁴ The second period, the age of Manifest Destiny, represents an era devoted to the settlement and development of the West. The third period, from 1860-1900, encompasses the age of the Great Surveys, in which Americans placed greater emphasis on the scientific exploration and survey of the West, and from which grew concerns over conservation and greater planning of westward expansion.

⁴⁵ *Ibid.*, 62.

⁴⁶ American Association for the Advancement of Science, “Ferdinand Vandever Hayden,” *Science*, 11:257 January 1888, 1.

⁴⁷ Fleming, *Meteorology*, 146.

forced several scientific publications out of print, and limited the capacity of government and military scientific efforts.⁴⁸ Inflation reduced the Smithsonian's effective endowment, and a fire in 1865 further damaged the Institution.

Although the war exerted a decidedly negative impact on many aspects of American science, but provided new opportunities as well. Whereas the Smithsonian suffered during the war, the Coast Survey survived relatively well intact. Possessing detailed maps and charts of southern ports and coastlines, the Survey quickly gained the favor of the Navy and War departments.⁴⁹ Bache used the Survey to conduct reconnaissance and special surveys, and served on an advisory board tasked with planning blockades and coastal operations. The Survey's wartime efforts strengthened the emphasis on practical work, and linked the institution and its scientific personnel more closely with the military and the federal government. Bache and the Lazzaroni, with the exception of Joseph Henry, appealed to the government's need for wartime, scientific advice, and secured the establishment of the National Academy of Sciences in 1863, hand selecting its membership.⁵⁰ The Academy proved controversial in the early years of its existence and exercised little real influence, but its founding officiated, in principle at least, the role of American men of science as advisors to the federal government.

⁴⁸ Bruce, *Launching*, 287-9, 294-5, 300.

⁴⁹ *Ibid.*, 298.

⁵⁰ *Ibid.*, 287, 302-4.

"A Commission of More than Usual Ability"⁵¹

the wants of the settlers, and the means of meeting them in the readiest and most economical manner, have been fully elaborated by the geologist, and will be embodied in a forthcoming report with much additional matter, scientific and practical, designed *in an authoritative form to furnish reliable information*⁵² not only to our own countrymen, but to the people of other lands who are anxiously examining every source of intelligence preparatory to emigrating to this favored region.

Joseph S. Wilson, commissioner of the General Land Office, 1868.

The Civil War led to a greater emphasis on planning, control, and development.⁵³ Freed from the sectional stalemate that had frustrated many antebellum efforts at coordinated planning of westward expansion during the war, Congress divided the Trans-Mississippi West into distinct territories in anticipation of their ordered settlement and development.⁵⁴ Mining operations boomed throughout the West, fueling expansion, corporatization, and industry. Railroads expanded throughout the period, promoting the sale and development of their vast landholdings, and providing greater access to formerly remote regions. For the West, this emphasis on planning and development encouraged extensive postwar surveys. The incorporation of the Army Corps of Topographical Engineers into the Corps of Engineers in 1863, and the diminished role of the Army in western surveys following the war, provided opportunities for civilian men of science and left the way open for the rise of the Great Surveys.⁵⁵

The King, Hayden, Powell, and Wheeler Surveys constitute the four "Great Surveys" of the American West. Primarily concerned with exploring and mapping new lands to facilitate settlement and development, these surveys carried out duties similar to the Army surveys of the antebellum period. However, the vast amounts of territory they explored, their extensive periods

⁵¹ Joseph S. Wilson, *Report of the Commissioner of the General Land Office*, 1868, 4. Quote refers to Wilson's characterization of those most suited to pursue geological exploration of the western territories.

⁵² [emphasis added]

⁵³ Fleming, *Meteorology*, 171.

⁵⁴ Hine and Faragher, *The American West*, 223, 236, 274.

⁵⁵ Bruce, *Launching*, 296. & Cassidy, *Hayden*, 25.

of operation, and their breadth of scientific focus, “embracing topography, geology, and the natural sciences,” represent important differences that make these surveys unique to the postwar era.⁵⁶ Differences in organization distinguish these surveys as well. The Hayden and Powell Surveys fell under the administration of the Department of the Interior, and, although closely linked with the Army through the assistance of the Quartermaster’s Department and their frequent use of military escorts, the surveys themselves represented wholly civilian enterprises. The King and Wheeler Surveys, while under the administration of the War Department, fell under the charge of a civilian director, as with the King Survey, or employed high proportions of civilian men of science, as with both.⁵⁷ These surveys grew increasingly associated with their directors, who guided their development, reported on their work, and, with the exception of King, who received a \$100,000 appropriation to fund three years of work at his survey’s founding, secured annual appropriations for their surveys throughout their operation.⁵⁸ In short, these surveys represented largely entrepreneurial institutions. Through Hayden’s abilities to balance government, commercial, public, and scientific interests, and his tireless efforts to publicize and promote the Survey, the United States Geological and Geographical Survey of the Territories grew into the most widely known and influential of the “Great Surveys.”

Upon Nebraska gaining statehood in 1867, territorial delegate Phineas W. Hitchcock requested that \$5,000 dollars in unused funds remaining from the state’s territorial appropriation be used to fund a geological survey.⁵⁹ Much as they had over a decade earlier when faced with the possibility of a territorial survey of Nebraska, Hayden and Baird argued that Hayden’s familiarity with the region made him a natural candidate for the position. However, unlike their

⁵⁶ Cassidy, *Hayden*, 31.

⁵⁷ Richard A. Bartlett, *Great Surveys of the American West* (Norman: University of Oklahoma Press, 1962),

xii.

⁵⁸ Cassidy, *Hayden*, xi, 32.

⁵⁹ *Ibid.*, 83.

previous efforts, the two ultimately secured Hayden's appointment through soliciting recommendations from a wide range of influential supporters. The survey guidelines tasked Hayden with examining Nebraska's geological formations, locating deposits of coal and other mineral and natural resources, determining aspects of the region's topography, and investigating the potential for agricultural or timber production. His instructions further directed Hayden to assemble geological, mineralogical, and paleontological collections, and to produce accurate graphical illustrations of objects and features of particular interest.⁶⁰ Although he found only limited potential for agricultural and resource development throughout much of the state, Hayden guarded his doubts closely, and instead highlighted what potential he found in his final reports.

Indeed, although his findings "nearly set at rest the prevalent idea that vast beds of coal existed at moderate distances beneath the surface," his report offered citizens of Nebraska the consolation that forest-tree culture would offer alternative sources of fuel within brief periods, even "where it was the general impression that the climate and soil were unfavorable to their growth."⁶¹ Hayden's careful mitigation of potentially unfavorable conclusions reflects his adeptness at appealing to varied interests. His assertion that timber culture would prove viable in areas previously deemed unfit for such usage, and Nebraskans' subsequent cultivation of forests in those regions attest to the authority increasingly ascribed to scientific interpretations of western landscapes and their appropriate usage in the postwar era.⁶² The successful completion of the survey won Hayden opportunities for further explorations and secured the continued support of the Commissioner of the General Land Office, Joseph S. Wilson, as a proponent of

⁶⁰ *Ibid.*, 85.

