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ALBERT CHARLES PEALE:
SCIENTIST-EXPLORER OF THE HAYDEN SURVEY, 1871-1879

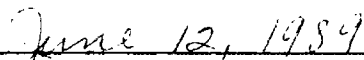
By
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B.A., University of Montana, 1983

Presented in partial fulfillment of the requirements
for the degree of
Master of Arts
UNIVERSITY OF MONTANA
1989

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History

Albert Charles Peale: Scientist-Explorer of the Hayden Survey, 1871-1879 (137 pp.)

Director: H.D. Hampton

From 1871 through 1879, Albert Charles Peale (1849-1914) served as mineralogist and geologist with Ferdinand Vandiveer Hayden's United States Geological and Geographical Survey of the Territories. With the Hayden Survey, Peale scientifically explored large tracts of uncharted land in the territories of Montana, Wyoming, Idaho, Colorado, and Utah. This study uses Peale's journals, scientific papers, and newspaper articles to examine Peale's specific activities as an explorer, scientist, and journalist in order to assess his individual and representative legacy in Western exploration.

The current published historical record of the Hayden Survey and Western scientific exploration presents problems in understanding Peale's work. This thesis addressed this historiographical limitation by establishing a dual context for viewing Peale's activities: the position of science in 19th century Western geographic discovery and the popular literature of scientific exploration.

This contextual approach demonstrates the fundamental value of Peale's career in the process of Western exploration. Peale's work has its primary significance in the cumulative efforts of the Great Survey scientists who closed the American period of Western exploration between 1867 and 1878. As explorers, they surveyed the remaining unknown regions of Western geography. As scientists, they brought modern science to the study of Western natural history and resources. As journalists, they communicated ideas and information that influenced national attitudes and Western land-use policy. Peale's work suggests that the scientist-explorers of the Great Surveys had a prominent role in determining the subsequent development of the Trans-Mississippi West.

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Introduction

Encamped near Ogden, Utah Territory, on June 4, 1871, 22-year old Albert Charles Peale penned a letter to his hometown newspaper. Printed eleven days later on the second page of the *Philadelphia Press*, his correspondence described the launch of an exploring expedition to the source of the Yellowstone River.(1) Peale belonged to Ferdinand V. Hayden's United States Geological Survey of the Territories, which had as its goal the first systematic scientific exploration of the long-mysterious Yellowstone region. In the two-column letter, Peale described the Hayden Survey's composition, and he related his own experiences with the expedition to that point.(2) Peale gave a brief history of the Survey, listed its members--noting their respective scientific specialities--and stated their objectives for the season ahead. He then described the railroad journey from Cheyenne, Wyoming Territory, where the party had assembled. Peale was serving as mineralogist for the expedition, and, true to his professional standing, he carefully characterized for his readers the geological structure of the countryside, noting the various rock formations and explaining that the red soil of the region resulted from the "granite nucleus" of the mountains the explorers were crossing.(3)

Peale did not limit his descriptions of landscape to objective scientific observations. He vividly detailed the romantic scenery of the region through which they traveled: the starkly rugged mountains and canyons that seemed "to have been dove-tailed together and then torn asunder."(4) They journeyed through a land of geographical mysteries and natural wonders, and Peale recited for his readers some of the strangely appropriate

placenames, like "Devil's Post Office" and "Witches' Cave", that denoted certain features.(5) Closing his letter, Peale stated that in five days the expedition would again be underway and would soon reach the Yellowstone.

While Peale signed his letter with the impressive pseudonym "Mineralogist"--thus punctuating his position as a scientist--his youthful enthusiasm belies the professional posture. His words reveal the powerful emotions of a young man well aware of the personal implications of the expedition. A heightened sense of anticipation pervades the letter, for more than mere adventure lay ahead for Peale. A recent graduate of the University of Pennsylvania Medical School, where he had studied under Hayden, Peale would now be pursuing his prime intellectual interest, geology, in one of the final unknown regions of the American West. Moreover, his role with this year's expedition could provide Peale the opportunity for future work with the survey.

Hayden's expedition, which completed its exploration of Yellowstone within two months of their departure from Ogden, was a scientific and popular success. In scientifically documenting Yellowstone's natural wonders, the explorers answered a long-unsettled question of Western geography, a feat that brought Hayden and his organization professional and public acclaim. Their achievement also convinced Congress to increase Hayden's funding, thus ensuring his mandate for continued exploration. Peale's work on the expedition obviously satisfied Hayden, for the young mineralogist continued his participation with the survey in subsequent years. As Hayden returned to Yellowstone in 1872 and later expanded his activities into Wyoming and Colorado, Peale's own role and stature increased

within the organization. By 1878, when the Hayden Survey disbanded, Peale had become one of its most experienced and influential members.

Peale's first letter to the *Philadelphia Press* not only recorded the commencement of a nationally significant exploring expedition, but it also marked the beginning of his own career as an exploring scientist--and part-time journalist--in the West. Throughout his tenure with the Hayden Survey, Peale compiled a substantial body of literature recording his personal experience and official duties. Although his newspaper correspondence lapsed in certain years, Peale eventually contributed over thirty letters to the *Press* and other newspapers.(6) In his official capacity he kept detailed field notes and made yearly contributions--totalling nearly 1,000 pages--to the published *Annual Reports* of the Survey.(7) Peale also kept detailed diaries in 1871 and 1872 and more limited journals in other years, which have survived intact, along with some letters and other private records. As a collection, his private and official writings comprise a large and potentially valuable personal account.

On an immediate level, Peale's collected writings gain historical significance primarily as a record of his own activities with the Hayden Survey. The preeminent scholar of Western exploration, William H. Goetzmann, has suggested that "in order to understand something of the internal history of exploration it is necessary to understand as fully as possible the explorer himself."(8) This study seeks to provide such an understanding. The primary purpose of this thesis, therefore, is to use Peale's collection to document and explain the career of a little-known, yet

significant, exploring scientist in the Trans-Mississippi West. Like many of his contemporaries, Peale's name has dwindled to a footnote in the published historical record of Western exploration. Studies of exploration traditionally focus upon expedition leaders, while ignoring the specific role of supporting personnel. This perspective remains appropriate for the earlier pattern of discovery, long dominated by towering figures. However, by the late 19th century, exploration had become a highly complex activity, dependent upon large numbers of skilled expedition members. The Western explorers of the 1870's carried out a variety of specialized duties in response to comprehensive cultural demands.

This broad cultural activity provides the key to understanding Peale's historic legacy. In fulfilling both his official and unofficial responsibilities with the Hayden Survey, Peale assumed three overlapping and, yet distinct, roles: explorer, scientist, and journalist. As an explorer, Peale helped probe and chart some of the last remaining unknown pockets of Western geography. As a scientist, he brought the spirit and practice of modern Darwinian science to the study of specific aspects of Western natural history. As a journalist, he communicated information and ideas about the West that influenced the course of regional development. These diverse cultural dimensions of Peale's career reveal the fundamental significance of his individual experience. This thesis seeks to explain Peale's varied cultural contributions and suggest that his activities deserve a notable position in the story of Trans-Mississippi exploration.

To imply that Peale's personal activities were unique, however, would distort the historical record and strictly limit any attempt to explain his place in the story of Western discovery. In the tenure and variety of his

experience, Peale typified a generation of explorers. Young college-educated scientists from eastern states filled the ranks of Western exploring expeditions in the decade following the Civil War. Peale's activities with Hayden paralleled to a remarkable degree the the careers of many exploring scientists in this period. Indeed, the full measure of Peale's personal contributions can only be explained by acknowledging this fundamental facet of his labors.

Peale's work had its primary value in the cumulative efforts of the exploring scientists of the Great Surveys. The Hayden Survey was one of four independent federal organizations that conducted a comprehensive process of exploration in the West from 1867 to 1878.(9) Their combined work closed the period of large-scale geographical discovery in the West. In isolation, Peale's personal achievements with the Hayden Survey made an interesting, but limited, contribution to this general activity. But viewed as part of this collective experience, his work stands as a significant strand in a process that profoundly influenced the subsequent development of the American West.

The need to explain Peale's career in context dictates the specific methodology of this study. Two historical topics within the larger story of 19th century Western exploration--the individual activities of the Hayden Survey and the national process of scientific exploration--comprise the most pertinent perspectives for viewing Peale's activities. As an organization, the Hayden Survey provides the immediate topical and geographic background of Peale's experience. As an institution, scientific exploration offers the general thematic structure for examining his work.

This thesis will emphasize these dual features of Western exploration to highlight Peale's individual contributions to the overall process of discovery.

Peale's position as an employee of the Hayden Survey shaped the specific course of his travels and activities in the West. Each survey was--to a high degree--a product of its leader's personal motives and interests. Scientific specialization, coupled with professional and public-relations considerations, influenced the full range of each organization's activities. Hayden's decision to examine Yellowstone and Colorado reflected these concerns and determined the geographical boundaries of his survey, as well as the precise scientific information his organization pursued in these regions. His desire for publicity, moreover, directed many of the informal duties that his scientists carried out. The approach that Peale followed in each of his roles directly reflected the personal emphasis that Hayden gave his organization.

Although the surveys were independent agencies that conducted their efforts in distinct geographical regions, they shared a common agenda. Scientific exploration--a specific tradition within the larger process of discovery--tied these separate organizations together. Scientific inquiry was one of a variety of motives that characterized the period of American exploration that began with the Lewis and Clark expedition and continued through the Great Surveys. While often associated with other objectives of Western exploration, the position of science in this process developed within its own unique framework. The Great Surveys represent the culmination of this development.

Throughout the century, Western scientific exploration included two general fields of activity: the use of scientific cartographic techniques and the study of the region's natural history.(10) From the early period of this process through the Civil War these objectives had remained distinct, both in personnel and position of significance on the expeditions. Topographic surveys, which required technical knowledge and a basic scientific education, remained a primary goal of exploration throughout this period. These labors were usually carried out by the Army officers who led the expeditions. The quest for uncovering the natural history of the West was largely the domain of civilian naturalists and scientists who accompanied the expeditions and was often an adjunct interest. While topography was usually associated with the primary objectives of these expeditions, natural history was clearly a secondary interest of government exploration in this era of Western discovery.

The Great Surveys realigned the position of science--and the scientist--in federal exploration. The survey leaders accomplished this by bringing together the previously isolated strands of science--topography and natural history--into a collective enterprise. Scientists themselves, they made science the central focus of all their activities.(11) Exploration historians have pointed to civilian leadership as the central theme of the Great Surveys but have insufficiently emphasized the significance of the civilian as a scientist.(12) The rise of institutionalized science--in terms of personnel and focus--characterized this period of discovery. Scientific exploration--as a distinct tradition within the overall process of exploration--provides the broad thematic context for viewing Peale's

activities with Hayden. Peale was a scientist first; all aspects of his work in the West depend on that central facet of his career.

Unfortunately, the published historical record of Western discovery is limited in both the specific and general context necessary for understanding Peale's labors. Currently no specific studies give a detailed account of the Hayden Survey or establish the development of scientific exploration in the Trans-Mississippi West. This limitation in the historical record has two important implications for this account of Peale. First, it emphasizes the value of his collected writings as an untapped historical source. A discussion of Peale's activities may offer some new insight into Hayden's organization and the overall process of Western scientific exploration. But the record also poses substantive obstacles in contextualizing Peale's activities in the West. This thesis must address these limitations by establishing the significant features of both the Hayden Survey and 19th century scientific exploration that provide the appropriate context for explaining Peale's experience.

The position of the Hayden Survey in Western discovery remains vague because of a critical imbalance in published studies of the Great Surveys. Historians have comprehensively documented the story of two of those organizations--under Clarence King and John Wesley Powell--in articles, monographs, biographies, and edited primary accounts. But the record of the surveys led by Lieutenant George Wheeler and Ferdinand Hayden is largely limited to chapters within texts and surveys that offer only a broad outline and analysis of their activities. To date, no published monographs establish the specific legacy of either organization or portray the lives of their leaders.

The neglect of the Hayden Survey stands as a particularly significant omission. While Wheeler and his men made some original contributions to exploration and science, much of their work duplicated both that of earlier explorers and of their contemporaries. Indeed, Wheeler's most capable scientists often defected to other surveys.(13) Historical interest in Wheeler lies primarily in his bitter conflicts with rival survey leaders and in his anachronistic position as the last of the significant military explorers.(14)

Hayden and his scientists, on the other hand, made notable geographic discoveries, charted a huge region of generally unknown terrain, conducted important work in terms of theoretical science, and compiled much practical information about the natural resources of the regions that they surveyed. Moreover, while the Wheeler Survey labored in relative obscurity, Hayden's organization remained in the forefront of national attention throughout their years in Yellowstone and Colorado.(15) But, while the Hayden Survey was highly publicized in its own day, the work of its leader and members has faded to a subordinate position in the story of Western exploration.

The chief reason for this lack of published studies seems to lie in the nature of the records used by students of the period. The predominant source used in accounts of the Hayden Survey is the collection of *Annual Reports* that Hayden and his scientists compiled following each season in the field. These government-published documents provide a narrative of the Survey's expeditions and reveal its chief scientific accomplishments, but their limited scope offers no comprehensive view of Hayden, his men, and the ultimate value of their efforts. Moreover, the reports provide only a carefully edited version of the Survey's activities; they tell only what

Hayden wanted his readers to know. In documenting his organization's achievements, Hayden--like the other survey leaders--was also pleading for professional respect, public support, and, above all, Congressional approval, all of which contributed toward increased funding for the survey in subsequent federal budgets. But aside from any limitations as potentially unreliable documents, these official writings reveal only a surface view of the survey. The reports describe the results of the expeditions; they tell little of the process. Furthermore, the collective account precludes the individual experience: the drama, danger, labor, tedium, and passion in the daily life of Hayden's scientists. Finally, the reports alone reveal little of the personalities involved, the character of Hayden and his men.(16) Without this perspective, no fully valid assessment of the Hayden Survey is possible.

Historians have generally ignored the sizable body of private records relating to the survey. While the number of Hayden's personal documents is limited, the members of his expeditions produced a large and varied literature. Several of Hayden's scientists served as newspaper and magazine correspondents.(17) Others recorded their experiences in journals, letters, and unpublished manuscripts that now exist only in widely scattered collections. While many of these records have been studied for their literary content, their historical potential remains undeveloped.(18) Of all these private collections, Peale's seems to be the largest extant and thus offers the best single source of information beyond the Annual Reports.

Peale's writings stand as a valuable, albeit limited, example of the larger experience, offering new information and insight concerning the survey. His journals and newspaper correspondence depict exploration at an

intimate level, chronicling daily routine along with more dramatic incidents the survey members experienced. Most significantly, Peale's field notes and scientific reports represent much of the substantive work of the survey. These records show both the kind of scientific information Hayden's explorers sought and the specific methodology they used to accomplish their objectives. An account of Peale's experience, therefore, may suggest some of the central characteristics of the Hayden Survey and provide some broader understanding of the organization's place in the historical record.

The problem of context applies on a broader level to Peale's position in the process of Western scientific exploration. Peale's record as a scientist of the Hayden Survey belongs to the culmination of this specific activity. But no convenient historiography exists from which to view Peale's work in this larger tradition. Historians have yet to establish a precise framework for examining the role of the scientist in exploration. The story of discovery in the West is generally related in the context of related topics, such as the fur trade, military conquest, or overland travel. This emphasis suggests a historiographical bias that ranks the pragmatic value of exploration over its deeper cultural significance.⁽¹⁹⁾ Even in studies of exploration, the position of science, if mentioned, usually remains confined to a minor topic submerged in the larger story. William Goetzmann provides the most thorough examination of science in exploration, but in the context of his studies that position is necessarily secondary.⁽²⁰⁾ Because Goetzmann's surveys are structured on the leadership and organization of exploration, the position of science is one strand in the larger process and difficult to follow in a distinct pattern of development. Selected biographies of individual naturalists and

scientists and studies that focus on the scientific nature of selected expeditions provide only isolated views of this activity. Thus, to date, no comprehensive synthesis of Western scientific exploration offers a measure for specific accounts.

Given the lack of a suitable historiography, the following five chapters attempt to establish thematic context while documenting the major aspects of Peale's career, focusing on the three primary roles that he assumed with the survey. The first two chapters examine the position of science and the scientist in exploration. Chapters three and four discuss the literature of exploration, and the fifth chapter explains Peale's specific role as an explorer.

Chapter one establishes a personal and professional context as a guide to understanding Peale's relative position in that process. Even a brief outline of the development of Western scientific exploration is a task far beyond the scope of this project. But through a remarkable historical concurrence, Peale's own family provides an appropriate vehicle for examining the salient features of that activity. Three generations of Peales represent the major stages of development in 19th century scientific exploration. His great-grandfather, Charles Willson Peale, was a prominent naturalist and the leading popularizer of science in the United States in the early decades of the 19th century.⁽²¹⁾ As founder of a prestigious museum of natural history and distinguished member of the American Philosophical Society, he had an indirect role in the scientific aspects of the Lewis and Clark expedition and much of subsequent Western discovery. Titian Ramsay Peale, son of Charles, and uncle to Albert Charles Peale, served as a naturalist on two significant Western exploring expeditions:

Stephen Long's exploration of the central Rocky Mountains in 1819 and the Wilkes Expedition two decades later, which included in its global voyage a brief foray along the inland Pacific Coast region of the West. When Peale joined Hayden's Yellowstone expedition he was participating in a family, as well as a national, tradition.

While this chapter ranges at times far beyond the Peale family circle, their standing as archetypal figures should remain apparent. Their experience, by implication, represents the evolution of science and scientific exploration in the United States. As a direct extension of the American scientific establishment, the process was shaped by the enormous revolutions in 19th century scientific thought. Charles Willson and Titian Ramsay Peale symbolize in particular the changing interests, education, and profession of the scientific explorer up to the Civil War.

Chapter two discusses Albert Charles Peale's specific scientific role with the Hayden Survey, particularly as part of this continuing process of scientific exploration. In theme the chapter examines his work as part of the specific activities of the Hayden Survey and of the postwar era of discovery. His individual labors, along with those of the Great Surveys in general, belonged to a distinct era of American and international science. The changes in this period dramatically altered the objectives and the position of the scientist in the West. Viewing Peale in this context, against the backdrop of the previous chapter, should help explain the nature of his personal scientific legacy. Moreover, taking Peale as a representative figure, it also suggests the precise role that science had in the Hayden Survey.