⁶¹ Joseph S. Wilson, *Report of the Commissioner of the General Land Office*, 1868, 1.

⁶² For a more complete treatment of forest-tree culture in western Nebraska see Robert Gardner, "Constructing a Technological Forest: Nature, Culture, and Tree-Planting in the Nebraska Sand Hills," *Environmental History* 14 (April 2009): 275-297.

further geological surveys of the public domain.⁶³ Wilson's recommendations for extending the geological survey to new areas of operation aided in the establishment of the United States Geological and Geographical Survey of the Territories, with Hayden as director, on April 1, 1869.⁶⁴

The Nebraska Survey set the tone for Hayden's directorship of the United States Geological and Geographical Survey of the Territories. Hayden maintained a close relationship with Baird and the Smithsonian, exchanging collections and research opportunities in exchange for Baird's considerable influence among men of science and politicians.⁶⁵ Hayden also established a policy of rapidly publishing results of the Survey's work as a means of popularizing the Survey, demonstrating its utility, and appealing to varied government, commercial, public, and scientific interests.⁶⁶ Hayden encouraged the rapid publication of maps, bulletins, and preliminary reports, circulated these publications widely, invited representatives of newspapers local to areas of the Survey's operation to accompany expeditions and document their service to local interests, contributed articles to popular publications, and encouraged his men to do the same.⁶⁷ Hayden used these strategies to great effect throughout the course of his directorship, but his efforts to popularize the Survey's 1871 expedition through present day Yellowstone National Park proved especially valuable in expanding the Survey's popularity and influence.

⁶³ Joseph S. Wilson, *Report of the Commissioner of the General Land Office*, 1868, 1-4.

⁶⁴ *U.S. Statutes at Large* 15 (1869): 306.

⁶⁵ Cassidy, *Hayden*, 85-6.

⁶⁶ *Ibid.*, 202-4, 147-8.

⁶⁷ *Ibid.*, 120, 148, 156, 173, 224-34.

"Not Its Parallel on the Face of the Globe"⁶⁸

Development is the great duty of the Republic, after all its recent trials. Resources are the gift of the Creator. Developing them depends on the work of man. Along the line of the Northern Pacific Railroad, as it follows up the water-courses, the Missouri and the Yellowstone on this side, and descends by the valley of the Columbia on the other, a vast body of agricultural land is waiting for the plow... Here, if climate and fertility of soil produce their natural result, when railroad facilities open this now isolated region to settlement, will soon be seen waving grain-fields and happy homes, and growing towns; while ultimately a cordon of prosperous States, teeming with population, and rich in industry and consequent wealth, will occupy that now undeveloped and almost inaccessible portion of our continental area.

Grand Traverse Herald, Traverse City, Michigan, March 23, 1871

The second expedition to the Yellowstone recently returned from that region with stories even more marvelous than those brought by the Langford Party of 1870. It has been said, in the West, that every man who goes up there loses his reputation for veracity. But we suppose the incredulous will be compelled to believe the account of Prof. Hayden, who had charge of the government expedition of 1871; and *it is proved by scientific measurements, made by him,*⁶⁹ that Langford had- with the bug-bears of unbelief and a lost character before his eyes- in many cases greatly underestimated the heights and depths and distances.

Liberty Weekly Tribune, Liberty, Missouri, December 1, 1871

Perhaps no other chapter in the history of the Hayden Survey better illustrates the variety of interests at work in the postwar exploration of western lands, or Hayden's abilities as "Geologist in Charge" to appeal simultaneously to such varied interests and promote the Geological and Geographical Survey of the Territories, than its 1871 survey and subsequent role in the creation of Yellowstone National Park. This particularly illustrative aspect of the Survey's history also constitutes that most frequently studied by historians. Although a full treatment of the season's explorations and the intricate and complex story of the creation of Yellowstone National Park is beyond the scope of this study, a brief overview of these events illustrates the

⁶⁸ F. V. Hayden, "The Wonders of the West II: More about the Yellowstone," *Scribner's Monthly*, 3:4 February 1872, p. 388-396.

⁶⁹ [emphasis added]

importance of the Yellowstone Survey in bolstering Hayden's efforts to promote the scientific exploration of the West and cultivate perceptions of western landscapes as scientific spaces.

Setting out from Ogden, Utah about June 1, 1871, the Hayden Party surveyed a narrow belt, "connecting the Union Pacific Railroad with the Yellowstone Basin."⁷⁰ The Survey likely scouted the potential route in return for the passes and reduced freight fees Union Pacific executives supplied them with that season.⁷¹ Turning south from Fort Ellis, Montana Territory, accompanied by a cavalry escort under Lieutenant Gustavus Cheney Doane, the expedition soon found themselves in a valley filled with "remarkable physical phenomena," "quite impossible for anyone to do justice to... by any description, however vivid."⁷² Fortunately, travel passes and reduced freight charges did not exhaust the railroad industry's contributions to the Survey's efforts that season.

Eager to capitalize on the region's tourism potential, Jay Cooke of the Northern Pacific Railroad arranged for the landscape artist Thomas Moran to accompany the expedition.⁷³ Although Moran, an illustrator for *Scribner's Monthly*, had previously created illustrations of the region's unique natural features and phenomena from the descriptions and rough sketches provided by the 1870 Langford expedition, his travels with Hayden in 1871 marked his first personal experience with the area.⁷⁴ The illustrations Moran created from the Langford Expedition's accounts accompanied Langford's article, "The Wonders of the Yellowstone." The article appeared in *Scribner's Monthly*, and, along with a series of popular lectures given by Langford, generated considerable national interest in the region and its phenomena. Langford's

⁷⁰ Ferdinand V. Hayden. *Preliminary Report of the United States Geological Survey of Montana and Portions of Adjacent Territories; Being a Fifth Annual Report of the Progress* (Washington, D.C.: Government Printing Office, 1872), 3-4.

⁷¹ Merrill, *Yellowstone and the Great West*, 15.

⁷² F. V. Hayden, "The Wonders of the West II: More about the Yellowstone," *Scribner's Monthly*, 3:4 February 1872, 388.

⁷³ Merrill, *Yellowstone and the Great West*, 15.

⁷⁴ *Ibid.*, 13.

popularization of the Yellowstone region built upon the tales of previous Yellowstone explorers, such as those recounted by Jim Bridger on the Warren expedition of 1856 and Reynolds expedition of 1859. As the leader of the first *scientific* expedition to successfully explore the area, Hayden built upon the interest generated by previous explorations to promote his Survey, but purposely distinguished the expedition from preceding efforts as well, offering geological explanations for the region's natural phenomena in addition to comprehensive and detailed descriptions of the landscape.