Chapters three and four examine a corollary feature of Western exploration. Exploration literature has traditionally appealed to a large audience, but for a variety of reasons the American public had an unusually high interest in the work of the Great Surveys. Peale's newspaper correspondence was a typical response to this public enthusiasm. The scientist-explorers of this era produced a huge body of popular literature in various forms. While their work was largely narrative, common themes tied their writings together, particularly in conveying images of the Western landscape. The third chapter of this study sets a historical context for this unique literature, while the following chapter explains Peale's position in the development of this literature and suggests some broader implications of its place in American culture.

The closing chapter of this thesis examines Peale in his third, and probably least significant, role, that of explorer. In theme it suggests that the exploration of the West was a waning activity in this period. When Peale joined the Hayden Survey, the purpose of exploration was shifting from geographical discovery of unknown regions to a systematic topographic and economic survey of territories in the process of development. His writings reveal that by 1878, when the survey returned to Yellowstone, his work no longer represented exploration in any guise; at that point he was strictly a scientist. The consolidation of the Great Surveys into the United States Geological Survey the following year officially closed the chapter of Western exploration, but Peale's record reveals that this process had already effectively ended. His work in Yellowstone the previous year showed the new direction that science would follow in the West.

These chapters show certain fundamental characteristics of Western scientific exploration that shaped Peale's individual experience. The variety of roles that Peale assumed reveals one important feature of this process. As explorer, scientist, and correspondent, Peale responded to a diverse set of requirements. Western exploration, particularly its scientific aspect, was culturally a highly complex activity. Peale's activities reveal both the numerous, often conflicting demands made of naturalists and scientists in the West since the beginning of the century and the nature of their response. Regional economic interests, popular culture, national politics, and European intellectual developments all stimulated and shaped the position that science would assume in exploration. Peale's position in the closing period of discovery reflects the ultimate evolution of this process. His varied contributions mirrored the disparate achievements that the final generation of scientist-explorers made on a regional and national level.

One consequence of the important cultural position of exploration was that it was an extremely competitive process. A fierce rivalry for publicity characterized, in particular, the leaders of the Great Surveys. This competition significantly shaped their geographic focus and scientific agenda. Moreover, it stimulated much of the literature that the scientists of the surveys produced. Whether in the field, or at home after the exploring seasons, these men often served as promoters of their respective surveys. Peale's writings reveal much about how Hayden's response to this competition determined the work of his survey.

The dominant external factor influencing Peale's career was his position as an agent of the United States government. As a salaried employee of the

Hayden Survey, his work was a direct extension of national policy. Congress had created and was responsible for funding the survey. The Government Printing Office published the survey's *Annual Reports*, and the Washington-based scientific community--particularly the National Academy of Science and the Smithsonian Institution--coordinated much of the organization's activities. Whether in the field or at Hayden's office in Washington, D.C., Peale's primary duty lay in fulfilling the mandate of the federal government. Here again, he reflects the overall pattern of Western scientific exploration. While privately funded naturalists and scientists roamed the West throughout the 19th century, comprehensive scientific study in the region was largely the product of an alliance between federally-sponsored exploration and a steadily expanding scientific establishment. Peale's activities belong to the culmination of this process; the Great Surveys represent, above all else, the coalition of institutional science and the federal government in Western exploration. The rise of science in federal Western exploration after the Civil War would determine a new relationship between the national government and the West that would continue to develop beyond the era of exploration.

This coalition of science and the national government in geographical discovery provides the starting point for examining Peale's place in Western exploration. To understand this final stage, it is first necessary to look to the beginning, when an intellectually curious president compiled a set of instructions for a Western exploring expedition. Peale's story follows directly from the moment Thomas Jefferson established an official American interest in the natural history of its newly acquired lands beyond the Mississippi River.

Chapter I

The Peale family and American Scientific Exploration

Two events in the spring of 1804 signalled the beginning of American exploration in the Trans-Mississippi West. Together they reveal the major forces at work behind this process and the direction it would follow throughout the century. The departure from St. Louis of Meriwether Lewis and William Clark's expedition up the Missouri River established Western exploration as a national enterprise that would continue for the next 75 years. The arrival in Philadelphia of the German naturalist, Alexander Von Humboldt, on his return to Europe from an exploration of Latin America, revealed the American project as part of an international process. At the center of these events stood Thomas Jefferson. As president of both the United States and the American Philosophical Society, Jefferson was the primary force behind the exploration of Louisiana and the chief object of Humboldt's visit.

When Jefferson dispatched Lewis and Clark to examine the nation's newly acquired territory beyond the Mississippi, he set the general tone of Western discovery for the next 75 years. The ramifications of the Lewis and Clark expedition are well known and have been voluminously studied by scholars.(1) Two significant precedents have particular relevance for the purposes of this study. By the mere act of sending a military expedition, Jefferson placed the United States government in the position of patron of Western exploration, a role the federal government would continue throughout

the century. Private adventurers, fur traders, zealous naturalists, and state-sponsored explorers all participated in opening the West, but the bulk of the process was carried out by agents of the national government. This federal direction established a structure in which Western exploration developed.

Jefferson also determined the range of inquiry that federal explorers would conduct in the West. In the instructions that Jefferson provided the Lewis and Clark expedition he established a broad field of information for them to pursue.⁽²⁾ The wide objectives the explorers sought mirrored Jefferson's official and personal interests in the region. As the nation's president he had an interest in political and commercial benefits from the expedition; as an individual with a variety of intellectual interests he saw the West as a vast unexplored region brimming with a wealth of untapped scientific information. Therefore, in addition to the traditional interest in geographical discovery for economic and diplomatic purposes, Jefferson asked the explorers to conduct a thorough examination of natural history along the route of their travels.⁽³⁾ By emphasizing scientific inquiry as a goal of the first American expedition into the West, Jefferson fixed it as an object of official interest. Though the pursuit of science would generally remain subordinate to other considerations, it remained an objective of Western exploration through the first five decades of discovery. In the post-Civil War era science would rise to dominance and alter the course and the impact of this process. The Lewis and Clark Expedition, through the direct influence of Thomas Jefferson, established scientific exploration as a permanent national institution, with profound implications for the development of the West.

At the same time that Jefferson initiated a specific American activity, his scientific instructions placed Western exploration in an international process of discovery. Humboldt's visit to the United States represents this larger context of the American venture. Humboldt was returning to Europe after a remarkable, five-year long scientific exploration through Latin America. On this privately-funded journey, he and his traveling companion, Aime Bonpland, had explored by canoe the unknown headwaters of the Orinoco River and on an ascent of Mount Chimborazo in the Peruvian Andes had climbed to a record high elevation.(4) These feats established Humboldt's enormous popular prestige as an explorer, and his scientific achievements earned him preeminent status in the European scientific community.(5) During his travels Humboldt had explored scientifically virgin terrain, collecting tens of thousands of geological, botanical, zoological, and ethnological specimens. Moreover, he recorded daily astronomical and meteorological observations, all of which represented a huge mass of raw scientific information. Humboldt spent much of the rest of his long life digesting and organizing these collections and observations into a comprehensive view of nature that profoundly shaped the direction of science.(6)

Humboldt's South American expedition was a seminal event in what historians have called "the Second Age of Discovery."(7) At a basic level, this new era of exploration, begun in the mid-18th century, represented a shift in geographical emphasis--from linear voyages to the New World and the Far East to a comprehensive survey by naval expeditions of the Pacific.(8) This process also saw the alignment of science with exploration. Prompted by the Enlightenment's quest for the pursuit of

empirical knowledge about the Earth, these voyages began to include contingents of naturalists who pursued scientific information about the unknown regions they visited.(9)

Humboldt's place in this era of discovery is noteworthy for two main reasons. In geographical terms he represents a major shift in emphasis, from exploration of coastlines and islands to that of continental interiors, particularly of South and North America.(10) Moreover, he had a considerable influence on the style that scientific exploration would follow around the globe and, particularly, in the western United States. Humboldt personally influenced many exploring naturalists, directly and through his published works.(11) In a greater sense, Humboldt was the father of Western scientific explorers in general, for these men conducted their work with what has been called a "Humboldtian world view."(12) Humboldt's scientific studies established the discipline of modern geography as a broadly encompassing field that included the wide range of interests that naturalists sought in the West.(13) His diverse interests reflected the various scientific fields that Lewis and Clark and later explorers sought. Humboldt's exploration in South America and his subsequent scientific work set a pattern that naturalists would follow until another explorer of South America, Charles Darwin, established yet a new direction for science.

Humboldt's decision to visit the United States brought together the two leading figures of New World scientific exploration. Stopping first in Philadelphia, where he met many of the nation's leading scientists at a gathering of the American Philosophical Society, Humboldt traveled to Washington to see Jefferson, the patron of American discovery. Dining with Jefferson and Secretary of State James Madison, Humboldt discussed his own

expedition as well as the prospects of Lewis and Clark, who were then ascending the Missouri River.(14)

Another guest at dinner that night, though less known today than Jefferson, Madison, and Humboldt, helped shape this early period of American scientific discovery. Perhaps best remembered for his portraits of heroes of the early republic, Charles Willson Peale was a prominent member of the American scientific community. Peale's active, diverse career demonstrates the chief characteristics of American science at this time and shows how Americans extended this institution into the West. Curator of the American Philosophical Society, skilled field naturalist and leader of a much-publicized scientific expedition, and operator of a popular and influential natural history museum, Peale, according to one historian, "perhaps as much as anyone, symbolized the Second Great Age of Discovery."⁽¹⁵⁾ Peale's career represents central aspects of Enlightenment science: the domination of Linnaean classification, the amateur status of science, the wide-ranging interests of the naturalist, and the close association of science with religion. His activities provide a key to understanding the influence of Enlightenment science in the initial stage of American Western exploration.

Though Peale never traveled far beyond the settled fringe of the eastern United States, he had a prominent position in American scientific exploration. In August and September of 1801, Peale conducted what has been recognized as the earliest example of a national scientific expedition.⁽¹⁶⁾ Peale was an active field naturalist, constantly searching for items of interest for his Philadelphia museum of natural history. Upon hearing that a farmer near Newburgh, New York had discovered some giant

bones on his land, Peale immediately organized an expedition to the site. Aided in part by contributions from the American Philosophical Society and the federal government, but funded mostly on his own, Peale overcame a variety of obstacles and successfully excavated two nearly complete mammoth skeletons.(17)

The discovery and reassembling of the mammoth skeletons excited considerable scientific and popular interest.(18) One reconstructed mammoth became a popular exhibit at Peale's museum. During Humboldt's stay in Philadelphia, he joined the curious visitors who viewed the mammoth and compared it to bones he had found in South America.(19) The other skeleton traveled with Peale's son Rembrandt to be exhibited in Europe. This tour, combined with Rembrandt's publication in London of a scientific description of the mammoth, attracted international acclaim for the discovery.(20)

American scientists seized the mammoths as compelling evidence in a raging debate within the international scientific community. Jefferson, in particular, used the discovery to refute the eminent Comte de Buffon's theory proclaiming the diminutive stature of New World animals.(21) Jefferson also believed the mammoth skeletons provided visual evidence that such creatures were still living on the continent, probably in the West.(22) Peale, Jefferson, and their contemporaries held to two doctrines, the fixity of species and special creation, that denied the theory of extinction. Peale's discovery further convinced them that animals such as the mammoth were not extinct; they had just not been found yet.(23) For Jefferson, this was an important scientific question that might be addressed by an exploring expedition. Peale's expedition to excavate the mysterious mammoth represented a scientific precursor to the Lewis and Clark expedition; his

discovery may have provided Jefferson with yet another motive for sending an expedition into the West. At the very least, Peale's mammoths stimulated the American scientific climate just as Jefferson was organizing the first national exploring enterprise beyond the Mississippi River.

Peale's relationship with Jefferson points to the early link between the American scientific community and Western scientific exploration, a pattern that continued throughout the period of discovery. In many respects, Western scientific exploration can be seen as the extension of the national scientific establishment. Indeed, the story of science in Western exploration belongs as much to the development of American science as to a regional history. Both institutions--science and scientific exploration--stimulated and reinforced the development of the other.(24)

Western scientific exploration would gradually become tied to American colleges and a professional national establishment, but in its initial stage the process was chiefly aligned with the American Philosophical Society. Founded first in 1743 and later on a permanent basis in 1769 by Benjamin Franklin, the Society was the foremost scientific organization in the nation.(25) Though it claimed members from various states, the Society was based in Philadelphia.(26) Peale, a widely skilled scientist with a unique talent for promoting public appreciation of science, was the curator of the Society's collections. Jefferson was the Society's leading figure; he served as its president and guiding force from 1797 until 1815.(27)

In many respects, the scientific objectives of the Lewis and Clark Expedition mirrored the ideals and interests of the American Philosophical Society. When Lewis needed scientific training before the expedition, Jefferson sent him to study with several Society members. Jefferson also

asked the same men to suggest specific information that the explorers should collect.(29) After the expedition, the Society served in the place of an official national scientific organization as the repository of certain specimens and Lewis and Clark's journals.(30) The organization's role in Western exploration continued and its members influenced general scientific interest in the West. Before Stephen Long's expedition set out with a contingent of naturalists to explore the central Rocky Mountains in 1819, for example, a committee of the Society wrote the scientific instructions for the explorers.(31)

Peale and Jefferson were close friends and frequent correspondents, but there is no direct evidence that Peale had a direct role in planning the Lewis and Clark expedition.(32) Lewis did have knowledge of the mammoth skeleton displayed at Peale's Philadelphia museum, so it is safe to assume that Peale did contribute in some way to Lewis's scientific education.(33) Peale's chief contribution to the expedition came after its return, when his museum offered the American public visual evidence of many of the scientific discoveries from the expedition. Jefferson and Lewis gave Peale Indian artifacts as well as large collections of skins, skeletons, and even live animals, many of which were previously unknown species.(34) Peale's Museum gradually came to serve as a vivid display of the scientific discoveries of Western exploring expeditions.(35)

Peale's Museum was an extraordinary institution in American science in the early decades of the 19th century. Through his vast exhibits and related activities, Peale provided the public with both the record of and a guide to understanding the scientific achievements of the age.(36) The privately-operated museum was a product of Enlightenment thought, which

stimulated the growth of museums, and an example of its influence in the United States.(37) Peale sought to include all the forms of nature, including the products of man.(38) The varied "rooms" of the museum reflected the wide interests of Enlightenment science. The museum buildings included an "Arts and Antiquities" room, another named for Peale's "Mammoth," rooms titled "Antique," "Model," "Quadraped," "Long" (for birds), "Marine," as well as other rooms with specific interests.(39)

Peale operated his museum at the leading edge of current scientific thought. He displayed each species of animal in various natural poses in the context of its natural habitat. In this respect he was ahead of most museum operators of his day.(40) Peale arranged the exhibits according to prevailing scientific doctrines. Most evident was the dominant influence of the Linnaean system of classification. Peale labeled plant and animal exhibits with the proper Linnaean nomenclature and classified each specimen in an accompanying descriptive catalog. In the major aspects of its structure, the museum reflected the towering influence of Carolus Linnaeus on science at this time.

Between 1736 and 1753, the great Swedish naturalist had produced a series of scientific studies that determined the course science would follow well into the following century.(41) The chief result of these works was the development of a system of biological classification providing the stimulus, methodology, and objectives for science and for scientific exploration. Linnaean classification offered scientists a new and--for the first time--workable system of organization in which to include all known species of plants and animals. Because of its simple application, Linnaean

nomenclature gained immediate popularity among scientists, and it soon became the generally accepted system of classification.(42)

Classification quickly took hold as the organizing structure of biological science and its chief objective. The naturalist became obsessed with finding and naming new species, and this quest for new species greatly stimulated scientific exploration.(43) Linnaean nomenclature inspired explorers to search out unknown lands and provided them with a system for conducting their scientific work.

Peale's Museum was only one example of the profound influence Linnaean classification had in the United States. Naturalists in the West organized their discoveries completely within the framework of his system. Lewis carried two books on Linnaean classification on the expedition and his description of plants and animals used Linnaean guidelines explicitly, as did subsequent explorers.(44) Linnaean nomenclature also stimulated the scientific exploration of the region, for with discovery came recognition of achievement. The plants and animals of the West bear the names of the naturalists and scientists who braved hardship and danger to find and to describe them.

Peale's exhibits reveal another aspect of Linnaeus's dominance. The museum's emphasis on exhibition and nomenclature showed the non-theoretical nature of science during this time. For most naturalists of the period, classification provided both the methodology and the sole purpose of scientific study. Any attempt at theory often prompted intense criticism from the scientific community.(45) All fields were obsessed with fact-gathering. Thus it was safe and proper for naturalists to limit their studies to classification and not speculate on their discoveries. This

adherence to non-theoretical science dominated much of Western scientific exploration. Lewis and Clark strictly limited their scientific interests to the collection of objective information. Their attitude reflected Jefferson's bias against theoretical science. This prejudice was most apparent in Jefferson's thoughts about the value of geology. Jefferson believed that geological theories on the origin of the earth were useless for serious science.(46) He directed Lewis and Clark to note the mineralogy of the regions they explored but to make little record of the general geological features along their way.(47) Jefferson's instructions to other travelers and explorers similarly suggested that they limit themselves to description and not devise any theories to fit their observations of nature.(48)

This non-theoretical approach to science appealed to the practical emphasis of American interest in natural history. Peale found considerable room in his museum for mechanical inventions that would benefit man.(49) Jefferson's interest in the mineralogy of the West rather than its geological structure was the product of his search for what he considered practical knowledge.(50) Indeed, the American Philosophical Society's motto, "promoting useful knowledge," characterized much of American science in this period.(51) Though theoretical science eventually became a motive for Western exploration, the search for practical scientific information dominated the work of scientists in this early period.