Moran's illustrations of the Yellowstone region again appeared on the pages of *Scribner's Monthly* in February of 1872, accompanying an article by Hayden that recounted the travels and experiences of the 1871 expedition.⁷⁵ The article and images popularized the Survey and proved instrumental in winning support for the creation of Yellowstone National Park, as did Moran's iconic painting of "The Grand Cañon of the Yellowstone."⁷⁶ William Henry Jackson's photographs also proved "of very great value" in preparing the Survey Report, where a selection of Jackson's images, reproduced as woodcuts, appeared alongside illustrations created by Moran.⁷⁷ While images produced by Moran and Jackson were invaluable in promoting the Survey, popularizing its work, and winning support for the creation of Yellowstone National Park, other images figured prominently in the report as well.

The official artist for the 1871 expedition, Henry W. Elliot, produced "a great number of sketches" depicting the landscapes and geological features the expedition encountered, and "constructed sections of the entire routes traversed during the season."⁷⁸ Elliot's sketches of geyser cones and geological formations appeared alongside his geological sections in the

⁷⁵ F. V. Hayden, "The Wonders of the West II,"

⁷⁶ Cassidy, *Hayden*, 232.

⁷⁷ Hayden, *Fifth Annual Report*, 1872, 5.

⁷⁸ *Ibid.*, 5.

Survey's *Preliminary Report*, presenting its readers with representations of the landscape as viewed by the geologist. Elliot's illustrations depicted the varied strata of geological formations, the inner workings of geysers and thermal springs, and simultaneously represented terrestrial topography and subterranean geological structure.⁷⁹ The descriptions that accompanied these illustrations further depicted a scientific landscape, providing comprehensive descriptions of features, measurements of their size and orientation, and characterizations of their geological compositions. For example,

The next bed is composed of rusty-brown slaty clays 200 feet thick. Then succeeds a remarkable group of quartzite beds, with unusual indications of shallow water deposition, inclining 75°. The river cuts directly through the ridge, forming a cañon 100 feet wide, with walls 500 feet high. The lower bed I have estimated at 2,000 feet in thickness, and it is mostly a close-grained compact quartzite, but sometimes it is an aggregate of small white masses of quartz and water-worn pebbles.⁸⁰

Although Hayden's article, "The Wonders of the West-II. More About the Yellowstone," that appeared in the February 1872 edition of *Scribner's Monthly* blended geologically detailed descriptions of the landscape with descriptions of scenery and a narrative account of the expedition's travels, it too promoted a "geologist's view," providing similar, if somewhat abbreviated descriptions to those contained in the *Preliminary Report* for 1871.

The river has carved out a channel through the basalt volcanic breccia and hot spring deposits, one thousand to twelve hundred feet deep and one to two thousand feet in width, at the bottom of which the water foams along with torrent-like rapidity. But the striking feature of this remarkable view is the effect of colors derived from the hot spring deposits, which have a brilliancy like the most delicate of our aniline dyes.⁸¹

By combining comprehensive geological descriptions and well-chosen images in his article and report, Hayden presented readers with persuasive examples of the thorough, detailed knowledge

⁷⁹ Elliot's images fill the pages of the 1871 Report, and a small selection of them will be included, either in the text or an appendix to better illustrate these characteristics.

⁸⁰ Hayden, *Fifth Annual Report*, 16-17.

⁸¹ Hayden, "The Wonders of the West II," 392.

gained through scientific surveys and fostered perceptions of the Yellowstone region as a scientific landscape.

In addition to promoting a particular perception of the western landscape, Hayden's article promoted ideas of that landscape's appropriate use. Asserting that "The intelligent American will one day point on the map to this remarkable district with the conscious pride that it has not its parallel on the face of the globe," Hayden concluded by asking, "Why will not Congress at once pass a law setting it apart as a great public park for all time to come, as has already been done with that not more remarkable wonder, the Yosemite Valley?"⁸² Although the "national park idea" did not originate with Hayden, he readily adopted the cause, devoting his considerable energy to winning support for the creation of Yellowstone National Park.⁸³ Hayden lobbied for support in Congress, and promoted his cause in popular publications, writing for the *American Journal of Science* in addition to *Scribner's*.⁸⁴

President Grant signed the bill establishing the Park on March 1, 1872.⁸⁵ Hayden celebrated the Park's creation in his report for the 1871 season (published in 1872), and would later claim sole responsibility for the Park's existence by law.⁸⁶ Hayden's efforts to establish Yellowstone National Park proved a boon to the U.S. Geological and Geographical Survey of the Territories, drawing greater national attention to the Survey, popularizing its priority in examining the area's geological features, and associating it closely with the region. The 1871

⁸² *Ibid.*, 396.

⁸³ For a comprehensive treatment of the origins of the "national park idea" and the creation of Yellowstone National Park see: Paul Schullery and Lee Whittlesey, *Myth and History in the Creation of Yellowstone National Park*, (Lincoln: University of Nebraska Press, 2003).

⁸⁴ Cassidy, *Hayden*, 120.

⁸⁵ *An Act to Set Apart A Certain Tract of Land Lying Near the Headwaters of the Yellowstone River as a Public Park*, (U.S.C., title 16, sec. 22.)

⁸⁶ Hayden, *Fifth Annual Report*, 162. &

U.S. Department of the Interior, *Letter from the Secretary of the Interior in regard to the Better Protection of the National Park from Injury*, 1878, 45th Cong., 2nd sess., House Executive Document 75 (Washington, DC, 1878).

"Yellowstone Expedition" won the Survey greater fame and prompted Congress to increase its appropriation to \$75,000 for the 1872 season.⁸⁷

The Survey's increased fame drew the attention of an abundance of applicants eager to travel west with Hayden in 1872.⁸⁸ Hayden used the greater appropriation to expand the size of the Survey, adding to his corps of topographers and engaging William Henry Holmes as an artist. The Survey fielded two parties for the 1872 season, making extensive explorations of Yellowstone National Park and the surrounding regions. However, "the burden of executive duty... in managing the affairs of so large an organization" prompted Hayden to seek the assistance of topographer James T. Gardner "to render the organization more perfect, so far as the topographical section [was] concerned."⁸⁹ Citing the difficulties of surveying in an area so far removed from railroad lines and fears of attack by the Sioux living in the areas of the Survey's operation, Hayden decided to move the Survey to Colorado for the 1873 season.⁹⁰

⁸⁷ F. V. Hayden to Columbus Delano, Secretary of the Interior, March 20, 1872, in House Executive Document 210, 42nd Congress, 2nd session (Washington, D.C.:GPO, 1872), 2.

⁸⁸ Ferdinand V. Hayden, *Sixth Annual Report of the United State Geological Survey Embracing Portions of Montana, Idaho, Wyoming, and Utah; Being a Report of Progress for the Year 1872* (Washington, D.C.: Government Printing Office, 1873), 1-10.

⁸⁹ *Ibid.*, 6, 10.

⁹⁰ Ferdinand V. Hayden, *Seventh Annual Report of the United States Geological and Geographical Survey of the Territories, Embracing Colorado, Being a Report of Progress of the Exploration for the Year 1873* (Washington, D.C.: Government Printing Office, 1874), 1.

"Always a Reckless Climber"⁹¹

...it is found by experience that when a scientific party is placed under charge of one who is not himself a devotee and enthusiastic laborer in some especial field of science, the work done is inferior in quality and quantity.

-F. V. Hayden, United States Geologist, 1874.

On July 28, 1873, Baird wrote to Hayden, "I notice what you say about the rivalry of another branch of the service, but I do not think it will amount to anything."⁹² He was wrong. Indeed, nineteen days before Baird wrote these words parties of the Hayden and Wheeler surveys met in Colorado's South Park, pushing the surveys' already strained relationship to the breaking point and sparking a Congressional inquiry into the duplication of survey work that precipitated the consolidation of the Great Surveys under the United States Geological Survey in 1879.

Although Hayden justified his Survey's 1873 transfer to Colorado as a response to safety and logistical concerns, other factors motivated the move as well. The surveyor's West was changing in the early 1870s. Clarence King's Survey of the Fortieth Parallel completed much of its work in 1872, leaving the remaining territories to Hayden, Wheeler, and Powell. If King's withdrawal reduced the number of rival surveys, it did nothing to reduce the competition for the diminishing areas that remained unexplored. As competition over territory increased, so too did struggles over appropriations and personnel. Hayden quickly recruited James T. Gardner as his chief topographer, and the two men secured the assistance of the Coast Survey to aid in their topographical triangulation and serve as an ally in Washington.⁹³ The Wheeler Survey continued to grow as well, attaining approximately the same size as Hayden's Survey by 1873. Each of the surveys increasingly viewed the other as a threat, and both Hayden and Wheeler sought to

⁹¹ As quoted in William Henry Holmes, "Mountain of the Holy Cross, Central Northern Colorado, About 30 Miles from Leadville," *The New Voice*, January 1899, np. The article recounts the 1873 ascent of the Mount of the Holy Cross. The above quote refers to the reason for Hayden's "misfortune to fall into one of the mountain torrents."

⁹² S. F. Baird to F. V. Hayden, July 28, 1873, Baird Correspondence, Record Unit 7002, Smithsonian Institution Archives, Reel 13, Volume 14, pg. 65.

⁹³ Cassidy, *Hayden*, 246.

monopolize control of the remaining territories. Although Hayden claimed that his proposed area of operations for the 1873 season was "unoccupied, at this time, as far as I can tell," existing evidence suggests that Hayden's move to Colorado represented an attempt to assert his claims to all of the western territories, and to challenge Wheeler and the Corps of Engineers on their own ground.⁹⁴

Although tensions between the Hayden and Wheeler Surveys simmered throughout the fall and winter, the matter of survey duplication lay unattended until April 15, 1874, when Representative Lazarus Shoemaker of Pennsylvania submitted a resolution to President Grant. Shoemaker's resolution called on Grant to inform the House of any surveys engaged in duplicate explorations, and proposed either the consolidation of all surveys under a single department, or a clear definition of each survey's geographical boundaries.⁹⁵ Grant solicited recommendations from both the War and Interior Departments, which he submitted to the House Committee on the Public Lands along with his response.⁹⁶ Viewing the Shoemaker Resolution both as a threat to the existence of their western surveys and an opportunity to lay claim to all future geological and geographical explorations in the West, agents of both the War and Interior Departments quickly made their cases to Grant.⁹⁷

The letters submitted to Grant by Secretary of War William Belknap, Chief of Engineers General A. A. Humphreys, Secretary of the Interior Columbus Delano, F.V. Hayden, and John

⁹⁴ F. V. Hayden to Columbus Delano, Secretary of the Interior, in House Executive Document 166, 42nd Congress, 3rd session, (Washington, D.C.: GPO, 1873), 2. Hayden proposed to begin his survey at the southern boundary of the area surveyed by King, 40°, 30' N, between the eastern boundary of the Green and Colorado Rivers and the western boundary of the 103rd meridian. James G. Cassidy, in *Ferdinand V. Hayden: Entrepreneur of Science*, pp. 243-7 cites correspondence between Hayden and Baird, and Hayden and Gardner that evinces Hayden's ambitions to lay claim to remaining territories and reveals that Hayden and Gardner anticipated greater hostility from the Wheeler Survey to result from the move.

⁹⁵ House Committee on the Public Lands, *Geographical and Geological Surveys West of the Mississippi*, 43rd Congress, 1st session, 1874, House Report 612, 1.

⁹⁶ *Geographical and Geological Surveys West of the Mississippi, Message from the President, 1874, 1-2.*

⁹⁷ Secretary of the Interior Columbus Delano also submitted a letter from John Wesley Powell, whose "Survey of the Colorado of the West and its Tributaries" remained under the direction of the Smithsonian Institution.

Wesley Powell presented decidedly antagonistic assessments of the problems of survey duplication and proposed divergent strategies for the consolidation of surveys. In addressing the duplication of survey work during the 1873 season, the proponents of both the War and Interior Department surveys, predictably, presented the overlap of operations as a result of their rivals' territorial ambitions. Belknap and Humphreys each maintained that Hayden's party did not adhere to an agreement that placed the upper Arkansas River as the boundary between survey territories.⁹⁸ For his part, Hayden insisted that the parties of his survey operated only in areas previously assigned to them by Secretary Delano, asserting that the Wheeler Survey party extended their examinations into these areas. Hayden further contended that a survey "conducted under the auspices of the War Department," presumably for military purposes, "could have no relation to or in any way necessarily conflict with the geological survey under [his] charge."⁹⁹

In asserting his Survey's compliance with the geographical limits placed on its operations for the 1873 season, Hayden sought to establish a legitimate claim to the unmapped portions of the Colorado Territory, an essential step in securing the continuation of survey operations necessary to complete his proposed geological and geographical atlas of the region. By dismissing his chief rival's survey as an unrelated examination undertaken for solely military purposes, Hayden challenged the War Department's claims of the scientific competency of its surveys' geological and topographical explorations, while asserting his own survey's claims to scientific authority in the process. Hayden's "presumption" that military considerations comprised the principle focus of Wheeler's Survey also implied an extant segregation of the scientific investigations pursued by civilian men of science from the narrowly focused military

⁹⁸ *Ibid.*, 2, 5.