Another reason that science at this time was non-theoretical was its close association with theology. Natural history and natural theology were almost indistinct from each other. This alliance owed much to Linnaeus's theories of the fixity of species and the "Great Chain of Being." These

widely accepted ideas fit easily into the theological belief in special creation.(52) The rapid increase in the study of natural history had been influenced by the desire to gain spiritual insight by observing nature. An "argument for design" was the foundation of natural theology.(53) The study of nature was closely tied to the practice of religion. Only those theories that could be reconciled with theology were acceptable. When the French scientist Georges Cuvier formulated a "catastrophic" theory of global geology that apparently matched the Biblical flood, his ideas gained immediate acceptance among geologists in Europe and the United States.(54)

American scientists in this period were particularly concerned with religion and sought to use science for its benefit.(55) Like Jefferson, Peale was an ardent Deist who saw little distinction between the practice of religion and the pursuit of natural history. He was equally convinced of both the fixity of species and of a hierarchical structure among animals and man.(56) To Peale, his museum served as a "Temple of Wisdom," where visitors could see the glory of the Creator through nature.(57) Between 1799 and 1802 Peale offered a series of public lectures in which he combined natural history and theology in an attempt to educate his audience.(58)

The lack of distinction between natural theology and science was reinforced by the amateur status of natural history study. In the early nineteenth century there was probably no such occupation as professional scientist. In the United States, science was generally an activity of leisure conducted by men who made their livings as doctors, clergymen, and, often, politicians.(59) Peale earned his livelihood from science, but he was a promoter first, a businessman who used science to make a profit, even

though he also had higher motives. While European scientists were moving from their amateur status, Americans lagged behind. There was some private patronage of naturalists by wealthy Americans--though small compared to that in Europe--but more important was the lack of government support.(60) Peale's constant effort to have the federal government sponsor his museum--and give him economic security--was completely unsuccessful. While many Founding Fathers were interested in science, the same men were often strict constitutionalists who disapproved of federal funding for science.(61) The national government would gradually become the chief patron of American science, but in the early 19th century patronage for science was sporadic and limited chiefly to Western expeditions.

If financial support was difficult to attain, so too were scientific instruments and books. Here again American naturalists depended on Europe, but equipment and publications had to be imported from abroad and were expensive, in part because of high tariffs on these kinds of products.(62) American naturalists also had little outlet for their discoveries, for there were few successful scientific journals in the United States at this time. Many, like the *Philadelphia Medical and Physical Journal*, edited by Benjamin S. Barton, remained in publication for only a few years.(63) Scientific discoveries were often published in European journals. Rembrandt Peale published his description of the mammoth--a discovery profoundly significant to Americans--in London from necessity as much as any factor. Europeans often published their American discoveries due to the lack of initiative by naturalists in the United States. Frederick Pursh, a German botanist, completed the first scientific publication from the Lewis and

Clark expedition when he classified the plants collected on the expedition and published them in London.(64)

One other reason for the slow development of American science was the limited availability of scientific education. Jefferson, Peale, and other men interested in natural history were largely self-taught. At this time it was still possible to gain a basic scientific understanding by reading a relatively small number of significant works. Moreover, the lack of institutionalized scientific education made the study of natural history necessarily an informal pursuit. Jefferson's confidence that Lewis could get a basic background in natural history with a few weeks' study in Philadelphia reveals the lack of depth in science at this time and suggests the unavailability of other alternatives.

Scientific education was largely limited to association with individuals or natural history societies, reading, traveling lecturers, or through institutions like Peale's Museum. Through his museum's various functions, Peale had an important impact on the development of American science. The museum provided a source of information for the general public, elsewhere unavailable. Moreover, individuals who would have an important part in advancing American science--and exploration--would be influenced by Peale's Museum. Prominent American naturalists and scientists like Joseph Henry, Alexander Wilson, and John James Audobon learned some basic techniques of scientific collection and exhibition at Peale's Museum.(65)

While knowledgeable men of science such as Jefferson and Peale directed the course of federal scientific exploration in this initial stage, little-trained, though often diligent, amateurs generally carried out this activity. In the second decade of the century, skilled private naturalists from the

United States and Europe began to probe the West, often accompanying fur traders for security. Men like the botanists John Bradbury, a Scot, and the English immigrant Thomas Nuttall, who accompanied a Pacific Fur Company expedition up the Missouri River in 1811, made valuable contributions to discovering the natural history of the region.(66) Despite the interest of Jefferson and the genuine contributions of Lewis and Clark to the name of science, the role of natural history in federal exploration remained clearly inferior to other motives. The amateur status of the naturalists who joined these expeditions reflected the secondary position of scientific objectives. Zebulon Pike's 1806 expedition to the southern Rockies included a physician, John Robinson, who was also to serve as naturalist. But Robinson's secretly assigned duty, gathering intelligence for the territorial governor, precluded much other activity, if it was ever intended.(67) The chief scientific value of Pike's exploration lay in the two live grizzly cubs that Pike gave to Jefferson. The cubs ended up with Peale, eventually mounted as a museum exhibit. After the Long Expedition, science in federally sponsored exploration had clearly slipped to a negligible role.

The decade following Jefferson's presidency saw a general hiatus in federally-directed Western expeditions. The job of probing the territory fell largely to the fur trade. Private naturalists, who often accompanied fur trappers in their travels, conducted the greatest share of scientific discovery. The year 1819 represented a resurgence in federal exploration, with Stephen Long's expedition to the central Rocky Mountain region. While Long's chief objective involved a geographical reconnaissance, the structure

of his party revealed an altered position of science in the process. This was the first American expedition to include a full contingent of trained naturalists, revealing a growing emphasis on scientific inquiry. The composition of the scientific corps, moreover, reflected the development of a new period in American science.

A second generation of Peales joined this new era of discovery at its outset. Charles Willson Peale used his government influence to have his son, Titian Ramsay Peale, appointed to the expedition as an assistant naturalist.(68) At age twenty Titian was already an accomplished naturalist. As an assistant at his father's museum, he had gained wide experience and considerable skill in mounting specimens for the museum exhibits. With Long, Titian's chief responsibility was preserving the expedition's collection. Titian already had valuable experience in the field. In 1817-18 Titian had joined three of the nation's leading naturalists-- George Ord, Thomas Say, and William Maclure--on a collecting trip to the Georgia Sea Islands and Florida.(69) His standing in the scientific community was acknowledged with his membership in the Philadelphia Academy of Natural Sciences.(70) Despite his youth and family influence, Titian's background clearly justified his position in Long's scientific contingent.

The role of Long's scientific corps suggests a marked contrast with the previous era of discovery. The naturalists' chief responsibility was the business of pure science. They were not expected to perform a variety of other duties. Besides Peale, the contingent included Thomas Say, zoologist, Augustus Jessup, geologist, and Dr. William Baldwin, botanist.(71) Their combined experience gave Long's expedition a scientific capacity far

previous ventures. All were well-educated men with

strong backgrounds in natural history. These were no quickly trained dilettantes, expected to supplement their knowledge by on-the-job training. Moreover, each had a scientific specialty, a specific field of knowledge and concentration. All of these factors pointed to a growing sophistication in the pursuit of natural history.

In the kind of information sought, little had changed since the time of Lewis and Clark. Long's expedition failed to achieve its primary objective, the source of the Red River, but in scientific terms, the expedition was a triumph of Linnaean exploration.(72) The naturalists collected numerous specimens, recorded many valuable observations, and widely disseminated their scientific achievements. They discovered and named many new species of plants and animals and contributed in general to a growing body of scientific knowledge concerning the West.(73) Titian returned with over 100 plant and animal specimens, along with 122 drawings he made during the expedition's travels.(74) His collections were properly classified and then exhibited in the museum, like the discoveries of earlier explorers. The emphasis of Long's naturalists on classification reflected the continuing dominance of Linnean methodology on scientific inquiry.

While classification remained his chief goal, the naturalist himself was changing rapidly. The specialized duties of Long's naturalists reflected the rapidly growing compartmentalization of science within specific disciplines. Charles Willson Peale and many of his contemporaries were generalists simply because it was possible--and desirable--to be widely knowledgeable in many scientific fields. But the rapid expansion of information in the early nineteenth century--a process greatly boosted by the discoveries of exploring naturalists--demanded specialization of

interest. The scientist was quickly being forced into narrowing disciplines. As a consequence, the general naturalist of exploring expeditions was being replaced by the botanist, the zoologist, and the geologist.

One result of this developing specialization was the tendency of scientists to travel and to collect for themselves. The study of natural history had generally been divided into two distinct positions, the "closet naturalist" and the field naturalist. The term "closet naturalist" characterized the scientist who analyzed and described the specimens brought to him by collectors, whether field naturalists, who were knowledgeable but usually limited their work to collecting, or by untrained amateurs. Naturalists like Humboldt, who combined both these activities, were rare in the 18th and early 19th centuries. Specialization, which required an intimate knowledge of a particular discipline, began to force serious naturalists into the field to view their subjects of interest in their natural context. No longer could they depend on amateur naturalists to collect for them. The deepening hold of classification, with its emphasis on the significance of discovery, as the true work of science, further encouraged them to carry their studies to their source. The security offered by military expeditions lured many naturalists beyond the line of settlement. Among these traveling naturalists were some of the nation's prominent scientists. On his collecting trip to Florida and on Long's expedition, Titian Peale had some distinguished colleagues to share both hardship and science.

Specialization in international science was accompanied by an increasing sophistication of American science as a cultural institution. American

science in this period was gradually moving away from an avocation of interested amateurs--subordinate to European scientists--toward an independent professional community. In 1818, Jefferson had retired as the president of the American Philosophical Society and symbolically closed one era in American science.(75) The chapter in science that followed was marked by an institutionalization of scientific education, a rapid rise in the number of scientific societies and journals, a growing intellectual independence from Europe, and an expanding role of the federal government in science. All of these factors contributed to the key characteristic of this new scientific period, the professionalization of the scientist.

This developing professionalism was in a large part the result of widening educational opportunities and the expansion of associated institutions. Naturalists in the age of Jefferson were usually self-taught, and they communicated with fellow men of science through correspondence. The number of American colleges offering specific scientific courses saw a marked increase in the first two decades of the 19th century. This scientific curriculum was offered at first in medical schools but soon became more widely available.(76) Formal training stimulated the number of scientists as well as setting standards of knowledge and study. Of equal significance was the proliferation of scientific societies and journals, many of which were associated with scientific schools and colleges. These institutions provided an outlet for this new, larger generation of trained naturalists.

One figure of the period was prominent in all these developments. Benjamin Silliman, professor of chemistry and natural history at Yale, was a guiding force behind the institutionalization of science in the 1820's.

As a teacher he had a towering influence. He and students--notably Amos Eaton, James Dwight Dana, and Edward Hitchcock--dominated four decades of development in American geology.(77) To promote the growth of this discipline, Silliman founded the American Geological Society, one of the most prestigious of the many new scientific societies that were sprouting throughout the nation.(78) Silliman's most significant act was the establishment in 1818 of the *American Journal of Science*, which became the leading American scientific journal of the 19th century.(79) But "Silliman's Journal," as it was often called, was only the best known of many new scientific journals that offered American scientists an outlet for their discoveries.

One result of this maturation of American science was that the United States was gaining a scientific independence from Europeans, particularly in examining the natural history of its frontier. Naturalists from the Old World still visited the West, but many were now wealthy travelers looking as much for adventure as scientific knowledge.(80) It took a European botanist to describe the plants discovered by Lewis and Clark because no American stepped forth to do it. But by the 1820's, American botanists like Asa Gray and John Torrey were classifying and publishing the native flora of the nation.(81) In the physical sciences, particularly geology, Americans remained dependent on Europeans for theory, but American geologists like Amos Eaton--a prolific writer whose papers dominated American scientific journals--assumed primary responsibility for classifying the geology of the United States. These widening educational opportunities, combined with a vast unknown continent that provided a source for their discoveries, gave American naturalists a new confidence

and self-reliance that stimulated the growth of a national scientific community.

Just as his father had symbolized one period of science, Titian Peale represented the key aspects of this new movement. Though he lacked the formal education of his contemporaries, Titian's association with the family museum gave him a fundamental scientific training, and his work with the exhibits provided him with a firm grounding in the principles of Linnaean classification. Moreover, Titian's collecting trips gave him experience in the field equalled by few naturalists of his generation. Seeking to expand the museum's exhibits, Titian traveled to Maine in 1829 and to South American from 1830 to 1832, collecting in Surinam, Brazil, and Columbia.(82) While Titian published few of his discoveries in journals, they were properly classified and recognized in the exhibits he prepared. When his father died in 1827, Titian became the museum's curator, assuming the scientific duties associated with its operations. In all these activities his chief concern was science, not business. His appointment as curator of the Academy of Natural Sciences and election to the American Philosophical Society reflected his recognized stature in the scientific community. In earning his living from the pursuit of natural history, he joined an increasing number of professional American scientists.

A burgeoning federal scientific program provided opportunities for many of these new scientists. Doubts concerning the proper relationship of the central government to science had created inconsistent policy in the early republic. While Jefferson and many of his contemporaries were strong advocates of science, they often held philosophically to a narrow definition of federal powers.(83) Jefferson ignored his constitutional scruples with

the Lewis and Clark Expedition. But Charles Willson Peale's persistent efforts to gain federal sponsorship for his museum failed entirely. Arguing that prestigious museums in Europe were sponsored by governments, Peale lobbied for many years to attain similar support.(84) Even Humboldt's intervention on Peale's behalf was of insufficient influence to sway the view that this was an improper role for the national government.(85) Throughout this early period, national leaders struggled over many similar issues but generally decided against federal sponsorship of science.

The pressing need to chart accurately the nation's coastline and continental interior redirected the government's relationship with science in the 1830's. The restructuring and expansion of the previously inefficient Coast Survey represented a new federal desire to use science as an aid to national development.(86) This same concern also prompted Congress to create the United States Army Corps of Topographical Engineers in 1838. The chief objective of the Corps became mapping national territory beyond the frontier. Cartographic needs made the federal government a leader in American scientific discovery and education.

The navigational and topographic mandates of these agencies required a sophisticated scientific background, which the military had to provide. From the necessity of training topographers, West Point became the leading engineering school in the nation.(87) The officers of the Topographic Corps were also expected to attain a broad scientific education. Many supplemented their knowledge by diligent attention to current scientific developments, while others learned by working directly with skilled scientists.(88) Lieutenant John C. Fremont gained much of his scientific

training on expeditions to Minnesota and the Dakota country in 1838-39 with Joseph Nicollet, a French immigrant scientist. Fremont learned techniques of field cartography, as well as how to collect fossils and plant specimens.(89) Though they were topographers foremost, many officers had at least a rudimentary education in the natural sciences.

The work of the Topographical Engineers revealed the continuing dominance of the military in Western exploration. The federal government determined the general direction for these expeditions and gave their leadership to the Army. Army officers commanded these parties and soldiers constituted the bulk of their membership. Scientific and artistic duties were often relegated to civilians, but they were subservient to Army authority. This military control gave a specific direction to the place of science in discovery.

The chief result was a division of scientific work into two distinct fields. Despite their broad education, the military officers generally limited their activities to topographic objectives. Civilian scientists were assigned the natural sciences. While this distribution of labor was an inevitable--and perhaps desirable--result of specialized training and interest, it represented a break from an earlier pattern of discovery. Enlightenment scientists like Jefferson and Charles Willson Peale made little distinction between practical scientific pursuits and natural history. Jefferson's orders to exploring parties revealed an emphasis on both pure and practical science. But the period beginning with the Long Expedition saw a gradual division between these objectives.

The combined efforts of Topographical Engineers and civilian scientists led to the first comprehensive scientific survey of much of the West.

Individual expeditions that gathered information along narrow routes of travel characterized the previous period of exploration. Some officers concentrated almost solely on cartography and made only token efforts toward natural history. Fremont, for example, accumulated a considerable amount of topographical information concerning the regions he explored, but his interest in collecting specimens and general scientific information was limited, and he developed an ability to lose what he had collected.(90) Other Army expeditions, however, were successful in both topography and natural history. The Boundary Survey that followed the Mexican-American War mapped and scientifically canvassed a huge unexplored region of the West. Led by Major William Emory, the survey's engineers successfully charted an exceedingly harsh and desolate area and in so doing, filled in a major gap in Western topography. Emory's civilian scientific contingent accumulated vast collections and discovered many new species. Prominent American scientists supplemented their work in the field by describing the collections in the Boundary Survey Report.(91)

Military exploration reached its pinnacle in the four Pacific Railroad surveys of 1853 and 1854, which included systematic reconnaissance through specific regions of the West.(92) Commanded by Army officers and staffed by contingents of civilian scientists, the expeditions conducted a comprehensive topographic and scientific survey along four proposed transcontinental routes. The maps and reports produced by the expeditions resulted in an enormous sum of knowledge about the West.

Titian Peale's return to the West came as a consequence of this new era of comprehensive discovery. In April, 1838, Titian joined his second federal expedition, the Great United States Exploring Expedition. Commanded

by Lieutenant Charles Wilkes, this naval expedition led to a four-year voyage of global exploration. The historical significance of the Wilkes expedition rests largely in charting the South Pacific and the discovery of Antarctica, but an accident placed Peale on the Western coast of the United States and back briefly in the story of Western exploration. His ship, *The Peacock*, foundered off the Oregon coast in July, 1841. True to their profession, Titian and his fellow scientists collected specimens and studied natural history during their overland trek to rejoin the expedition at San Francisco.(93)

Titian's return to the West two decades after the Long Expedition suggests certain changes that had come to science in the interval. The position of the scientists on the Wilkes voyage shows that while science had become an integral component of exploration, the division of personnel caused a stratification in scientific objectives. Wilkes, like many of his Army counterparts in the West, viewed cartography as the primary work of exploration.(94) Wilkes's scientific contingent was insignificant in his view. His naval officers conducted the cartographic work of the voyage. With the military in control of the leadership of expeditions, the role of the civilian scientist remained in a subordinate position. As a direct consequence, the type of science he pursued was also secondary. While fields of natural history such as zoology, botany, and geology had a place in Western exploration, they remained an adjunct of the greater process. The quest for practical science, represented chiefly by topography and the focus on natural resources, was the primary emphasis of discovery. This split of scientific interest into two distinct fields of emphasis and status was a central characteristic of military exploration.

The composition of Wilkes's scientific contingent demonstrates that however subordinate pure science was in the view of the military, it was growing rapidly in sophistication. The scientists' specific duties reflected the increasing specialization of interest. Peale--a general naturalist with Long--was a mammologist and ornithologist with Wilkes.(95) The expedition also included two botanists, a conchologist, and a mineralogist.