⁹⁹ Geographical and Geological Surveys West of the Mississippi, *Message from the President*, 1874, 10.

surveys of the War Department. Although no such segregation of survey methods and practices yet existed, both Hayden and Delano endorsed such divisions of labor in proposing their plans for consolidation.¹⁰⁰

As with accusations of responsibility for the duplication of survey work, the consolidation plans proposed by the competing surveys and departments manifested in predictable forms. Hayden and Delano advocated the consolidation of all scientific and geographical surveys, "except those for military purposes," under the supervision of the Department of the Interior. Belknap called for the consolidation of all but the surveys conducted by the General Land Office under the direction of the War Department, as did President Grant. A. A. Humphreys favored placing all surveys under the War Department, with no apparent exceptions. Powell, with his survey under the direction of the Smithsonian Institution, and likely wary of treading on the toes of potential future patrons, supported the consolidation of "surveys made for general purposes" under a single department and claimed that he was "not a judge" of the explorations "necessary for military purposes."¹⁰¹

While the varied proposals for consolidation differed in their suggestions for the appropriate roles of War and Interior Department surveys, the proposals shared the assessment of the worth and necessity of geological maps as accurate sources of information regarding mineral and resource deposits. Delano, Hayden, and Powell asserted the necessity of geological maps for the development of western territories and American industry, and Hayden argued that the creation of such maps and the survey work necessary for their creation must fall under the direction of a geologist "to be of any value."¹⁰² Humphreys appealed to the long history of War Department surveys in the West, dating from the Lewis and Clark Expedition, in an attempt to

¹⁰⁰ *Ibid.*, 9, 11.

¹⁰¹ *Ibid.*, 1, 2, 6, 9, 11, 15.

¹⁰² *Ibid.*, 11.

win greater support for such surveys and illustrate the expertise of Army topographers, gained through decades of practice. However, Humphreys did not cast the dispute between War and Interior Department surveys as a competition between the traditional practices of topographical engineers and those touting the value of new forms of specialized knowledge. Instead, he asserted the competency of War Department surveys in conducting geological explorations as well, citing the close cooperation among Army surveys and "the many scientific societies and men of science of the country" to organize these surveys' scientific investigations and promote efficient and accurate work.¹⁰³ Thus, although War Department surveys could claim a long-standing tradition as explorers of western lands and illustrate the extensive area mapped through their labors, the efforts of Hayden and others to promote scientific surveys and geological maps as the most accurate and valuable means of exploring western lands cast such investigations as the standard by which survey efforts were judged. This preference for scientific surveys narrowed the competition between the War and Interior departments, largely, to a question of scientific competency. In an attempt to resolve these disputes, the Committee on the Public Lands conducted special hearings.

Between March 11 and 21, 1874, Washington Townsend, chairman of the House Committee on the Public Lands, oversaw hearings to investigate the matter of consolidation. The Committee ultimately resolved that sufficient territory remained to occupy all surveys for years to come, but the hearings nonetheless proved an important victory for proponents of civilian, scientific surveys. Members of the Committee with links to the Hayden Survey aggressively questioned Wheeler during the proceedings. This interrogation ultimately drew out the revelations that civilian men of science represented the majority the Wheeler Survey's scientific personnel, that the number of qualified engineers available often fell short of the

¹⁰³ *Ibid.*, 6.

demand for these individuals, and that many of the survey and mapping techniques employed by Wheeler's Survey were in fact pioneered by civilian scientific surveys. The hearings further illustrated the historically increasing role of civilian scientific surveys in western exploration and development following the Civil War. While the Townsend Hearings did not spell the end of the Wheeler Survey, these findings diminished its status as a legitimate rival to Hayden and Powell. Recommending only that the Secretaries of the War and Interior Departments consult with one another to ensure that each survey operated in distinct areas, the Committee placed the Hayden, Wheeler, and Powell surveys back in the field for the 1874 season.

Hayden returned to Colorado to gather data for his proposed atlas and assert his Survey's claims to the region. Spying an opportunity in the Townsend Committee's transfer of Powell's Survey from the Smithsonian Institution to the Department of the Interior, Hayden attempted to expand his claims in Washington as well. Hayden and Gardner, who actively assisted in the administration of the Survey after joining it in 1872, viewed Powell as their chief rival after the Townsend Hearings. Citing their Survey's established position within the Department of the Interior, and arguing the utility of placing the Department's geological survey efforts under a single institution, Hayden and Gardner attempted to annex Powell's survey. Rather than tying Powell to the Hayden Survey, however, these efforts exacerbated tensions between the surveys and transformed Powell into Hayden's staunchest opponent. Despite vigorous efforts by both Hayden and Powell to sway the House Appropriations Committee to support their survey over that of their rival, the men found themselves in a stalemate until 1876. In that year, Powell, with his Survey's examination of the Colorado River and Grand Canyon nearly complete, requested that the House Appropriations Committee re-designate his Survey's duties as "for the

continuance of the geographical and geological survey of the Rocky Mountain region."¹⁰⁴

Powell hoped to challenge Hayden's claims to the Rocky Mountain region and perpetuate his Survey's existence, but his efforts instead sparked a push within Congress to "some time or another bring these surveys to a close." Anticipating the conflicts that lay ahead, Hayden redoubled his efforts to complete the *Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory*, completing much of the remaining survey work during the 1876 season.

¹⁰⁴ Cassidy, *Hayden*, 256.

"Such Complete Maps as are Required"¹⁰⁵

The great survey under Dr. Hayden, of which the present atlas is the latest product, appeals in it to the public interest in the most direct manner. Nothing can be more desirable for a community to know than the material constitution of their possessions, and in no way is this knowledge more quickly and exactly communicated than by the geological map.

-*The American Naturalist*, 1878

"The consummation and crown of all the labours which Dr. Hayden and his staff ha[d] carried on so triumphantly for the last five years," the *Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory* presented readers with an aesthetic and cartographic masterwork.¹⁰⁶ Simultaneously a work of art and a comprehensive representation and descriptive guide to the landscape of Colorado, the *Atlas* served as both a means of promoting the Hayden Survey and as a compelling example of the utility and value of the Survey's work. The *Atlas* contained a triangulation map, drainage map, economic map, general geological map, six-section detailed topographical map, six-section detailed geological map, geological sections illustrating the vertical structure of geological strata, and a series of panoramic views sketched by William Henry Holmes.¹⁰⁷ In addition to contributing panoramic sketches, Holmes remained in Washington to oversee the completion of the *Atlas* during the 1877 season. Holmes devoted "a large portion of the time... to the preparation of the 'Economic Map,' the 'General Geological Map,' the 'Geological Sections,' and the 'Panoramic Views.'"¹⁰⁸

¹⁰⁵ Geographical and Geological Surveys West of the Mississippi, *Message from the President*, 1874, 12. "Therefore, both for economic and scientific reasons, geologists should control the geological surveys, and make such complete maps as are required to show the physical conditions and resources of the Territories. The maps, if complete enough for the above purposes, will be permanently suitable for all other uses."

¹⁰⁶ As Arch. Geike stated in "American Geological Surveys," *Nature*, (September 12, 1878), 516.

¹⁰⁷ Department of the Interior, U. S. Geological and Geographical Survey of the Territories, F. V. Hayden, U.S. Geologist in Charge, *Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory* (New York: Julius Bien Lithographers, 1877), cover page and table of contents.

¹⁰⁸ Holmes, *Random Records*, "The Naming of Mount Holmes, Utah," vol. 2, section II, 68-9.

Containing such varied representations of the Colorado landscape, the *Atlas* rendered the area profoundly legible as a scientific space.

The triangulation map, the first representation presented to readers of the *Atlas*, depicted Colorado as an intricate network of precise triangulation points, an irregular assortment of mountain peaks connected by a rationalized web of perfectly straight triangulation lines that exhibited no evident relationship to the serpentine ridges and valleys of the physical landscape. Although Hayden included an explanation of the Survey's topographical methods in the Report for the 1876 season, no such explanation appeared in the *Atlas*, leaving readers uninitiated in topographical practices to contemplate the Colorado Landscape through the Survey's esoteric purview.¹⁰⁹ The drainage, topographical, and geological maps and sections that follow the triangulation map defined Colorado's landscape in terms of surface topography, physical and geological composition, and the subterranean structure of geological systems, which related the landscape's makeup to geological timescales as well. Holmes's panoramic sketches depict both sweeping expanses of Colorado's mountain districts and Survey personnel at work. These studies offered readers the kind of "on the ground" perspectives unattainable from the maps and geological sections, but also, through presenting Survey members as features of the landscapes thus perceived, emphasized the role of Survey personnel as interpreters of these landscapes, and seemed to suggest this role as their natural and appropriate occupation.¹¹⁰ In short, the variegated representations contained in the *Atlas of Colorado and Portions of Adjacent Territory* provided a comprehensive, color-coded guide for the Colorado Landscape and emphasized the origin of such comprehensive knowledge in the labors of the Hayden Survey's scientific personnel. These representations exhibited the extensive knowledge of western landscapes

¹⁰⁹ Hayden, *Geological and Geographical Atlas of Colorado*, legend.

¹¹⁰ *Ibid.*, sheets XIX and XX.

generated by the Hayden Survey and cultivated perceptions of such landscapes as the special purview of scientific surveys, but none so fully epitomized a color-coded guide to the legible landscape, or promoted the value and utility of the Hayden Survey, as did the “Economic Map of Colorado.”

As its title suggests, the “Economic Map of Colorado” “exhibit[ed] at a glance the economic features of the whole region.”¹¹¹ When deciphered using the accompanying key, the patchwork of colors and patterns of dots and dashes that make up the “Economic Map” presented readers with a landscape reduced to commodities and areas defined by appropriate usage. The map delineated regions rich in mineral and coal deposits, characterized forestlands according to the predominant type of timber, showed the distribution of sage and badlands, traced the unusable areas above the tree line, classified riparian zones as agricultural lands, and designated suitable pasturelands.¹¹² A comprehensive guide for the settlement and development of the Colorado landscape and its available resources, the “Economic Map” served as a powerful testament to the value and utility of the Survey’s work and an enticing example of the results attainable through such comprehensive scientific survey.

Hayden, true to form, fastidiously employed the *Atlas* as a means of promoting his Survey and its work. He carefully managed the distribution of the limited number of available copies, gifting editions of the *Atlas* to editors of popular publications, colleges, scientific societies, prominent men of science, and representatives of industrial interests.¹¹³ Hayden’s meticulous promotion efforts secured widespread support for the continuation of his Survey and nurtured perceptions of scientific examinations as an especially productive method of western exploration. The *Atlas* received laudatory reviews in the United States and abroad. Reviewers

¹¹¹ Geike, “American Geological Surveys,” 516.

¹¹² Hayden, *Geological and Geographical Atlas of Colorado*, sheet III.

¹¹³ Cassidy, *Hayden*, 294-5.

touted the *Atlas* as a signal contribution to geological knowledge, a prime example of the federal government's commitment to the dissemination of accurate and useful information regarding public lands, and a testament to Hayden's extensive labors and talented directorship.¹¹⁴

However, the reviewers overlooked that the credit for the "vast fund of information given by the maps" did not belong to the Hayden Survey alone.¹¹⁵

Between 1873 and 1876, members of the Hayden Survey conducted extensive examinations of the majority of the area depicted in the *Atlas's* topographical and geological maps. However, the portions of these maps describing the region east of 104 degrees of longitude, comprising slightly less than one third of Colorado's geographical area, were reproduced from earlier maps and reports constructed by General Land Office surveys.¹¹⁶ As these maps portrayed an area "quite level and uniform in character," Hayden likely felt that "any map on a scale of sufficient size which [was] accurately done and ha[d] sufficient details [would] generally answer all the purposes of the geologist."¹¹⁷ Nonetheless, Hayden took care to free his Survey from the responsibility for any errors contained in this portion of the map, stating in the notes for the "General Geological Map of Colorado" that "East of Longitude 104 the Geology has not been studied in detail."¹¹⁸ The notes for the "General Geological Map" contained another notice informing readers that "The Geology of all portions north of parallel 40° 30', not visited by the Geologists of the Survey, has been compiled from the maps of the 40th parallel Survey, Clarence King in Charge." Already embroiled in a controversy resulting from the

¹¹⁴ Geike, "American Geological Surveys," 516-17 & *The American Naturalist*, "Review: Hayden's Geological and Geographical Atlas of Colorado," 546-7.

¹¹⁵ Geike, "American Geological Surveys," 517.

¹¹⁶ Hayden, *Geological and Geographical Atlas of Colorado*, sheet IV.

¹¹⁷ Geographical and Geological Surveys West of the Mississippi, *Message from the President*, 1874, 12. The above quote reflects Hayden's assessment that ordinary geographical and topographical maps were satisfactory for the description of level and uniform areas, but that the examination of mountainous regions necessitated the construction of detailed geological maps. This assessment dates from 1874, but I have found no evidence to indicate that Hayden's views on this matter changed at any time during the consolidation controversy.

¹¹⁸ Hayden, *Geological and Geographical Atlas of Colorado*, sheet IV.

duplication of survey work, Hayden likely viewed this usage of existing materials as a prudent course of action. In this context, his use of maps compiled by General Land Office Surveys, which also fell under the auspices of the Department of the Interior, particularly in describing regions of little apparent geological interest, represented a practical means of promoting efficiency and avoiding further accusations of duplication. Hayden's use of King Survey maps, however, invites further investigation.