This fragmentation of scientific disciplines was associated with other dramatic changes in the internal character of science. Dismissing the theological foundation of the previous era, scientists began to adopt a secular spirit in their studies. For Charles Willson Peale and many of his contemporaries, the study of natural history had been closely associated with theology. Studying nature was an act of worship to the Jeffersonian scientist. But while popular natural history retained and even strengthened its ties to religion in the following period, professional scientists began to distance themselves from natural theology.

In the biological sciences, this break brought a complete independence from any theoretical structures. The sole object of botany, zoology, and related fields became pure classification, without any implication beyond scientific knowledge.(96) Professional scientists now had little interest in the Enlightenment's Great Chain of Being; they were satisfied with the discovery of facts. The term natural history retained its amateur, romantic association. A new word, biology, coined by the French naturalist, Lamarck, would gradually come to include specific scientific disciplines composed of professional zoologists and botanists.(97)

While biologists were shunning speculation, geological theory reached a high stage of development in this period. One geologic theory in particular further distanced the scientist from the theologian and brought fundamental change to science and its position in society. Geologists in the late 18th and early 19th centuries had formed conclusions about the formation of the Earth--most notably the "catastrophic" theories of the German Abraham Bottlob Werner--that were reconcilable with Biblical accounts of creation and were therefore acceptable theories.(98) In the United States, Benjamin Silliman and others had made an ardent effort to harmonize science and scripture.(99) The majority of American scientists were also catastrophists in this early period. Though they had to dismiss certain inconsistencies, these geologists still reconciled religion with their scientific studies.(100)

In 1833, with the publication of the Charle Lyell's *Principles of Geology*, scientific theory directly opposed theology. Lyell had taken his fellow Englishman James Hutton's theory of uniformitarianism and empirically proven the revolutionary idea that the earth's structure had developed over a vast period of time. American geologists were generally slow to accept uniformitarianism, in part because of its theological implications but also because the consistent strata discovered on Western exploring surveys seemed to support catastrophism. Geologists gradually began to accept the compelling evidence behind Lyell's theories, and in Europe and the United States his uniformitarianism soon predominated geological studies.(101)

Lyell's theory had revolutionary implications across the spectrum of science and philosophy, but one result carried particular significance for

scientific exploration. Lyell brought science into direct conflict with religion, but in the process he released the scientist from the need to integrate his discoveries with theology, a task that was proving troublesome in many fields. No longer restrained by the strict bounds of natural theology, the scientist was gradually becoming free to examine nature on its own terms. In South America, Indonesia, and the American West, exploring naturalists would find evidence that suggested a new way of viewing the biological, as well as physical, history of the globe. With this discovery a new age of science emerged.

For Titian Ramsay Peale this scientific era was offering few opportunities. Though Titian had once been at the forefront of scientific knowledge, by the time of the Wilkes Expedition he had slipped from the mainstream. Despite Titian's vast experience, his educational background had become too general for this specialized and sophisticated era of science. Wilkes and government associated scientists rejected the *Zoology* report he prepared following the voyage as out of date and unscientific; another scientist prepared a new volume on his collections.(102) His career in science effectively ended when, soon after the expedition, the family museum was sold. Titian moved to Washington, D.C. and worked as an assistant examiner at the Patent Office until he retired and returned to Philadelphia.

Titian Peale's career as an exploring naturalist represents a watershed era in scientific discovery. As a member of the first scientific contingent to probe the West, Peale joined a new kind of government exploration, one in which American scientists viewed the region firsthand and made their own collections. Though individual naturalists had previously traveled beyond

the Mississippi River, the knowledge they gained was isolated. The Long Expedition initiated a gradual, but comprehensive, process of discovering the natural features of the West. Titian's participation ended at a time when the role of the scientist in exploration was expanding further and at a time when a new era of science was emerging. This period would close when another exploring naturalist brought a revolution to science and marked the way for a different kind of explorer--including a new member of the Peale family--who would fundamentally change scientific discovery.

Chapter II

Albert Charles Peale: Scientist-Explorer

Albert Charles Peale's role in this era of scientific discovery was perhaps minor in his individual scientific contribution but gains significance in the collective process of scientific exploration. His experience represents the activity of the Great Survey scientists who assumed control of Western exploration and transformed it into a scientific enterprise. Unleashed by the Darwinian revolution, these scientist-explorers conducted a comprehensive scientific examination throughout large regions of the West. Peale's record reveals certain fundamental features of his individual efforts, which, by implication, represent the specific work of the Hayden Survey and much of the common legacy of the Great Surveys. Peale's various scientific activities symbolize the extent to which geology predominated the four surveys' studies of Western natural history. Peale's specialized interest, mineralogy, the stratigraphic survey he carried out with Hayden, and his work in geologic cartography all reveal the predominance of geology in the Hayden Survey's agenda. Peale's work also indicates the successful blend of practical and "pure" science that characterized all the surveys of this period. Peale's experience, in sum, suggests that his career had more in common with the emerging era of modern science than the previous period of scientific exploration.

In 1871, when Peale traveled west to join Ferdinand Hayden's Geological Survey of the Territories, profound change had come to Trans-Mississippi exploration. The American Civil War brought an abrupt halt to the steady, topographically oriented process of exploration conducted by the United States Army. When this activity resumed after its five-year hiatus, a new and powerful set of influences determined a change of course for Western discovery. The rapid settlement of the region stimulated a demand for a survey of natural resources to aid in the West's economic development. This was a task the increasingly ambitious and powerful civilian scientific establishment was eager to assume. Accompanying the rising influence of the American scientific community was a revolution in science itself. The generation of scientist-explorers that surveyed the American West after the American Civil War carried with them an entirely new scientific agenda.

Peale's career belonged to a scientific era distinct from that of Charles Willson and Titian Peale. A convergence of events in 1859 symbolized the end of one scientific era and the beginning of another. The death of Alexander von Humboldt closed the age of the naturalist, and the publication of Charles Darwin's *Origin of Species* opened the period of modern science. Darwin's theory of evolution brought Lyell's revolution of time to biology and changed the fundamental basis of scientific thought.

Humboldt was not personally a religious man, but his "cosmos" was a cyclic world, one that corresponded with natural philosophy.(1) The views of the naturalist allowed room for special creation and a metaphysical explanation of nature. European and American scientists had continued to successfully reconcile their work with theology. While some geologists had increasing difficulty with this task, biologists found no contradictions.

The argument for design, coupled with their adherence to pure classification and abhorrence of theory, allowed them to keep religious beliefs and scientific labors intact. If Charles Willson Peale's colleagues saw no distinction between the study of nature and theology, Titian Peale's contemporaries still did not yet find them exclusive. But the theory of evolution destroyed the balanced, harmonious world of science and theology.

Darwin's theory prompted an immediate conflict within the international scientific community. In the United States the controversy was represented by the opinions of two of the nation's most prominent scientists, botanist Asa Gray and the geologist Louis Agassiz. Gray, Darwin's confidant and correspondent, came to the immediate defense of evolution, debating Agassiz and others in scientific journals and arranging for publication of an American edition of *The Origin of Species*. Agassiz, who was probably the best known scientist in America, led the opposition to Darwin. Agassiz argued fervently against evolution on both religious and scientific grounds, citing scripture and science to defend the immutability of species against the principle of natural selection.(2)

But after this initial flurry, the conflict between the defenders and opponents of evolution by scientists in the United States settled down. The Civil War subsumed public and--to a certain degree--professional American interest in the debate, and Darwin's compelling evidence gradually convinced most scientists of the validity of his theory. Early skeptics like James Dwight Dana, Titian Peale's shipmate on the Wilkes Expedition and a leading American geologist, became eager supporters of evolution and Agassiz's death ended the most credible opposition. Crucial supporting evidence for evolution, moreover, had come from the American West. Yale

professor Othniel C. Marsh's fossil discoveries in Nebraska demonstrated the evolution of the horse.(3) By the early 1870's most American scientists accepted evolution as scientific fact.(4)

Beyond the broad revolution in science, the acceptance of Darwin's theory had specific methodological implications for scientists exploring the West. The recognition of Lyell's uniformitarianism and Darwin's evolution had eliminated the need to seek--and place--discoveries within a preconcieved context. Religious doctrines had limited scientific inquiry to classification and "safe" theories. But the new age of science freed scientists from these constraints and opened the natural world to unlimited discovery. Of all the Great Survey leaders, only Clarence King was an anti-evolutionist; the work of most of the survey scientists revealed complete lack of interest in theological concerns.(5) As a result, they produced an explosion of scientific information and theory that dwarfed the previous period of discovery. Completely free of restraints, this first generation of Darwinian explorers revealed the basic scientific history of the West in a remarkably brief time.

The acceptance of natural selection led to a shift in scientific inquiry from classification to process. Time became the central concern of science.(6) Both uniformitarianism and evolution required long periods of time to function. A particularly looming question became the age of the Earth, an issue that could be effectively addressed in the high mountain ranges and deep canyons of the West. One consequence of this emphasis on earth history was that the discipline of geology--with its cognate field of paleontology--gained new significance in this period.(7) The fact that the

three civilian leaders of the Great Surveys were geologists represented the lure of the West to a new generation of specialists.

These revolutions in scientific thought were paralleled in the United States by the rise of a powerful civilian scientific establishment. Both developments would control the direction that scientific exploration would take in the West.

The initial period of discovery was marked by an informal relationship between the American scientific community--for the most part represented by the American Philosophical Society--and the national government. The interval between the Long Expedition and the Civil War saw a military control that tolerated little civilian interference. Though Spencer Baird, James Hall, John Torrey, and other prominent scientists often selected the members of the civilian contingents and assisted with the publication of scientific reports, they had little influence on the status of scientific discovery on Army expeditions.(8)

After the Civil War, civilian science gained a powerful new voice in federal scientific policy. This power was exercised chiefly by formal and informal organizations of American scientists. The American Association for the Advancement of Science, organized in 1847, had gradually become a large and effective lobby for national patronage of science.(9) The National Academy of Sciences, founded in 1863 and composed of the most distinguished American scientists, strongly promoted the interests of pure science.(10) Most influential perhaps, was a select group of government- and Harvard- affiliated scientists known as the "Lazzaroni." Its most prominent members, Joseph Henry, Secretary of the Smithsonian, Alexander Dallas Bache, director of the Coast Survey, and Louis Agassiz and Benjamin

Fairce, professors at Harvard, sought to improve both the quality and position of science in American culture.(11) One specific goal was to wrest control of government-sponsored science from the military.(12) The success of these civilian scientific interests shaped the course of Western exploration in the 1860's and 1870's.

One member of this new civilian establishment was well-prepared for an influential position in Western discovery. Of all the Great Survey leaders, Ferdinand Hayden had the longest personal experience in the West. From 1853 to 1855 he had worked privately, collecting fossils along the Missouri River in the Dakota territories and in Kansas.(13) After these private trips, Hayden joined government exploring expeditions. Hayden accompanied two expeditions led by Lieutenant G. K. Warren to Eastern Wyoming and the Black Hills region. With these trips Hayden became part of the federal scientific establishment, sending fossils he collected to prominent scientists at the Smithsonian Institution and the Philadelphia Academy of Natural Sciences.(14) In 1859 and 1860 he participated in an expedition led by Captain William F. Reynolds, which unsuccessfully attempted to probe the unknown region of the headwaters of the Yellowstone River.

Hayden's activities with these expeditions gave him a valuable background in scientific exploration. Moreover, in his collaborations with other scientists he contributed valued information to the study of Western geology. Hayden made important discoveries of fossils, and with Fielding Bradford Meek he established a significant stratigraphic column that served as a crucial reference for other geologic studies.(15) In addition to his scientific papers produced for the military reports, Hayden also compiled a geological map of the regions he surveyed.(16)

The Civil War interrupted Hayden's Western collecting expeditions; for its duration he served as a surgeon in the Union Army. Immediately after the war he resumed his studies in the West. In 1866 Hayden returned to the Dakotas to collect fossils, sponsored by the Philadelphia Academy of Natural Sciences.

In 1867 Hayden was again involved in federally sponsored science, though a significant change had come to his relationship with government exploration. With an appropriation of \$5,000 from the General Land Office, Hayden made a geological survey of Nebraska. Hayden, like other scientists before him, was no longer an appendage on a military expedition. The grant was for a direct scientific survey to be conducted by a civilian scientist. This pattern was continued the following year, when the General Land Office renewed his funding and Hayden surveyed the front range of the Colorado Rockies.

On these surveys, Hayden began an approach to exploration that would assure his success in gaining popular and government support. Though his previous work in the West had been in pure science, Hayden recognized the importance of emphasizing practical discoveries. In his reports he optimistically emphasized the availability of natural resources and prospects for development.(17) Hayden enthusiastically observed the abundance of coal deposits in Eastern Colorado that could be used to smelt the iron ore also present in the region, assuring support for his studies from the local people. For Hayden, these kinds of observations became an important component in his government reports.(18)

In 1869 Hayden's field work took an important shift when his activities were transferred to the Interior Department. Under this agency Hayden

established an organization titled the United States Geological Survey of the Territories. With a budget of \$10,000 Hayden hired a staff of scientists and assistants and expanded the scope of his previous efforts.(19) Hayden broadened his focus beyond geology into other fields of natural history, including entomology, botany, and zoology. Hayden and his scientists surveyed along the Front Range of the Rockies, starting at Cheyenne and heading south to northern New Mexico.(20) His report showed an extended interest in practical science, including comprehensive studies of prospective mining and agricultural resources of the regions surveyed.(21)

The following year Hayden received \$25,000, hired a larger staff, and moved his survey north to explore Wyoming Territory. He made an important addition to his organization by hiring William Henry Jackson as an official photographer. The conscious attempt to cater to public opinion with a visual record of the Hayden Survey's travels would become an integral component of Hayden's efforts to gain support.

A similar appreciation of publicity was undoubtedly a strong motive behind the expedition to Yellowstone the following summer. Long a source of national curiosity, the region had recently been probed by private and military expeditions that verified the existence of its thermal features and other natural curiosities. Hayden's decision to examine that "unknown but marvelous region of the Yellowstone Basin" certainly resulted from his appreciation that a well-documented, comprehensive expedition to the region would gain considerable national attention.(22) One rival scientist in the West had already caught public interest. John Wesley Powell's successful descent of the Colorado River drainage in 1869 immediately transformed him

into a public figure. Though less daring than Powell's feat, a Yellowstone expedition would also have a dramatic aspect that would gain popular and scientific attention.

If a major purpose was attention for his survey, Hayden's means of achieving publicity was a thorough scientific examination of the area's natural history. Hayden compiled a large and diverse contingent of well-educated specialists. His expedition primarily included students and professors from various universities and colleges who filled specific scientific positions.(23)

As the expedition's mineralogist, Hayden chose a student from the University of Pennsylvania, where the survey leader had served as Professor of Geology and Mineralogy since shortly after the close of the Civil War. Just before the 1871 Yellowstone expedition, Albert Charles Peale graduated from the Medical School of the University of Pennsylvania. While their precise relationship is undocumented, it seems certain that Hayden and Peale became associated there.

Little record exists concerning Peale's early life, so the specific origins of his scientific interest are uncertain. Hayden appears to be one of two likely influences that edged Peale toward a scientific career. Born in Hecksherville, Pennsylvania, on April 1, 1849, Peale was undoubtedly influenced by family tradition. While the family museum closed when Peale was quite young, he certainly knew of Charles Willson Peale's passion for natural history. Even a more direct contact certainly came from Titian Peale, who had retired to Philadelphia and lived there until his death in 1885. Albert was well acquainted with his grand-uncle's scientific adventures in the West and around the globe. Albert Peale clearly had a

strong interest in Titian's experience, for years later he composed a biographical account of his grand-uncle.(24)

Albert Charles Peale chose a traditional method of becoming a scientist by an education in medicine. Though this means was gradually being displaced by scientific schools at some universities, medicine still provided a respected general scientific education. Hayden's academic training was in medicine. Both men at times used their medical background, Hayden in the Civil War and Peale with the survey. But Peale and Hayden had little in common with the physician-naturalists of an earlier era, who had practiced medicine full-time and pursued natural history as an adjunct to their vocational interests. Both were scientists by choice; the study of medicine was a mechanism for joining the profession.

Peale's selected specialty, mineralogy, represented a link between his medical training and his interest in geology. As a scientific field, mineralogy reveals how far science had developed by the postwar era of exploration. The discipline progressed in the previous decades from a method of descriptive natural history to one of strict scientific analysis. Mineralogy had entered American higher education through medical schools early in the century.(25) Up to the 1840's mineralogy remained a branch of Linnaean natural history; mineralogists classified specimens according to observable external characteristics. James Dwight Dana led the movement away from strict taxonomy in his 1841 edition of *System of Mineralogy*.(26) By Peale's time the classification of minerals was firmly based on chemical analysis. In his training and chosen field, Peale's role in scientific exploration met the prevailing standards of American science.

Peale filled two scientific roles in Yellowstone and in subsequent work with the survey. As the expedition's mineralogist he investigated an area of specific interest. Like other survey members, he was also responsible for the general geological studies that were the major concern of the expedition. Because the expedition's leader was a geologist, Peale served alongside Hayden in the geological reconnaissance that the survey conducted along its route of progress. The trip to Yellowstone gave Hayden the opportunity to continue his general geological survey of the West. The official point of departure for the expedition was Ogden, Utah Territory. From that spot Hayden joined his previous geological studies with the current season's work.(27) Peale played a significant role in Hayden's continuing geological survey in the West.

Peale's diaries and newspaper columns of that and following seasons often read like a travelogue of Western geology. As a record of the expeditions, they suggest the methodology and specific interests of the survey's general geological work.

Peale spent much of his time throughout the expedition surveying the geological features along the route the survey followed to the Yellowstone region. Though Peale and Hayden often worked together, at other times Peale found himself at his chief's disposal for geological chores. "This evening I went to the top of the hill or rather, mountain back of camp to see at the request of the Dr., whether or not the topmost rocks were igneous."(28) Peale was clearly a geological journeyman, constantly working in the service of science.

Throughout the expedition, the survey was concerned with both pure and practical aspects of geology in the region, as an entry in Peale's journal shows:

About a mile to the East of Fort Hall the Dr. and I came to a number of hills composed principally of a very fine grained red sandstone of an excellent quality for building purposes. The rocks that succeed these and lie upon them are limestones in which the Dr. found some very rare fossils.(29)

Though to the geologists, paleontology was undoubtedly the higher calling, attention to construction materials insured the scientists' position as agents of progress.

Unlike other surveys that emphasized studies of mining, Hayden's organization undertook only a cursory examination of mining activities they encountered.(30) The survey traveled quickly through the regions where there was much mining, and little mention was given to it in the final report of the survey.(31) But as he noted in his newspaper correspondence, when the survey's geologists did look at mines they provided a valued service.

About three miles above Oxford (Utah), while examining the character of the rocks, I found five men mining for silver on top of the mountain. Their ledge is seven feet wide, into which they have sunk a shaft to the depth of thirty feet. Having never had any of the ore assayed, their faces were radiant when I informed them that I considered it very good.(32)

Viewing the mines around Virginia City, Montana, Peale noted the capital investment necessary for development of the region, but added, after examining a specimen of copper ore, that it would "no doubt add much to the prosperity of Montana."(33) If mining was not yet a major focus, the business of promotion was a central aspect of the survey's reports.

While working with Hayden in the general geological studies, Peale was also studying the mineralogical structure along their line of travel. His record of mineralogical studies reveals his individual contribution to the Yellowstone expedition. As the expedition moved steadily toward the Yellowstone country, Peale had to limit his activities largely to collecting specimens rather than detailed studies.(34) His chief attention was fixed on the mineralogical structure and resources of the region, but Peale also studied unique features found on the journey. When the survey paused at Fort Hall, Idaho, Peale recorded the characteristics of several hot springs he located three miles from the fort.(35) These studies helped him to establish a method for studying thermal features that he would follow in Yellowstone.

Despite these initial studies, Peale was awestruck by the vast scope of the hot springs that the survey first encountered when they entered the Yellowstone region. "We were totally unprepared to find them so beautiful and extensive. Before us lay a high white hill, composed of calcareous sediment deposited from numerous hot springs."(36) From that point, Peale entered a mineralogical wonderland. The chief focus of his attention became the documentation of its unique and remarkable aspects, never before viewed by a specialist in his field.

In the *Annual Report* compiled after the expedition, Peale contributed a 40-page chapter on his mineralogical studies.(37) Peale offered a narrative description of mineralogical characteristics along the route the expedition traveled, but the bulk of the account is a detailed description of the geysers, hot springs, and other thermal features of Yellowstone. The report gives a general description of each site he examined, noting its size,

shape, and color. Peale also provided a list of water temperature, a detailed record of chemicals present in the water, soil, and atmosphere, and compared them to descriptions of other thermal areas around the world, offering quotations, for example, of scientific studies made of thermal regions in New Zealand and Iceland.(38)

A passage describing some springs near the group's camp along the Yellowstone River demonstrates a typical account in his chapter:

Near these mud-craters there were also some alum-pools containing alum and sulphur. On the edges of these pools there were a number of holes, from which there was abubbling of water that flowed into the springs. Upon ascending the hill, at whose base these springs were situated, we could see immense volumes of steam rising toward the southeast. Proceeding in that direction about 400 yards we came to a sort of cave in sandstone rock. The entrance is about 15 feet high, and it gradually slopes inward for about 20 feet. At this point, at regular intervals of a few seconds, there bursts forth a mass of steam, with a pulsation which shakes the ground, while a stream of clear water flows from the mouth of the cavern. Its temperature was 184 F. The water had a very faint alum taste, and gave off a slight odor of sulphurated hydrogen. This spring we named the Grotto.(39)

While Peale's account is mainly descriptive and non-theoretical in terms of the geological reasons for the geyser eruptions, he quotes other scientists who studied thermal regions in different areas of the world.(40) Peale's reluctance to speculate on the origin of the geyser basins perhaps suggests a youthful insecurity, but it also reflects most of the scientific work of Hayden's survey. Their primary goal in Yellowstone was to document and record its natural characteristics, not to theorize on its development. Peale's report closes with a two-page "Catalogue of Thermal Springs," a chart giving the location, chemical structure, and temperatures of the features he viewed, and a six-page catalogue of minerals and rocks found, with their location.(41) Sober in tone, particularly in comparison with his

diary and newspaper writings, the report comprised a concise record of the first scientific examination of Yellowstone's thermal activities.

Like that of other scientists with the survey, Peale's chief contribution lay in the solid scientific labors he performed in the region. While he contributed to the publicity of the survey's achievements with his newspaper correspondence, Peale's primary legacy rests with his studies of the Yellowstone geyser basins. Though the survey traveled quickly through the region, Peale was able to examine and record their salient characteristics. Peale scientifically documented the most exotic of Yellowstone's natural features in its initial period of discovery; his record still provides the foundation for all subsequent scientific studies in the region.

For Hayden, the Yellowstone expedition was a triumph of scientific exploration. With an increased organization he had expanded the scientific, as well as geographic, range of his survey. By bringing a large and well-equipped party to the exotic region, Hayden was able to make a comprehensive study of its natural history and spectacular landscape. The photographs of William Henry Jackson and paintings of the artist Thomas Moran served to document these wonders and enhance the written reports. The resulting publicity brought Hayden and his survey into the forefront of national attention. Moreover, the survey's activities had a significant influence on the decision of Congress to declare the region a national park the following year.(42)

Following up on this initial success, the Hayden Survey returned to Yellowstone the following year. Peale's scientific work that exploring season expanded the previous year's activities. His report for that year

was much more extensive, over double the length of the previous year's report.(43) Peale divided his narrative into six chapters, rather than one continuous record, adding catalogues of thermal springs, minerals, and rocks as in the year before. The structure of his account retained the descriptive style of his previous report, but an important addition was included with illustrations of stratigraphic columns, geological formations, scenic views, and thermal features annotated with scientific descriptions. Peale's report revealed the developing precision of his thermal studies. One entry for August 12th depicts a detailed record of a single geyser through several eruptions, beginning at 6:19 a.m. and ending at 7:51 p.m.(44) His report also added comparative descriptions of hot springs with those described by earlier explorers, such as an account of Beer Springs on the Bear River, which Peale notes that Fremont named in 1843, "from the agreeable taste of the water."(45)

Peale's work in Yellowstone in 1871-72 suggested the degree of sophistication that had come to scientific exploration. As a follow-up to his previous year's studies, the report shows the increasing confidence and skill that Peale displayed in his scientific labors.

In 1873 Hayden shifted the focus of his survey from Yellowstone to Colorado Territory, citing a variety of factors for his decision. In a letter to the Secretary of the Interior, Hayden noted the difficulties of continuing efforts in the Yellowstone region, including the high expense of

transportation and supply and the hostility of Indians in the area.(46) Recognizing a fresh prospect for his organization, Hayden observed that Colorado "promises to yield more useful results, both of a practical and scientific character."(47) Equally important to Hayden was the fact that no other government surveys were operating in Colorado at the moment.(48) For Hayden, the region represented an opportunity to survey a territory in the process of rapid settlement but that was also scientifically unknown ground.

In Colorado Hayden concentrated the main scientific objectives of the survey in two complementary fields, topographic and geological mapping. Each season Hayden determined an area of the territory to be surveyed and directed several parties to complete the work. One group of topographers established a system of primary triangulation as a baseline for charting the region. Then various divisions, each including a topographer, assistant topographer, geologist, assorted scientific specialists, and support personnel, carried out the secondary triangulation and detailed topographic studies.(49) In four years Hayden's divisions completed a highly accurate geographical survey of the Colorado Rocky Mountain region.

Peale's record provides a representative account of the survey's travels through the Colorado and illustrates the methodology and scientific nature of its geological studies. Each season Peale accompanied one of the divisions as its chief geologist. In 1873 the Survey explored the eastern flank of the Rocky Mountains. Peale was with the Middle Division, surveying the South Park region.(50) The next year, Hayden shifted his expedition west; Peale and his associates mapped west-central Colorado, the first comprehensive exploration of the unknown territory between the Grand

and Gunnison Rivers.(51) With the Grand River Division in 1875, Peale pushed their work westward, crossing the territorial boundary several miles into Utah.(52) In 1876, Peale served again with the Grand River Division, one of the four parties that surveyed northwestern Colorado and completed the survey of the new state.(53)

That year Peale composed a series of newspaper articles describing the history and operations of the Colorado Survey. In one of these feature stories, Peale offered an account that succinctly summarized the work of the survey geologist:

Equipped with hammer, clinometer, barometer, and note-book, he sallies forth on the indispensable mule. He attacks his work in two ways; first by a method of general observation, and second by a study of details. The former is conducted from stations located on the highest peaks in the neighborhood. Here sketch-maps are made, on which the geological formations are defined in crayon colors; the general features of the country around are noted, and profile sections in various directions are outlined. The detailed work comprises the measuring and describing of strata, the noting of the occurrence of mineral deposits, and the collecting of specimens of mineral rocks and their organic remains--fossil plants and animals or their impressions.(54).

Peale's writings reveal the gradual sophistication of the Survey's work, from wide-ranging natural history studies in Yellowstone to the precise, systematic geographic Colorado survey. In form, Peale's Colorado reports followed the descriptive narrative he used in his previous geological accounts. But there is a significant substantive contrast between the Colorado and Yellowstone work. In Yellowstone, Peale limited his geologic surveys to rapidly conducted, almost casual, general observations of the countryside along the line of travel. His labors in Colorado comprised a comprehensive, detailed study of the geological structure of the area assigned. One aspect of the work was the

construction of detailed stratigraphic sections. Drawing sketch-maps and recording his measurements, Peale established the geologic structure of successive layers of composition. His extensive reports, when taken with the records of the other survey geologists, resulted in the compilation of the geological history of the Colorado mountain region, providing a crucial chapter in the natural history of the western United States.

The survey's geological studies not only represented a focus on pure science, they also showed the increasing emphasis on the practical benefits of scientific discovery. Peale's stratigraphic records, while documenting geologic history, offered information on the economic potential of the territory. His columns chart the presence of coal deposits and quartzite, key resources in the potential development of the territory.

Another shift from the Yellowstone survey was a new focus on mining activities. The 1873 report included a record by Peale of the mining work in the region surveyed.⁽⁵⁵⁾ When his division encountered working or abandoned mines within their district Peale described the size of the lodes being worked and the value of the ore uncovered, along with a census of the local population. His studies also included geological mapping that illustrated the structure and composition of formations surrounding particular mines.⁽⁵⁶⁾

As seen in Peale's reports, the Survey's work in Colorado represented the successful combination of pure and practical science. This blend of scientific studies had become the hallmark of Hayden's expeditions. With this dual focus, Hayden appealed on one hand to Western interests and on the other to the professional scientific community. In addition, by blending two related scientific activities, Hayden increased the efficiency

of his survey. In a newspaper letter Peale noted the integration of his labors with that of the topographers.

The geographical and topographical work is of great importance and subsidiary to that of the geologist. The latter examines the rocks by which the country is underlaid and the limits of formation, dealing with the natural history of the past, and the causes which have produced the present condition of the earth's surfaces, while the topographer maps the surface itself--its mountains, streams, plateaus, and other physical features.(57)

With the labors of his geologists and topographers combined, Hayden's Colorado survey compiled an enormous body of valuable information in a brief amount of time. Hayden and his men comprehensively documented the region's natural history, carefully mapped its terrain, and assessed its economic resources. Their labors represented the high level of scientific achievement that the Great Surveys brought to the West.

This comprehensive approach of post-Civil War surveys contrasted with the isolation of science into two distinct fields of interest, the pattern that had characterized much of military exploration. In the period of the Great Surveys the quest for practical information and pure scientific knowledge were brought together. The balance the survey leaders sought can be seen in some of their fields of inquiry. Clarence King's Survey of the Fortieth Parallel produced a valuable study of the Western mining business in addition to forming significant theories about glaciation and Western geological development.(58) One result of John Wesley Powell's exploration of the Colorado Plateau was his profound analysis of problems in Western settlement in his *Report on the Lands of the Arid Regions of the United States*.(59) Another publication from his survey was Grove Karl Gilbert's

classic geological study, *The Geology of the Henry Mountains*, which offered significant new theories on the creation of mountains in the West.(60)

Throughout the *Annual Reports* of Hayden's organization can also be seen this balance of scientific pursuits. When the Colorado work was finished, Hayden moved his survey north, shifting its topographic and geologic mapping to Idaho and Wyoming. Peale's 1877 report, which reached 140 pages, followed the same descriptive geology of the work in Colorado. Assigned the Green River District of the Survey, Peale extensively described the stratigraphy and formations of the region he traveled. Accompanied by charts, his report contained information as widely varied as new fossils discovered to beds of coal, noting species unknown to science as well as the economic potential of the area. For Peale and other scientists of the Great Surveys, all information had value, whether to the professional scientist or to the prospective settler.

When the Survey returned to Yellowstone in 1878, Peale left behind the general geological work and resumed his studies of the thermal springs. In Yellowstone his work represented a pure scientific survey of the region's thermal features. In his 391-page report, illustrated in color and in black and white plates, Peale provided a comprehensive, detailed catalog that sought to include all thermal features in the park. While his own work was primarily descriptive, Peale devoted a major section of his report to a discussion of theories behind geyser activity and included a detailed account of thermal regions worldwide in a bibliographical appendix to the report.

Though he was familiar with current theories in mineralogy and geology, Peale's own studies remained non-theoretical. Like Hayden and the other

scientists with the survey, Peale sought to include his discoveries within prevailing scientific thought rather than use them to form theories of his own. But if his work was largely descriptive, it showed an interest in theory that contrasts with the work of earlier naturalists in the West. Jefferson's explorers rejected theory as non-scientific. Titian Peale and his contemporaries saw it as irrelevant. This early age of exploration viewed Linnaean classification as the highest goal of science. The scientists of the Great Surveys worked in the Darwinian spirit of modern science that embraced all areas of scientific knowledge. If Peale's Yellowstone work was non-speculative, he recognized its place in international scientific developments and made certain that his scientific reports demonstrated this context.

The survey's efforts that year showed other changes that had developed in federal Western exploration. Peale's work in Yellowstone revealed a change from scientific exploration to pure science. Peale and the other survey scientists were no longer exploring an unknown scientific region. Their goal had shifted to a comprehensive scientific examination. The activities in Yellowstone represented the ultimate stage of a process that had begun with Lewis and Clark. Throughout the period of exploration, the role of science had gradually increased from a secondary interest pursued by amateurs to a dominant purpose under the direction of scientists. The Great Surveys represent, perhaps above all else, the triumph of the scientist in Western exploration. With the exception of the Wheeler Survey, the surveys all had a close connection with the scientific establishment, both in the nation's capitol and in major universities. More important was the fact that civilian scientists, again excluding Wheeler, controlled the

leadership of the surveys. Though geographic discovery remained a purpose of Western exploring expeditions in the period after the Civil War, the quest for topography, economic resources, and natural history were united and given equal consideration under the control of the civilian scientist.

Peale's position in the survey demonstrates a simple, but significant aspect of the Great Surveys. With the exception of support personnel, such as packers and cooks, the surveys were composed almost solely of trained scientists. The pursuit of science was no longer limited to contingents of naturalists that accompanied expeditions. While artists, photographers, soldiers, packers, and journalists often accompanied the surveys, it was scientists, usually young college graduates, who made up the main complement of the expeditions and accomplished the primary objectives of the surveys in the areas they explored. In their hands, the discovery of the West reached its highest cultural level of achievement.

Chapter III

The Literature of Discovery

The cultural legacy of the scientist-explorers extended beyond their contributions to science. As a corollary to their scientific work in the West, these scientists produced an enormous body of popular and scientific literature. This literature proved an effective and popular method of conveying images and information about the West to the rest of the nation. As such, this literary work compared in significance with their exploring and scientific endeavors. In form, their writings varied widely, but in content and theme, they shared a common literary agenda. Official government reports, privately printed books, articles in professional and popular serials, and newspaper correspondence were all means of disseminating a huge amount of information about their work, their adventures, and the region they explored. This chapter seeks to examine the chief characteristics of this literature of Western exploration, in particular, noting its development during the Great Surveys.

As should be expected, the literary quality of Western explorers' writings varied substantially. Military officers and government-sponsored scientists often composed their official reports with little attention to style. Many others were diligent and capable writers whose work reflected their care and skill. However meticulous and dull, or lively and inspiring, much of the literature these explorers produced was extremely popular among the Eastern reading public.

While the literature of scientific exploration remained popular throughout the nineteenth century, this work peaked both in volume and literary quality during the era of the Great Surveys, when national interest in the West was high and competition among scientific explorers was fierce. The men of the Great Surveys responded to these demands from the public and their leaders by producing a significant body of literature that would provide information and images at a crucial moment in the development of attitudes toward the West.

A variety of factors stimulated public interest in the Great Surveys. The standard appeal of travel accounts, the lure of the exotic West, and a preoccupation with science combined to create an unusually high interest in exploration during this period. Travel literature has traditionally held wide public appeal. This literature flourished in the eighteenth and nineteenth centuries, an era of great geographical discoveries. The public eagerly awaited news of current exploring expeditions, and many explorers, upon their return, rewrote their journals into popular travel accounts.(1) In the nineteenth century, the narratives of African explorers like James Grant, David Livingstone, and the *New York Herald* journalist, Henry Morton Stanley, were popular in Europe and America.(2)

Americans, however, had another source of exploration literature far more appealing than the travel of foreigners in distant lands. The Trans-Mississippi West was of particular interest to Americans in the East. Too dangerous and prohibitively expensive for most Easterners to visit--even as late as the 1870's--they fulfilled their curiosity by reading whatever sources of information were available.(3) Eastern magazines such as *Harper's*, *Scribner's Monthly*, and the *Atlantic Monthly*, among many others,

catered heavily to Eastern interest in the West.(4) Thus it was natural that the exploits of Western explorers found their way into eastern magazines and that many of these often-serialized accounts were eventually published and became highly popular books.

Another factor of nineteenth century American culture--a burgeoning popular awareness of science--further stimulated interest in Western exploration. One historian has aptly described the middle decades of the century as the "heyday of natural history," referring to the English and American public's interest both in natural history and professional scientific developments.(5) Natural history collecting was extraordinarily popular among all classes of society in both England and the United States, though it was considered especially in vogue among the wealthy and the ever-imitative middle class.(6) Moreover, raging scientific debates over geological and biological controversies kept science constantly in the public eye. The work of Charles Darwin alone was enough to keep science as front-page news during the entire third-quarter of the century. One natural consequence of this interest in natural history and science was a huge increase of the popular literature in these fields. The volume of popular nature writing--by both amateurs and professional scientists--expanded dramatically between the 1840's and 1870's.(7)

Books on natural history were published at an extraordinary rate. Many popular scientific magazines, such as the *American Naturalist* and the *Popular Science Monthly* successfully appealed to a much wider audience than that of the ever-increasingly specialized professional scientific journals.(8) Even general interest magazines like the *Atlantic Monthly*

featured natural history essays and reports of scientific developments as regular topics.(9)

Thus, during the era of American exploration of the Trans-Mississippi West, there was enormous popular interest in exploration, the West, and science in general among the Eastern reading public. Clearly, any activity that combined all of these features found a large and eager potential audience.