As with his Survey's use of General Land Office survey maps, the necessity of avoiding further duplication precluded a resurvey of the area north of 40° 30', compelling Hayden to rely on maps generated by the King Survey. The region previously mapped by King's Survey was much smaller than that examined by the General Land Office surveys, comprising approximately one eighth of Colorado's geographical area.¹¹⁹ However, this strip of land along Colorado's northern boundary included the kinds of "broken and mountainous region[s]" for which Hayden had argued in 1874, two years after the conclusion of King's Survey operations, that "no maps which have heretofore been made can possibly answer the purposes of the geologist."¹²⁰ That these maps did in fact answer Hayden's purposes in creating the "General Geological Map of Colorado" and other portions of the *Atlas* illustrates that the disparities in the competency of survey personnel and the quality of work produced between War and Interior Department surveys were not as pronounced as Hayden professed.

Indeed, the two surveys shared more than maps in common. Despite King's engineering background and long tenure in the employ of the War Department, he shared Hayden's status as a civilian man of science, a characteristic Hayden routinely asserted as a key requisite for a successful director of scientific surveys. James T. Gardner, Hayden's Chief Topographer since

¹¹⁹ Hayden, *Geological and Geographical Atlas of Colorado*, sheet IV.

¹²⁰ Geographical and Geological Surveys West of the Mississippi, *Message from the President*, 1874, 12.

1872, formerly served as Topographer for the King Survey, and in fact, oversaw the creation of both the King and Hayden Survey maps used in constructing the *Atlas of Colorado*. Although Gardner served as an enthusiastic ally in Hayden's campaigns against Wheeler and the War Department, the employment of both he and his topographical work by surveys of each department serves as a glaring contradiction of claims that War Department personnel and their work could not answer the purposes of geological surveys. Viewed in this light, Hayden's promotion of western landscapes as scientific spaces, and assertions that scientific investigations constituted the only credible and accurate means of securing the comprehensive knowledge necessary to ensure their efficient development represent a somewhat overstated, rhetorical strategy aimed at creating a greater space for science in the federal government and securing his survey's predominance.

Overstated rhetoric and borrowed maps aside, Hayden effectively employed the *Atlas* to promote his survey and cultivate perceptions of the West as a scientific landscape, fittingly examined by men of science. Despite Wheeler's best efforts to promote the competency of his scientific personnel and engineers as practitioners of scientific surveys, the findings of the Townsend Hearings, persistent campaigning by Hayden and Powell, and meticulously cultivated perceptions of the *Atlas of Colorado* as a shining example of the potential worth of civilian scientific surveys combined to effectively eliminate Wheeler's Survey as a legitimate rival to Hayden and Powell by 1878. With the preference for civilian, scientific surveys apparently secure, competition among Hayden, Powell, and King to promote their personnel and themselves as those best suited to the task intensified.

In return for his carefully distributed editions of the *Atlas*, Hayden solicited letters commending the Survey, its work, and his abilities as its director. Hayden compiled these letters

into a volume, *Extracts from Letters and Notices of Eminent Scientific Men and Journals in Europe and America, Commendatory of the United States Geological and Geographical Survey of the Territories*, which he rapidly published as evidence of his Survey's merit as a scientific institution.¹²¹ Hayden drew on earlier letters for the volume as well, neglecting to date much of its contents. Many of these earlier commendations reflected allegiances long frayed or shifted by 1878. A polemical and often antagonistic opponent, and an ambitious man of science with a habit of claiming perhaps more than his due share of credit for scientific contributions, Hayden found reluctant allies and worse among many former supporters within the scientific community. Powell and King, however, combined their influence among scientific and political circles to secure the referral of the consolidation question to the National Academy of Science in 1878.¹²² The referral, a setback for Hayden in any case, proved especially damaging following the May 1878 death of Smithsonian Director and NAS President Joseph Henry.

Othniel Charles Marsh, a perpetual and bitter opponent of the Hayden Survey, received the directorship following Henry's death.¹²³ Fearing the consequences of Marsh's appointment, Hayden attempted to influence the selection of NAS committee members tasked with reviewing the issue ahead of the Academy's next regular meeting. Marsh held a "special" meeting earlier than expected, however, packing the committee with Hayden's opponents. On November 6, 1878, the NAS recommended the establishment of a singular United States Geological Survey tasked with "illustrating the resources and classification of the land, [and] reports upon general and economical geology."¹²⁴ To achieve this goal, the NAS further suggested discontinuing all

¹²¹ Cassidy, *Hayden*, 294-5. & F. V. Hayden, *Extracts from Letters and Notices of Eminent Scientific Men and Journals in Europe and America, Commendatory of the United States Geological and Geographical Survey of the Territories*, (Washington D.C.: R. O. Polkinhorn, 1879).

¹²² *Ibid.*, 265.

¹²³ Cassidy, *Hayden*, 269.

¹²⁴ *U.S. Statutes at Large*, 20 (1879): 395.

surveys in their existing forms, restricting Army survey efforts to those of military necessity, and diminishing the proposed survey's natural history investigations. This last suggestion represented a calculated attempt to diminish Hayden's support in Congress.

Hayden, particularly after receiving increased appropriations in 1872, frequently underwrote studies in botany and zoology. Although Hayden maintained that the additional work of naturalists entailed "very little additional cost," Powell and Marsh offered strikingly similar assessments opposing Hayden's view.¹²⁵ Both men emphasized the necessity of restricting government survey investigations to those that generated utilitarian results, and Powell advocated restricting the proposed geological survey to investigations promoting the development of agriculture and mining specifically.¹²⁶ Marsh aggressively promoted the NAS plan. Hayden downplayed the extent of his support of natural history studies and lobbied against the NAS's proposals. However, limiting the scope and cost of survey work appealed to government interests, and won extensive Congressional support for the NAS plan. Fighting what increasingly seemed a losing battle, Hayden changed his tactics, supporting the plan and promoting himself as the most qualified candidate for the directorship of the consolidated survey.

While Hayden campaigned against Marsh and Powell, King, busily compiling commendations of his own, pushed to secure the directorship for himself. King solicited letters of support from eminent geologists, university faculties, and Marsh, which emphasized his connections to the scientific community, abilities as director of the 40th Parallel Survey, and knowledge of "economical geology."¹²⁷ King's supporters, in turn, sought yet more

¹²⁵ Hayden to Carl Schurz, Oct. 20, 1878, in *Surveys of the Territories*, 45th Congress, 3rd session, 1878, House Misc. Doc. 5, 11.

¹²⁶ Cassidy, *Hayden*, 274-5. & John Wesley Powell, *Report on the Methods of Surveying the Public Domain* (Washington, DC: Government Printing Office, 1878), 12-14.