Had these explorer-naturalists and scientist-explorers proven dry or pedantic writers, surely the public reception to the writings of scientific exploration would have quickly diminished and curtailed the growth of the literature. But many of these explorers possessed considerable literary talent, and the literature of scientific exploration continued to grow until it peaked in the 1870's, during the work of the Great Surveys.

Popular interest was not limited to writings specifically intended for the public. While the public clamored for--and received--much information about the scientific exploration of the West in books, magazines, and newspapers, another much less likely source of common interest was the official reports of the government exploring expeditions. Generally, these reports--intended to communicate the results of the expeditions to Congress and professional scientists--comprised two sections. The first section of the report was usually a narrative of routes traveled and selected activities written by the expedition commander. Scientific papers--usually based on discoveries and field research--generally made up the rest of the reports. Many of these reports failed all literary expectations. As can be expected, the scientific papers generally had little popular appeal. Often even the narratives--though the expedition members experienced remarkable

adventures in unique, virgin terrain--were dull and devoid of significant literary interest.

The officers of the United States Army Corps of Topographical Engineers often proved highly incapable stylists, or at least made no effort to make their reports interesting. Their reports were so commonly dull that one officer of the Corps composed a parody of the official army scientific reports. Lieutenant George Horatio Derby's "Official Report of Professor John Phoenix, A.M., of a Military Survey and Reconnoissance [sic] of the route from San Francisco to the mission of Dolores, made up with a view to ascertaining the practicability of connecting these points by a Railroad," satirized both the style and structure of the reports of the Topographical Engineers who were surveying possible routes for a transcontinental railroad during the 1850's. In his report, Professor Phoenix described the adventures experienced by the surveyors--most of whom, by the way, shared the last of Phoenix--over the entire two-mile long route in a barely intelligible, ostentatious official style.(10)

Other problems also limited the popular appeal of the reports. Many reports were published far too long after expeditions to arouse public interest. The federal government published the official record of the Lewis and Clark Expedition, several years after the expedition's return. By then, other accounts had become available, and the public had alternatives to the expensive and often difficult to acquire official reports.(11) Later government reports were often never intended for public amusement. The leaders of the transcontinental railroad surveys, in particular, wrote their reports primarily as propaganda works, for the purpose of promoting a

particular route. They were designed more to influence--rather than entertain--Congress and the public.(12)

If government reports were sometimes merely the dull and unimaginative products of an officer dutifully fulfilling his orders, a surprising number of government explorers and scientists possessed, or developed, literary skills equal to or surpassing their other talents, and their reports were printed in unusually large numbers to satisfy the public demand. Charles Wilkes's vast 2,100 page, five volume, *Narrative of the United States Exploring Expedition of 1838 to 1842*, published in 1845, went through sixteen editions and apparently had a significant impact on American literary culture, stimulating works by Herman Melville and Mark Twain, among others.(13) The federal government printed ten thousand copies of Lieutenant William H. Emory's report of a topographical expedition from Santa Fe to California made during the Mexican-American War. One historian has noted the extended value of Emory's report beyond mere entertainment by pointing out that "it became a major work on the Southwest and a handbook for hundreds of overlanders in the next few years."(14)

The best of the government reports combined practical information with high literary quality. Many contributed to the fame of the explorers and scientists who wrote them. John C. Fremont dictated his adventures to his wife Jessie who then transformed them into lively and fascinating accounts that far surpassed official standards and requirements. Tens of thousands of copies of the reports of Fremont's expeditions to the Rockies and the Far West were printed and distributed to the American people. Western emigrants, notably Brigham Young, who decided to settle his Mormon followers in the Salt Lake Basin after reading Fremont's account of the

region, used his reports as guides to travel routes and good settlement sites. Perhaps more important, the wide popularity of Fremont's narratives, combined with his well-publicized exploits during the Mexican-American War, made him a national hero and earned him the Republican Party's nomination for the presidency in 1856.(15)

The quality of government reports peaked during the publicity-conscious period of the Great Surveys. The survey leaders and their scientists paid close attention to style and literary appeal. As a result, their reports reached a wider and more eager audience. The entire first edition of Hayden's report of his survey's 1871 Yellowstone expedition was completely distributed almost immediately upon publication. All 12,000 copies of his report were quickly given away or purchased. One result of the reports, already noted, was that scientific verification of Yellowstone's "wonders" helped convince Congress to declare the area the first national park. Another consequence of the popularity of the expedition report was that it helped keep Congress and the public in full support of Hayden's survey, which to Hayden meant continued funding and further exploration.(16)

Hayden was able to return to Yellowstone the following year with a more extensive expedition, and his subsequent report was even more widely printed and distributed to expectant readers.(17)

Some scientists proved that even the scientific papers could have high literary quality. Scientists such as Clarence E. Dutton, of John Wesley Powell's survey, and Franklin P. Rhoda, with Hayden in Colorado, wrote professionally significant papers that also delighted and instructed interested laymen.(18) Dutton and Rhoda were among many scientists with considerable literary, as well as scientific, talent.

Magazine editors recognized the publication value of the scientist-explorers' accounts and often solicited articles. A letter from the editor of *Scribner's Monthly*, Roswell C. Smith, dated August 11, 1871, sent to Hayden at Fort Hall, Idaho, requests a three- or four- page article "setting forth the new wonders brought to light by your expedition." Smith wanted a "literary accompaniment" for Moran's sketches. The letter pleads for the rapid return of the article.(19) After persistent courting by the editors of the *Atlantic Monthly*, Clarence King used his experiences with the California Geological Survey and his own Fortieth Parallel Survey to contribute seven articles, serialized in the magazine between May and December of 1871.(20) John Wesley Powell, responding to editors' pleas for articles about his Colorado River expeditions, wrote serialized accounts for *Scribner's* and *Popular Science Monthly* that were published in 1875.(21) Both Powell and King followed up on the interest in their articles by expanding their serialized accounts into what became bestselling books. King's *Mountaineering in the Sierra Nevada* was extremely popular among both tourists and armchair travelers and, according to students of exploration, it "still stands as one of the best-written books of scientific travel in the West."(22) Powell used his own journals to further enhance his magazine accounts into a popularly oriented official account that would later be privately reprinted.(23)

Government-sponsored explorers had a long tradition of using their journals and reports for writing privately-published books. Patrick Gass's journal from the Lewis and Clark Expedition, reprinted in 1807 as *A Journal of the Voyages and Travels of a Corps of Discovery*, was the first published book about the expedition. Priced at one dollar, the work was eagerly

purchased by a public seeking more information about the expedition. Eventually, seven more expedition members published their journals or wrote narrative accounts.(24)

The Commissioner of the Boundary Survey for the Treaty of Guadalupe Hidalgo, John Russell Bartlett, used his official journal to write a popular travel guide to the Southwest.(25) Ferdinand Hayden used his scientific notes in his *Sun Pictures of Rocky Mountain Scenery*, which he designed as a guide for laymen to understanding the geologic scenery along the transcontinental railroad route of the Union Pacific.(26) An explorer's journal could be used for a variety of projects.

Magazines, books, and governments reports informed certain readers about scientific exploration in the West, but many of these sources were often expensive or difficult to acquire and thus failed to reach a large or socially diverse audience. Therefore, newspapers, because of their widespread availability, were probably the most effective means of disseminating information about the various Western exploring expeditions. These expeditions were in themselves noteworthy and of course required notice in the papers. Newspaper editors also realized the value of exploration accounts as "feature" articles, as well as news items, and either sent their own reporters to accompany expeditions, or solicited the contributions of expedition members.

Newspaper interest and coverage of Western exploration was stimulated early in the century by the return of the Lewis and Clark Expedition. Their departure had been overshadowed by the Louisiana Purchase, and the length of their journey convinced many Americans that the explorers had perished in the West. Several newspapers carried erroneous reports of

their assumed demise. Therefore, their unexpected return in 1806 was a significant news item and was certainly well-publicized in the press. Perhaps more important was the first article written by an expedition member. William Clark sent a letter to his brother in Louisville, Kentucky, which was immediately published in the Frankfort (Kentucky) *Palladium* on October 9, 1806 and was soon reprinted in newspapers across the nation.(27) Clark's letter offered a brief account of the route taken and some of the adventures the expedition members experienced. Though it reported little of the expedition's notable accomplishments in natural history, the letter claimed the geographical distinction of the expedition's having been "completely successfull" [sic] in discovering "the most practicable rout [sic] which does exist across the continent by way of the Missouri and Columbia rivers."(28)

Newspaper interest continued throughout the era of Western exploration and reached its highest production in the coverage of the Great Surveys. Reports of John Wesley Powell's daring journey down the Colorado River, Clarence King's exposure of a diamond hoax, and Ferdinand V. Hayden's discoveries of natural wonders in Wyoming and Colorado were all "front-page news" throughout the nation.(29) Newspapers also covered the surveys more comprehensively. In 1873, the *New York Tribune* published a special scientific edition that featured, among other articles on exploring expeditions, several full pages on the work of Hayden and his men in Yellowstone and Colorado.(30)

Large newspapers often sent their own reporters. The *New York Times* was only one of several Eastern newspapers that sent reporters along with most of the surveys.(31) Smaller papers used other approaches in covering

the surveys. William N. Byers, owner and editor of the *Rocky Mountain News*, traveled as the guest of Powell in 1867 and 1868 and of Hayden in the mid-1870's.(32) Byers wrote many articles about the surveys for his own paper, and many of these were reprinted in other newspapers. Because of the wide publicity he gave to the surveys, Byers was a most welcome guest indeed.(33)

Journalists were always welcome guests of the surveys because they provided an element all the survey leaders so desperately sought--public awareness of their work. All four survey leaders competed vigorously for personal fame and, more significantly, for continued and increased Congressional funding. The survey leaders understood that most Congressmen had little understanding of the scientific work of the expeditions; King, Powell, Hayden, and Wheeler therefore realized that enthusiastic public support was the best means of influencing a budget-conscious Congress.(34) Newspaper coverage was the easiest and most effective method of keeping the public's attention.

Wheeler took perhaps the most unique approach to publicizing his survey by putting a professional journalist on the survey payroll. In 1871 Frederick W. Loring accompanied Wheeler's expedition up the Colorado River, ostensibly as a "general assistant." His real job was to correspond with newspapers and magazines and thus publicize the work of the survey. Loring sent three articles to *Appleton's Journal* during the summer, apparently planning to write more articles upon his return to the East. Wheeler's hopes for publicity were ruined, however, when Loring and two other survey members were killed in a stagecoach robbery at the end of the summer.(35) Partly due to this incident, and the reluctance of Wheeler's men to

contribute articles to the press, the Wheeler Survey remained the least known, and most vulnerable to funding cuts, of all the surveys.

Powell and King encouraged their men to correspond with newspapers, but both of the surveys depended for publicity more on the personal fame and writings of the leaders, rather than any literary contributions of the survey employees. Some members of the Powell and King organizations did write for newspapers, but their leaders far overshadowed this work.

If the members of the King, Wheeler, and Powell surveys made only modest, if still interesting, contributions to the literature of scientific exploration, Hayden's men achieved markedly different results. In many ways, Hayden was the most public-minded of all the survey leaders. Unlike Powell, he was highly regarded by both Easterners and Westerners for his emphasis on the practical benefits of science. Hayden was perhaps best known personally, according to one source, for popularizing "geology on the grandest scale in the new states and territories."⁽³⁶⁾ Hayden wrote numerous magazine and newspaper articles, and he successfully encouraged many of his men to follow his lead.

Peale was one of many Hayden Survey employees who corresponded extensively with newspapers--generally in their hometowns--over a number of years, and many others contributed occasional letters to newspapers. Hayden wrote for several papers. Robert Adams, Jr., corresponded for the *Philadelphia Inquirer*. Ernest Ingersoll wrote for the *New York Tribune*.⁽³⁷⁾ In all, members of the Hayden Survey combined to produce a huge volume of correspondence published and reprinted in a large number of newspapers in the East and Midwest.

For many reasons, the scientist-correspondents were more successful in communicating information and ideas to the reading public than were the professional journalists who accompanied the expeditions. Most of the survey members were young men, thrilled at the opportunity and adventure of exploring the West; their newspaper letters reflect their youthful enthusiasm. They were also usually well educated--nearly all college graduates, many with advanced degrees--and familiar with the conventions of current nature writing, which many of them emulated.(38) Moreover, the scientists were participants in the exploratory process and held a distinct advantage over journalists who were guests of the expedition and necessarily viewed the scientific work from the perspective of outsiders. The professional reporters were often limited to descriptions of camp life and routes traveled. The scientist-correspondents had the insiders' advantage of being fully capable of presenting all aspects of survey life and work.

If their position enabled the scientist-correspondents to write of their scientific activities, this type of information also presented challenging problems. Often their scientific work was limited to biological or geological classification, of little interest to most prospective readers. Moreover, the nature of their work was often too complex for the average reader to understand, much less appreciate. Thus, many of the survey correspondents also limited their writings largely to narrative accounts and only general descriptions of their scientific work.

The best of the scientist-correspondents, however, responded to these challenges by ignoring the complex, technical aspects of their work and instead used their scientific and literary skills to create accurate, vivid

descriptions of the Western landscape for Eastern readers. Acute scientific observation, bolstered with powerful poetic imagination, often produced remarkable literary works, which must have significantly influenced Eastern images of the West.

Chapter IV

Albert Charles Peale: Exploring Journalist

Peale's newspaper writings belong to the journalistic tradition of Great Survey literature. American newspapers gave wide coverage to the West during this period. Peale was one of many Great Survey scientists who corresponded with their hometown and other newspapers. In substance, Peale's letters varied from general travelogues to feature articles that focused on specific topics, such as the history of the Hayden Survey, details of its scientific studies, geographical discoveries, and the daily life and work of the scientists. Overall, they provided a vast sum of information about the West to his readers. Peale's correspondence, moreover, fits a central theme in the literature of Western exploration. Peale's letters, like much of exploration literature, suggested that the West was a region of bountiful resources and exotic natural wonder, a dual, conflicting image of the western landscape. This chapter describes the information and images that Peale offered to his readers and then suggests where his writings belong in the literature of Western exploration.

Peale's literary legacy was primarily confined to writing for newspapers. Peale's contributions to the *Annual Reports* were strictly scientific in substance and style and were not intended for the public. His diaries and letters, though often overlapping his newspaper accounts, remained private. Peale never published his journals, or used them as the basis for published accounts, as many explorers did. Peale's newspaper correspondence, however,

reached a wide audience. Peale wrote for at least three newspapers, the *Philadelphia Press*, the *Illustrated Christian Weekly*, and the *New York Times*. The content of his work varied widely, reflecting the diversity of his own experience. As an historical source, Peale's newspaper writings demonstrate the kind of information that reached the American public from the Great Surveys..

Peale was not a master stylist, but his enthusiasm and scientific knowledge gave his writing an energy and authority that made his correspondence highly readable and informative. Peale composed most of his letters and articles in the first person, both singular and plural. Peale's use of various pseudonyms permitted him to speak as a knowledgeable insider but also offered a sense of objective distance from the survey's experiences and achievements. Excerpts from his writings should demonstrate his capacity as a writer. Peale's literary abilities were limited but were more than adequate for his task. The content of his correspondence makes his work significant.

Peale's newspaper writings assumed two basic forms, the narrative letter and the feature article. Each of these forms varied in composition and purpose, but shared general characteristics in style and objects of interest. His narrative letters, written from the field, were designed to provide a continuous source of information about the expeditions, while the feature articles, produced after the exploring seasons, usually highlighted specific items of interest. Both offered Peale's readers considerable information about the survey's activities and experiences and the regions through which the explorers traveled.

Peale's field correspondence was primarily limited to the Philadelphia *Press*, though in 1877 he would send a letter to the *New York Times*. Peale wrote regularly for the *Press* through most of his years with Hayden. In the first two Yellowstone expeditions, Peale wrote frequently, seven letters in 1871 and five in 1872. When the survey shifted to Colorado, Peale's *Press* correspondence continued, but at a reduced rate. He apparently wrote nothing in 1873, but in 1874 he wrote two letters to the *Press*, three in 1875, and two in 1876.

In form, Peale's *Press* letters followed a basic travelogue structure. His narrative provided a progressive record of the survey's travels. For his readers, Peale usually began each letter by reminding them where he had previously left them. A typical entry read like his second dispatch from the 1871 expedition, written "in camp on Blacktail Deer Creek." Peale noted that "In my last letter I had, I believe, traced our progress as far as Cache Valley."⁽¹⁾ Peale, as he often did in his letters, then described the route of the expedition's progress, discussing the geographical features and other sights along their line of travel. Peale's technique of the continuous narrative remained throughout his correspondence, though varying in detail with the frequency of his letters. Careful readers of the *Press* could have followed Peale through five exploring seasons and learned much about Western natural history and the settlement of the region.

Peale's feature articles, written between exploring seasons for the New York-based *Illustrated Christian Weekly*, were more carefully crafted than his field letters and showed closer attention to style. In content these articles focus on topics similar to Peale's correspondence. Unlike his letters, they were accompanied by William Henry Jackson's photographs. Peale

integrated his articles with the photographs. Free from the need to fully describe scenes of interest, Peale often gave more room in these articles to human interest--whether historical or current--than in his correspondence.

In both kinds of Peale's writings, however, the spectacular quality of Western geography made scenery a continuous topic of interest. The Rocky Mountains provided ample scenic wonders for Peale to offer readers. But they also presented problems in illustrating their appearance. Description of the unique Western landscape challenged Peale and other writers who sought to convey images of Western scenery.

At times Peale expressed his frustration in describing exotic wonders to his readers. Writing of some hot springs along the East Fork of the Madison River in Yellowstone, Peale abandoned any attempt to illustrate them and merely declared that they "rival any fairy palace that can be imagined."⁽²⁾ At other times he used comparisons with other landscapes possibly familiar to others. The "natural gateway" to a valley in Idaho, Peale wrote, was similar to "pictures of the Giant's Causeway in the north of Ireland."⁽³⁾

More often, Peale used his scientific background to help him describe scenery. In his account of Wild Cat Canyon in Montana, Peale blended a geologic history lesson with his description. After breaking camp in the morning the expedition

...ascended the hills, which were formed when this basin was covered with water by the deposit at the bottom of the lake. Reaching the summit there suddenly burst upon us a grand picture. We stood upon what seemed to be the rim of a vast amphitheatre. At the bottom, far below us, was a green line marking the course of a stream; while on the sides, converging towards the centre, were rounded hills with projecting ridges of sandstone, whose white color contrasted prettily with the green of the grassy slopes. On the top, even where we stood, and often projecting over the edges, was a capping of black basaltic rock, looking as though placed

there with rule and compass, so mathematically exact did it seem. The background to all this was formed of peaks and hills, with a blue, snowy range in the extreme distance.(4)

Peale frequently used geological descriptions to convey scenic interests the survey witnessed. As in his descriptions of Yellowstone, he combined scientific information and scenery to provide readers with a view of Colorado geography. Depicting the formations of the "Garden of the Gods" near Colorado Springs, Peale noted that

the rocks...are soft sandstones, their bright brick-red color forming beautiful contrasts with the grassy slopes. These rocks have been subjected to a vast amount of erosion, to which they readily yielded from their softness, and the many ridges and tower-like forms scattered throughout the garden are the remnants of upturned parallel strata.(5)

If at times, Peale's enthusiasm prompted him to use scientific terminology beyond the knowledge of his readers, his use of geological imagery to describe Western scenery gave his images credibility and evocative power.

Peale also blended scientific observations with incidents of travel. In a detailed discussion of a major geyser basin, Peale inserted an account from the expedition's adjacent camp.

One of the smaller springs, which had a temperature of 194 Fahrenheit, we used as our dish-pan, while from another we obtained water with which we made our coffee. Still another subserved the use of a washtub, in which we cleansed our clothing. The water would rise and then disappear, taking our clothing to the depths below, where they would be boiled and then brought back, while steam would escape, the heat of which dried them. The only thing wanting was a hot boulder to roll over and iron them. One member of the expedition having trusted his ony shirt to the tender mercies of this spring, was much surprised on returning to find that it had disappeared, and the picture he presented as he fished and fished in vain for that shirt was ludicrous in the extreme. Fortunately, however, the geyser probably becoming nauseated, vomited forth his garment, to his intense delight.(6)

Human interest was a key feature of Peale's accounts of the West. Miners, Mormons, soldiers, and ranchers were all duly noted and characterized in his

letters and feature articles. Of all the Western inhabitants he encountered, Peale gave the most frequent attention to Indians. In this emphasis, he was probably responding to an intense interest among Americans in the region's most exotic residents. In one of his letters from Colorado, Peale gave a long description of the Ute Indian reservation, whose territory Peale's division explored during the 1875 season. Peale wrote a long passage describing the distribution of provisions among the Indians, and he gave a detailed, if unsympathetic, view of the principal chief, Ouray, a "dignified old scalawag."⁽⁷⁾

In that same year Peale's division had another encounter with Indians which demonstrated that dangers remained in Western exploration. In surveying the Sierra la Sal mountains, the scientists encountered a band of renegades who attacked Peale's contingent. Peale and his fellow scientists were caught in a continuous battle with the Indians for most of a day. Forced to abandon all their equipment and supplies, Peale's group traveled for three days across the canyons until they reached a survey supply camp.⁽⁸⁾ Peale composed a long article detailing this incident. His letter reminded readers that adventure was still readily available in the West.

Other articles also highlighted adventurous incidents. These often focused on specific feats, such as ascents of mountain peaks. In 1874, Peale contributed a two-part article to the *Illustrated Christian Weekly* that recounted a first ascent of Mount Blackmore by Peale and two other survey members during the second Yellowstone expedition.⁽⁹⁾ In form, Peale's story followed a standard mountaineering account. After a four-day climb, beset with great toil and dangers, Peale and his companions finally attained the

summit. Depicting the extraordinary view from the peak, Peale explained the main geographical features of the Yellowstone region to his readers.(10)

While Peale's field correspondence was composed of many elements, whether human interest, adventure, scenery, or science, all were part of one overriding purpose--to explain the work of the Hayden Survey. Peale's letters clearly show that he had no self-aggrandizing interests. Peale wrote his articles to convey the survey's experience, not that of an individual.

At the beginning of each season's correspondence for the Philadelphia *Press* and the *New York Times*, Peale outlined the organization of the Hayden Survey, listing its members, and discussing the goals for the year. Peale often explained the specific scientific and topographic objectives and the exact region to be worked. A letter to the *New York Times* in 1877 informed his readers precisely what territory the expedition would explore that year.

The area to be surveyed includes something over 300,000 miles, divided into three districts, lying mainly in Wyoming Territory, but trenching on Utah and Idaho on the West. Two of these districts, the Green River and Sweetwater, have as their southern line the parallel 41 [degrees] 45 [minutes], (or about the northern boundary of Clarence King's survey of the fortieth parallel) and the parallel 43 [degrees] as their northern line. They extend from longitude 107 [degrees] to longitude 112 [degrees], and are separated by meridian 109 [degrees] 30 [minutes], the Sweetwater Division taking the eastern portion, and the Green River Division the western. The Snake River Division works an area extending as far north as 44 [degrees] 15 [minutes], and having the same meridians as east and west boundaries.(11)

If Peale carried his description past the interest of the average reader, he made certain that the survey's geographical range was well understood.

In his feature articles written for the *Illustrated Christian Weekly*, Peale also acted as a spokesman for the survey. In 1875 Peale contributed a two-part account of the discovery of a large concentration of cliff dwellings in southwestern Colorado. In these articles, titled "Ancient Ruins of the Far West," Peale described an aspect of the survey's work in which he had not personally participated but that had enormous publicity value. While abandoned ruins had been found in the West before, William Henry Jackson's photographic division was the first group of explorers to document large concentrations of these structures.(12) Peale devoted his first article, based directly on Jackson's record of the ruins, to a detailed account of the size and construction of the buildings.(13) In the second, Peale summarized an Indian legend that sought to answer what had happened to the inhabitants of the cliff houses.(14) The story relates that the people had built the dwellings for protection from raiding enemies who had finally driven them from their homes. They eventually settled in the desert Southwest, the ancestors of the present day Moqui Indians. Peale also discussed the distribution of Indian ruins throughout North America, comparing the work of the Mound Builders of the Mississippi Valley and that of the Toltec civilizations of Mexico with the ancient inhabitants and current Pueblos of Colorado, Arizona, and New Mexico.(15) The discovery of these ruins gained Hayden public attention at a moment when all four surveys were struggling to maintain Congressional funding. Peale's articles helped to publicize a key feature of the survey's operations in Colorado.

In 1876 Peale wrote a four-part series of articles discussing the survey's history and its present activities in Colorado.(16) In the initial article he recounted the development of Hayden's organization, beginning with

a brief biography of Hayden and his early work in the West.(17) Peale then described the gradual growth of the survey, from Hayden's solitary wanderings through Nebraska to a large and highly structured field survey comprised of numerous specialized divisions. The second article focused on the daily routine of the expeditions' travels in Yellowstone.(18) To demonstrate how the scientists carried out their duties, Peale depicted a typical day's travel during the 1871 expedition. He explained how, as the survey's wagons moved along the road, "the scientific corps worked a belt of country on both sides of the line of march."(19) Peale described how the camp was set each night and how specific tasks, like guard duty, were assigned. The following article discussed the changes that had come with the explorers' shift to Colorado. Most of the piece is concerned with the means of transportation the scientists used in Colorado, the mule trains. Peale pointed out how the loss of wagons significantly reduced the provisions and personal equipment the scientists were now able to carry. His chief concern was with the whimsical character of the mules themselves. Peale told

how they seem to delight in doing what is most unexpected...stopping when they should go and going when they should stop. With what an innocent and unconscious look they allow you to approach, when suddenly down go their ears and up their heels in the most wicked manner. A chapter would not be sufficient to describe the mule in all the lights he presents himself during one season.(20)

But Peale also noted the advantages of using mules in the mountains.

With all their vagaries they are better adapted to the work than are ponies. They are sure-footed, strong and will stand any amount of fatigue, living simply upon the grass they pick up during the night, for there is no room to carry forage for them.(21)

Peale's fourth article described in detail the scientific work of the Colorado survey. He explained the specific labors of the various divisions

and that of their individual members. Peale discussed how the Primary Triangulation party established a system of triangles and how the other topographic divisions carried out the rest of the cartographic work.

The secondary triangulation...consists in locating many points, in fact all mountain-tops, junctions of streams, and everything else that is at all prominent or important. Finally the topography is filled in by sketches made from the high peaks which overlook the country.(22)

In the same article Peale also noted how the accumulated scientific information was published.

First, annual reports are made of each season's labors. They are illustrated with maps and sections, and contain new and valuable information of the country explored. Second, from time to time miscellaneous publications are brought out on various subjects of interest connected with the West, such as 'Elevations,' 'Botany,' 'Meteorology' and 'Entomology.' To secure the early publication of important results bulletins are occasionally issued. These are all in octavo form. Third, the more technical results are published in quarto form. These are more especially intended for scientific men, and are elaborately illustrated. All collections are deposited in the National Museum at the Smithsonian Institution, whence they are distributed to the collaborators of the Survey to be investigated and described in special reports.(23)

After this series of feature articles, Peale's literary efforts sharply diminished in scope. Throughout his newspaper writings, Peale attempted to explain the scientific work of the survey while at the same time conveying the romance of Western exploration. By the time of the Colorado Survey, the specific labors became increasingly technical and specialized, and more challenging to interpret for his readers. His early writings included much geological description, but this was gradually replaced with more general information on the survey's activities, particularly on the colorful and entertaining aspects of the expeditions in Colorado and the adjoining region. When the survey transferred its focus to Wyoming, Peale limited his correspondence to general summaries of the expedition's topographical

studies. With the dramatic discoveries in Yellowstone and Colorado already in the past and the current work of the survey too sophisticated to hold the attention of the average reader, Peale's newspaper contributions dwindled both in number and in the scope of information he included.

One result of the extensive and varied information that Peale and other correspondents gave was that much of the public gained considerable knowledge about exploration and the West. A corollary element of these writings was a set of images that the scientists conveyed about the lands. Peale and his contemporaries suggested a dual--and contradictory--theme of the region as an area of remarkable scenic wonders and one of much economic potential. This thematic aspect of Peale's writings explains his specific contribution to the developing national image of the West.

Peale's scenic descriptions evoked a variety of images about the landscape he explored. The West in his articles was full of "the beauties, freaks, and wonders of Nature."⁽²⁴⁾ His letters and articles in the newspapers were often subtitled with such evocative descriptions as "The Wonders of the Yellowstone," "A Grand Sight," and "New Wonders on the Crater Hills." These titles suggested Peale's common focus on the exotic aspects of the regions explored. Peale described strange geological and natural features like hot springs, geysers, mud cauldrons, natural amphitheatres, and other unusual sites with names like "Devil's Gate," "Mystic Lake," and "Garden of the Gods" that depicted their odd and picturesque nature.

More often his writings emphasized the natural beauty of certain regions. Selections from his articles show the focus on picturesque qualities of scenes. He described Echo Canyon in Utah as "majestic and awe-

inspiring."(25) Peale saw another area, in Yellowstone, as "truly...a wonderful country" and noted the "exquisite beauty" of hot springs."(26) Peale at times encompassed the entire West in his descriptions, telling his readers of "the grandest scenery to be found on our own or ny other continent....The Western sunsets are particularly grand."(27) Some regions were described with more complex imagery. One sight was a "striking grand" scene that had a "wilderness of beauty pervading it...."(28) Another article, noting the progress of an expedition, declared that "our whole trip thus far had been literally through a garden."(29) In these descriptions, Peale's impressions were part of a developing literary tradition that saw the West as a region to be admired for its extraordinary beauty as well as exploited for its abundant resources.

The historian John Allen has offered the thesis that two integrating images dominated thought about the West at the beginning of the 19th century.(30) Allen suggests that the region conjured two ideas in the minds of Americans: a route to the Orient and an area of tremendous natural wealth, waiting to be exploited.(31) The Lewis and Clark Expedition dispelled the idea of the Northwest Passage but bolstered the theme of the West as a garden. The explorers gathered a vast amount of information that suggested that the West was a land full of untapped riches.

Explorers after Lewis and Clark would contribute another image to the perception of the West. This new picture suggested that the region was one of remarkable natural wonders. Lewis and Clark presented the nation with exotic animals and plants, but had offered little in scenic description. Lewis, for example, in describing the most picturesque sight from the

expedition, the Great Falls of the Missouri River, confessed his inability to provide a vivid rendition of the spectacle.(32)

Soon explorers began to convey evocative images of picturesque sights in the West. In an expedition along the Arkansas River, George C. Sibley depicted the Grand Saline, a unique natural feature. Though his descriptive powers were limited, he attempted to offer some idea of the landscape.

It has a striking resemblance to a field of brilliant snow after a rain, with a light crust on top. On a brilliant sunny morning, the appearance of this natural curiosity is highly picturesque: it possesses the quality of looming, or magnifying objects....(33)

The chief purpose of exploration was to open up some of the West's economic resources, so it was natural that accounts would include descriptions of regions ready to be exploited. But at the same time many explorers noted the scenic beauty of the Western lands. The writings of explorers that reached the public slowly developed this twin theme of untapped wealth and scenic grandeur. Descriptions like these were often closely positioned in published writings.

A letter published in a Philadelphia newspaper, written by (Daniel) Potts, a member of Ashley's fur trapping exploration up the Missouri River in 1822, shows how these images were combined. In his description of a valley near the Yellowstone River, he viewed at once the scenic and practical qualities of the sight, noting how it was "adorned with many flowers and interspersed with many useful herbs."(34) Potts also found there a wonder of nature, one that he saw with both an appreciation for its beauty and usefulness.

At the upper end of this valley on the Horn is the most beautiful scene of nature I have ever seen. It is a large boiling spring at the foot of a small burnt mountain about two rods in diameter and depth not ascertained, discharging sufficient water for an overshot mill....(35)

Western explorers would continue to blend observations of scenery and resources in their writings. In an entry in his journal for July 10, 1843, John C. Fremont viewed Pike's Peak, calling the sight "luminous and grand, covered from the summitt [sic] as low down as we can see, with glittering white." (36) Just after this passage he noted the presence of a particular "species of clover which is much used in certain parts of Germany for pasturage of stock....Its abundance here greatly adds to the pastoral value of this region." (37)

While this dual image of the West as a garden--to be admired and exploited--was developing, a new idea began to enter the view of the Western landscape. When the valley of the Yosemite was turned over to the state of California in 1864 to be preserved in its natural condition, the notion of conservation began to enter the equation. This act was the beginning of a tension that gradually developed in the nation's attitude toward the lands being opened to settlement.

The period of the the Great Surveys witnessed an escalation of these constraisting themes. At this time the public became increasingly aware of the unique nature of the West. One response was the establishment of Yellowstone as the first national park in 1872. Some of the credit for the park's creation has been attributed to the artists and photographers who were part of the exploration of Yellowstone. Historians have credited the paintings of Thomas Moran and the photographs of William Henry Jackson and the artistic records of others with offering visual representation that influenced the preservation of unique regions. (38) Their work gave those lobbying Congress the evidence to support claims that these areas were indeed exotic and worth preserving in a natural state. Their images had a

powerful influence on those in the government and the public who viewed them.

While these visual representations had a direct impact on a select audience, another source of images had a broader reach. The literature of the Great Surveys reinforced a developing national view toward the West as an exotic wonderland. The scientific reports confirmed the objective reality of the unique landscape. These records convinced the political and social elite of the scenic value of certain lands.

Reaching an even wider audience, the popular publications from the surveys further supported the notion that the West was a region of extraordinary natural features. The titles of magazine and newspaper articles suggest how frequently exotic scenery entered the survey writings. A common word in these titles, "wonder," indicated the unique quality of the landscape discussed. Nathaniel Pitt Langford wrote a piece for *Scribner's Monthly* called "The Wonders of the Yellowstone."⁽³⁹⁾ Henry Wood Elliott, a Hayden expedition member, titled an article "The New Wonderland."⁽⁴⁰⁾ Hayden sent an article to *Scribner's* with the title "Wonders of the West--II: More about the Yellowstone."⁽⁴¹⁾ Collaborating with Peale for another piece on Yellowstone, Hayden used the phrase "Wonders of the Rocky Mountains" in its name.⁽⁴²⁾ The term "wonders" was frequently applied to regions other than Yellowstone. A member of the Powell Survey, Frederick S. Dellenbaugh, for example, titled an article about the Colorado Plateau, "A New Valley of Wonders." ⁽⁴³⁾

Some entire articles attested to the exotic quality of specific landmarks. One of the most spectacular sights found by any of the surveys was Hayden's discovery of the Mount of the Holy Cross in the Colorado Rockies. Others

had viewed the peak before Hayden's expedition in 1873 but it had never been climbed or its unique feature authenticated. That summer William Henry Jackson photographed the mountain, with its 1,500 foot high natural cross on its face, and the following year artist Thomas Moran painted the peak.

Another visual record of the mountain reached the public. Writing for the *Illustrated Christian Weekly*, expedition member William Henry Holmes offered a picture of the peak that emphasized its sense of awe and majesty.(45) Holmes depicted his first sight of the mountain,

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 we felt ourselves in its
very presence.(46)

He recounted the difficult ascent of the peak and that of the photographic party, which had climbed a nearby ridge to record the view of the mountain and its remarkable external view. Through the day clouds covered the peak, offering little chance of recording their accomplishment. After despairing of attaining a photograph, the clouds lifted, and

...there, set in the dark rock, held high among the floating clouds, he beholds the long-sought cross, perfect, spotless white, grand in dimensions, at once the sublimest thing in nature and the emblem of heaven.(47)

Holmes's account of the peak was probably the highest expression of the West as a land of mystery and unique beauty published in newspapers. His readers could but little help considering the West an extraordinary region. But similar images were conveyed by many of the survey correspondents. Their work reinforced this view of these natural features as possessing compelling interest.