¹²⁷ Cassidy, *Hayden*, 297-9.

commendations. In addition to this already considerable support, King solicited a letter from the NAS committee on the surveys, effectively recommending him for the position. In the face of such strong opposition, even Hayden, the supposed "master of the scientific situation at Washington," found no means of rescuing his Survey or his position as "Geologist in Charge."¹²⁸ President Rutherford B. Hayes signed the Sundry Civil Bill establishing the United States Geological Survey, under the direction of Clarence King on March 3, 1879.¹²⁹

"Economical geology" constituted geological studies undertaken in support of practical considerations, specifically the development of the western territories, their resources, and industry. "General geology" embraced studies undertaken for "purely" scientific purposes.

¹²⁸ J. P. Lesley, "Notice of Ferdinand Vanevere Hayden, M.D., Ph.D., LL.D.," in the *Proceedings of the American Philosophical Society* 25:127 (1888): 61.

¹²⁹ Foster, *Strange Genius*, 311-12.

Conclusion

To the general interest in science excited by the enthusiastic labors of Dr. Hayden, in his geological explorations, is due in a great degree the existence and continuance of the present United States Geological Survey.

-*Science*, "Ferdinand Vandever Hayden," 1888

...he was so frank, forcible and direct that it was impossible to suppress or resist him. He had the western people at his back so heartily and unanimously that he was for a long time master of the scientific situation at Washington. He was a warm personal friend of some of the highest officials of the Government, who never failed to support strenuously and successfully his surveys. I think that no one who knows the history of geology in the United States can fail to recognize the fact that the present magnificent United States Geological Survey, now under the direction of Major Powell, is the legitimate child of Dr. Hayden's territorial surveys.

J. P. Lesley, "Notice of Ferdinand Vanevere Hayden," 1888

Although consolidation marked the end of Hayden's Survey, the discontinuance of the United States Geological and Geographical Survey of the Territories did little to diminish Hayden's involvement in American geology or stifle his ambitious pursuit of the directorship of the USGS. Hayden accepted a position as one of six principle geologists of the USGS at its establishment in 1879, and busied himself completing the unfinished reports and maps remaining from his former Survey and conducting limited fieldwork.¹³⁰ He doggedly pursued a return to his former status, attempting to undermine first King's, then Powell's directorship, until Powell's evident abilities as director and Hayden's own declining health weakened his resolve. Hayden remained with the USGS until failing health forced his retirement on December 31, 1886, ending more than thirty years as an explorer and interpreter of western landscapes. He died on December 22, 1887. Through balancing government, commercial, public, and scientific interests by providing opportunities for many of the nation's emerging men of science, and by promoting and popularizing geological surveys through rapid and prolific publications, Hayden secured

¹³⁰ Clifford M. Nelson, Mary C. Rabbitt, and Fritiof M. Fryxell, "Ferdinand Vandever Hayden: The U. S. Geological Survey Years, 1879-1886," in the *Proceedings of the American Philosophical Society* 125:3 (1981), 238-43.

science a significant place in the federal government and American West, and cultivated perceptions of western landscapes as scientific spaces.

Indeed, tracing Hayden's development as a man of science and the director of the U.S. Geological and Geographical Survey of the Territories offers important insights into the rise of nineteenth-century American men of science, particularly geologists, to positions as government advisors and specialized, expert interpreters of western lands and their appropriate uses. Scientifically educated through medical school, and beginning scientific work as a collector, Hayden's path to geology typified the experiences of many aspiring, antebellum men of science. Geology represented perhaps the most prominent field of American science in the mid-nineteenth century, and geologists quickly took advantage of the opportunities presented by western landscapes. While the assertion that Hayden's "collections furnished the data for profitable scientific investigation; and the researches then begun mark the commencement of the epoch of true geological investigation of our great West" may attribute too much to Hayden alone, this statement captures the fundamental links between the development of geological science and the development of western lands and resources.¹³¹ Hayden's work in geology and natural history certainly contributed to the "true geological investigation" of the West, revealing unique features of American geology and promoting new systems of classifying and interpreting western landscapes. His participation in antebellum western exploration and scientific study introduced Hayden to essential patronage networks and influential connections, and provided him with the familiarity of the upper-Missouri region that served him so well following the Civil War.

The 1867 Nebraska Survey established Hayden as an effective director, won him extensive political and scientific support, and introduced him to the importance of rapid

¹³¹ *Ibid.*

publication of survey materials for the promotion of his Survey and its view of western lands. This strategy of rapidly publishing materials served Hayden's purposes particularly well on the 1871 Yellowstone Expedition. Hayden characterized his Survey as the first *scientific* exploration of the region, popularizing the accuracy and credibility of the expedition's findings, and its priority in examining the area's unique thermal and geological features. Employing images by Elliot, Jackson, and Moran in conjunction with his descriptions of the landscape in reports and popular publications, Hayden cultivated perceptions of Yellowstone as a scientific space and promoted its establishment as a national park. The Expedition won the Survey greater fame and appropriations, allowing Hayden to expand the size of his operation and secure vital personnel as competition among the surveys intensified.

The consolidation controversy sparked by Hayden's 1873 move to Colorado pitted the War and Interior Departments against one another in a struggle for the administration of territorial exploration and prompted critical reappraisals of the proper roles of military and civilian surveys within the public domain. These growing divisions cast civilian men of science and Army engineers as antagonists in a struggle for the authority to interpret western landscapes. Hayden and other men of science associated with civilian surveys laid claims to this authority through asserting their specialized knowledge and expertise as essential qualifications to ensure the accurate work of surveys embracing scientific investigations.¹³² Although civilian men of science proclaimed scientific investigations of western landscapes as their especial purview, War Department surveys employed scientifically trained personnel and regarded scientific investigations as essential aspects of their survey work as well.¹³³ Thus, the polemical assessments each department offered regarding the quality and economic utility of the work

¹³² House Executive Document 240, 10.

¹³³ *Ibid.*, 3-4.

produced by rival surveys did not represent disparate perceptions of the value of scientific investigations so much as they reflected disputes over notions of scientific competency and the proper roles of military and civilian surveys in ongoing processes of western exploration. The Townsend Hearings and aggressive campaigning by Hayden and Powell diminished Wheeler's status as an opponent and won greater support for civilian-directed, scientific surveys. The Hayden Survey's *Geological and Geographical Atlas of Colorado and Portions of Adjacent Territory* won yet more support for scientific surveys and served as a striking representation of the West as a scientific space. With the preference for scientific surveys secure, the controversy that began as a clash between civilian and military surveys developed into a struggle among civilian men of science for the directorship of the U. S. Geological Survey. The coordinated efforts of his rivals for the position ultimately diminished Hayden's role in western explorations. However, the institutionalization of geological surveys within the USGS nonetheless represented a powerful reification of the perceptions of western landscapes as scientific spaces, aptly examined by scientific surveys, which Hayden so intensely cultivated.