The Great Surveys, then, were presenting a dual portrait of the West. If a major aspect of their scientific goal was the unlocking of the region's natural resources for economic development, the presentation of the region as one of great scenic value contributed a contrasting idea in the overall view of the Western landscape.

The period of exploration that began with the Lewis and Clark expedition and closed with the Great Surveys thus saw a shift in images toward the Western lands. The role of explorers in this process is significant, for in their position as agents of the federal government, they established a general tone for the development of the West. The information and ideas that explorers offered were often translated into attitudes and policy. At the beginning of the century the value of western lands was obvious to Americans. The idea of the West as a garden to be fully exploited was a straightforward notion. But the introduction of the view that the same region was a natural wonderland confused the agenda. This idea did not initially conflict with the uninhibited exploitation of the territories. But as a new system of beliefs about use of public lands and resources developed, the view of the West was no longer simple. Conservation as a national policy brought a new and ambivalent attitude toward Western lands. The West was still seen as a garden, but one that the nation could either exploit or preserve.

Students of federal land policy have examined the central aspects of this controversy. Commonly known is the role of Hayden and other prominent explorers in influencing government actions in Yellowstone and other areas that were declared national parks. Moreover, the contributions of the artists and photographers who presented visual documentation of these

features are well documented. But the role of the numerous scientists who corresponded with magazines and newspapers throughout the nation has gone unexplored. The precise measure of their contribution is impossible to ascertain, but their place in this development deserves to be recognized.

Peale's correspondence characterized these twin attitudes toward the Western landscape. In his newspaper correspondence he saw room for exploitation and conservation. Peale was a single explorer, but his labors represent the activities of a generation of explorers who wrote about the West. The cumulative effect of their literature is problematic, but warrants acknowledgement in the larger context of the explorer's contribution to the national view of the West.

Chapter V

Albert Charles Peale and the Close of the Exploration Frontier

In Peale's first letter to the *Philadelphia Press*, he noted that the day before the Hayden party reached the town of Green River, Wyoming, John Wesley Powell had launched his second expedition of the Colorado Plateau drainage from that same place.⁽¹⁾ Though he was probably unaware of its significance, Peale's brief record of that near meeting pointed to a landmark moment in Western exploration. Each expedition represented a distinct aspect of that process. Powell's expedition marked the last great acts of geographical discovery in the West. Hayden's survey of Yellowstone symbolized the comprehensive exploration that the Great Surveys brought to the region. Together they reveal the distinguishing characteristics of this final period of Western exploration.

Powell's 1871 expedition continued his remarkably daring probe into one of the last great pockets of geographical mystery in the West. His first voyage down the Green and Grand Rivers had established the general outline of the Colorado Plateau region. Powell's follow-up expedition completed this reconnaissance and at the same time closed a chapter in Western exploration. During the second year in the field, Powell's chief lieutenant, Almon Thompson, made two discoveries that the first expedition had missed. Thompson and his men found and correctly located the last remaining unnamed river in the United States, the Escalante, and the last unknown mountain range, the Henry Mountains.⁽²⁾ With this information, the basic structural picture of the West was complete.

While Powell's feats closed one kind of Western exploration, Hayden's Yellowstone expedition marked the culminating period of another feature of that process. Historians of exploration have suggested that the terms discovery and exploration have distinct definitions. The traditional goal of discovery is to make something known, to uncover, while the objective of exploration is to complete the work of the discoverer, to open up territory.(3) Powell's expeditions were primarily acts of discovery. Hayden's explorations in Yellowstone and in Colorado represented the chief purpose of the Great Surveys, a systematic, scientific reconnaissance designed to unlock the natural history and economic resources of the West.

Peale's record provides a measure of the exploring scientist's role in this activity. His own experience suggests the high degree of knowledge and skill that characterized much of this work. His scientific and literary contributions reflect the diverse cultural achievements of the Great Surveys. Peale's writings also demonstrate that while the surveys marked the apogee of Western exploration, they eventually represented something else entirely. Peale's role as an explorer ended before the consolidation of the surveys. Somewhere in the process he had become just a scientist. The comprehensive approach that the Great Surveys brought to exploration transformed the mission of the scientist in the West. As agents of the federal government, many continued to work in the region, but they would contribute to a different chapter in its development.

The accumulation of accurate topographical information concerning the West was chiefly a product of the 19th century. The era of discovery

from the Lewis and Clark expedition up to the Civil war had represented a gradual displacement of enormously inaccurate geographical myth with precise cartographic knowledge. Private and government explorers disclosed the major features of Western geography, laid out the best routes of travel, and recorded this information in increasingly accurate maps. By the end of the Civil War, they had established the greater outline of the western United States. Only pockets of geographical uncertainty remained to explore.

The early years of the Great Surveys represented a balance between scientific and geographic discovery. Clarence King's Survey of the 40th Parallel could hardly be considered an exploration of virgin terrain, as it followed the line of the recently completed transcontinental railroad. But from 1867 through 1873, his survey compiled a remarkably thorough topographic and geological record of a relatively unknown region. Though his greatest achievements were scientific rather than topographic, one result of King's expeditions was to chart a huge expanse of Western terrain. Wheeler's Survey, like King's, actually explored little unknown terrain, but it scientifically surveyed and mapped vast uncharted areas of the Southwest, including some particularly desolate regions of eastern California, Arizona, and Nevada.(4) Powell's exploration of the canyons of the Colorado River in 1869 and 1871 filled in the last major void in Western geography and at the same time brought the science of modern geology to the Colorado Plateau.(5)

Although Hayden's 1871 expedition emphasized natural history over topography, it fit this same pattern of exploration. His scientists conducted a general geographical survey through what had recently become

a relatively well-traveled region. Hayden was personally familiar with much of the adjacent territory. In 1860 he had served as geologist on an expedition commanded by Captain W. F. Reynolds, which sought to explore the headwaters of the Yellowstone River. At that time only indefinite information existed about the area. Seemingly unbelievable tales were told of the region's strange natural features. Yellowstone was one of the great geographical questions of the West. But deep snow in the mountains thwarted the Reynolds Expedition, and the area remained a source of mystery for another decade.(6)

By the time Hayden returned with his own survey, other explorers had accomplished the discovery of the region. Two expeditions confirmed the existence of the hot springs, geysers, and other exotic natural curiosities and established the general pattern of the region's geography. A private party entered the Yellowstone area in 1869 and a joint military-civilian expedition explored it in 1870; these groups verified the reality of the Yellowstone wonders for the public.(7)

Hayden, however, had a different purpose in exploring Yellowstone. His survey's primary role was to collect and disseminate scientific information. While previous explorers had substantiated the rumors about Yellowstone, Hayden's artists and scientists sought to document and enumerate its wonders for the national welfare. This scientific emphasis precluded any major contributions in recording the topography of the region. Hayden's chief interest was in opening up Yellowstone's natural features; cartography at this time was beyond his concern.

Peale acknowledged the follow-up role the 1871 expedition assumed when he stated for his readers that one of the party's objectives was to

offer "another chapter upon that almost unknown country about which so many strange and marvelous stories" had already been presented.(8)

Moreover, upon entering the Yellowstone area they found at Mammoth Hot Springs a party of invalids soaking in the pools for therapy.(9) Peale emphasized in a newspaper account that the survey was the "first organized party that has ever visited these springs" and that the scientists would make a detailed study of the spot. The presence of convalescing travelers, however, dimmed any implication that the survey was discovering unknown terrain.(10)

The expedition made only a limited effort that season toward recording the geographical structure of the region. They used a familiar route to reach Yellowstone and traveled within the area along generally established trails. With the exception of a brief survey of the shoreline of Yellowstone Lake, Hayden paid little attention to topographic concerns.

The expedition's geographical contributions were largely confined to specific forays. Peale played a prominent part in many of these feats. With Hayden and another survey member, Peale made the first ascent of Mount Washburn. Peale also was one of a party that descended to the bottom of the Grand Canyon of the Yellowstone River to measure its depth.(11) While traveling south toward Yellowstone Lake, Peale and other scientists found and named previously undiscovered geyser basins and other thermal features. Overall, the survey accumulated a number of individual achievements, but added only fragmented information to the general geographical knowledge of the region.

When Hayden's organization returned to Yellowstone the following season, its structure suggested an increasing emphasis on recording precise geographical information. The survey included three trained topographers, presumably assigned to map the region.(12) Hayden also divided the expedition into two parties. Hayden's section, to which Peale belonged, returned to Yellowstone by the previous year's route. Another group, commanded by James Stevenson, sought to establish a southern route into Yellowstone and to discover the source of the Snake River.(13)

Stevenson's expedition made the season's chief contribution to geographical knowledge by correcting the position of the Teton Range on current maps.(14) One of Peale's geographic achievements that summer was an ascent of Mount Blackmore, a high peak overlooking the sources of the Gallatin River.(15) Despite the presence of the topographers, the second Yellowstone expedition was characterized by only the most general geographic work. Exploration was limited to a rapid survey of surface topography and the survey produced little specific cartographic information.

When the survey shifted to Colorado in 1873, Hayden reversed its scientific emphasis. Topography replaced natural history as the primary focus of the scientists' efforts. Each season Hayden selected a section of Colorado to map and assigned the work among divisions which concentrated on specific areas. The broad geographic discovery the survey had carried out in Yellowstone changed to a systematic effort to accurately chart a particular region.

Peale's Colorado writings record the survey's topographic labors in addition to his own work. Peale served as geologist with various

triangulation parties, and his travels document the expedition's movements through Colorado. In 1873 the Survey worked in central Colorado and in 1874 shifted to Western Colorado.(16) In discussing his division's work that season, Peale noted the need for accurate maps of the region. He told his readers that exploring parties led by the Army explorers Fremont and Gunnison had traveled through the region but had not offered "very much to our knowledge of Western Colorado."(17) Describing the methodology of the triangulation parties, Peale explained how their labors would provide precise information from which detailed maps could then be constructed.(18)

Peale's own duty primarily involved geologic mapping and collecting specimens. But his work also complemented the topographic objectives. A major goal of the survey geologists was to produce a colored geological map to accompany the final map of Colorado Territory.(19)

Hayden's Colorado survey also revealed a significant change in the general pattern of Western exploration. For the first time, explorers were running out of fresh territory to examine. The result was a heightened conflict among the various surveys. When Peale's Grand River Division surveyed Western Colorado in 1875 and their topographic and geologic work carried them just into Utah Territory, they revealed a fundamental limitation in the present structure of exploration.(20) In scientific terms, the extension of their mapping made sense, but it put the Hayden Survey technically beyond its assigned region. Their move onto the eastern edge of the Colorado Plateau put them in the domain of the Powell Survey. The previous year the survey had connected in the

north with Clarence King's 40th Parallel Survey.(21) These contacts with other surveys were part of a continuing political controversy.

Hayden's topographic parties had already encountered their rivals east of the Rocky Mountains. In 1873 one of Hayden's groups met a party from the Wheeler Survey, mapping the Arkansas River drainage, which Hayden's division was also charting.(22) This meeting brought the surveys into sharp conflict. By this time the surveys were overlapping to the extent that Congress decided to investigate the situation. The initial inquiry intensified the struggle between the civilian surveys and Wheeler's military establishment. The immediate result was that Congress delayed action and continued to authorize funding for all the surveys, but the parties involved realized that further conflict was probable.(23)

The struggle for control of Western exploration revealed that the explorers were quickly running out of large tracts of unknown land with much scientific or popular appeal. In his 1871 report Wheeler had already noted that the era of discovery conducted by independent explorers was over and should be replaced with a comprehensive survey.(24) The implication, of course, was that his survey was best equipped for the work.

Despite the Congressional investigation, the conflict between the surveys resumed promptly. Hayden extended his survey further into Utah, encroaching on Clarence King's domain, and Wheeler continued his probes into Colorado. Wheeler and Hayden increasingly duplicated cartographic work until, by 1878, the two surveys had mapped over 50,000 square miles of the same territory.(25) Moreover, when Hayden sent William Henry Jackson in 1877 to photograph Indian villages in the northeast area of

Arizona, Hayden trespassed not only on Powell's geographic domain but also on his personal scientific specialty, ethnography. The issue was settled only when Powell agreed to end studies in natural history if Hayden would leave ethnography for the Powell Survey.(26) As Hayden's men finished the work in Colorado, the conflict among the Great Surveys broadened into a struggle for control over leadership, scientific specialty, and geography.

In 1877, Hayden moved his survey beyond his competitors into northern Utah, Idaho, and Wyoming. There he continued the highly successful topographic work carried out in Colorado. But it was also familiar territory. The survey had already traveled through much of this terrain. Moreover, by this time it was difficult to suggest that they were involved in exploration. In 1871, Yellowstone still represented a remote, exotic region in the process of discovery. While the Colorado survey was conducted in a settled territory, its rugged mountains offered a daunting challenge to the scientists. Moreover, discoveries of the Mount of the Holy Cross and Mesa Verde showed that some mysteries remained in Western geography. The 1877 survey would uncover no such wonders.

That season Peale served as geologist with the Green River Division in Wyoming, continuing the geological mapping he had pursued in Colorado. The following year he returned to Yellowstone Park, and left the topographic work completely. There he resumed his studies of the region's thermal features. That year he achieved what was perhaps the most important scientific work of his career, producing for the Survey's report an extensive scientific treatise totaling nearly 400 pages.(27) But Peale's work was by this time strictly scientific. His precise study

of Yellowstone's geysers had little resemblance to his previous activities with the survey. Peale's labors no longer involved arduous travels through desolate uncharted regions of the West. His discoveries were those of a scientific discipline; they contributed nothing to topographic information. The return to Yellowstone marked the end of Peale's career as an explorer.

That season Peale's newspaper correspondence also ceased. There was little adventure in his present work. Moreover, his studies were complex and specialized beyond the interest of the average reader. In his role as an explorer, Peale's experience had wide appeal; as a scientist he had little to offer the public.

Peale's position reflected the progression of Western exploration as a process. In effect, the scientists of the Great Surveys had successfully explored the vast bulk of unknown territory to the degree that some new scientific agenda was necessary. The federal government would soon provide this direction.

In shifting terrain Hayden had not escaped the continued conflict among the federal Western surveys. After a bitter struggle among the survey leaders, Congress followed the recommendation of the National Academy of Sciences and consolidated the separate groups into the United States Geological Survey. The new single survey meant the elimination of Hayden's organization, which was officially terminated on June 30, 1879. The new agency also resulted in a shift of emphasis away from natural history and topography to economic geology.(28) In 1874 Powell had suggested that scientific exploration should focus on a survey of

resources.(29) The Geological Survey would adopt this policy. It would not make even the pretense of exploring the West.

For Hayden the consolidation prompted an even more significant change. The Academy Committee comprised allies of both King and Powell, Hayden's rivals for control of the new Geological Survey. Influenced by Congressmen and several prominent scientists, President Rutherford B. Hayes appointed King director of the federal agency.(30) Hayden was out of a job.

When the Hayden Survey was eliminated, work in the field ended, though Peale, Hayden, and other survey members continued to compile their scientific studies for the 1878 Annual Report.(31) In 1883 Peale and Hayden joined the Geological Survey and resumed their studies of Western geology. The two men worked briefly in North Dakota and then in the Three Forks region of Montana for three years, continuing the same kind of geologic cartography that Hayden's survey had conducted in Colorado and Wyoming.(32) Hayden died in 1887, but Peale kept working for the survey through 1898, when he accepted a post at the National Museum.(33)

During this period Peale continued to write, publishing scientific articles for the Geological Survey and the public.(34) His writings were historical as well as scientific at this time. His most important effort was a biographical sketch of Hayden. In this manuscript, written in 1891, Peale provided the basis of subsequent accounts of Hayden's career. Peale wrote a 30-page biography, accompanied by a list of scientific societies to which Hayden belonged, a list of genera and species named for Hayden, and a bibliography of Hayden's publications.(35) In this account Peale defended Hayden's suspect scientific reputation and personal

character, noting that Hayden was "generous to a fault" and that among most of his scientific peers Hayden's "honesty and integrity" were beyond reproach.(36) Peale retired from the Geological Survey in 1898 and worked for the National Museum in Washington, D.C.. Peale died in Philadelphia on December 5, 1914.

Peale's place in Western scientific exploration demonstrates the diverse cultural contributions made by the exploring scientists of the Great Surveys. As explorers they systematically charted the last great geographical voids in the American West. As scientists they brought a new era of modern science to the study of Western natural history. As journalists, they provided images and information that helped shape national land-use policy. Their cumulative activities closed the exploration frontier and opened the West for a new period of conservation and development.

Like most of his fellow scientists, Peale's role as an individual was overshadowed by the collective experience of the surveys. The primary historical value of his record lies in the larger story of Western discovery. But Peale has a fitting personal legacy in placenames along the path of the Hayden Survey's travels. Peale Island in Yellowstone Lake, the Peale Mountain Group on the Idaho-Wyoming border, and Mount Peale, highest of the Manti LaSal Mountains in eastern Utah, all serve as reminders of his place in Western exploration. In those remote regions of the Trans-Mississippi West, Peale helped bring a four-hundred-year process of discovery to its highest cultural position.

Notes

Introduction Notes

(1) *Philadelphia Press*, 15 June 1871, p. 2.

(2) Ibid. Western exploring expeditions during this period were generally known by the names of their respective leaders, thus Hayden's organization was commonly referred to as the Hayden Survey.

(3) Ibid.

(4) Ibid.

(5) Ibid.

(6) Peale also wrote for the New York-based *Illustrated Christian Weekly* and the *New York Times*.

(7) Ferdinand Vandiveer Hayden, *Bulletins of the United States Geological and Geographical Survey of the Territories, 1867-1883*. (Washington: Government Printing Office, 1867-1883).

(8) William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West*, (New York: W.W. Norton, 1966), p. xiv.

(9) In addition to the Hayden Survey, the Great Surveys included the following organizations: the geological and Geographical Exploration of the Fortieth Parallel, under Clarence King; Lieutenant George M. Wheeler's Geographical Surveys of the Territories of the United States West of the 100th Meridian; The United States Geographical and Geological Survey of the Rocky Mountain Region, led by John Wesley Powell.

(10) A strong tradition of distinguishing between the practical and intellectual benefits of scientific inquiry characterized American attitudes toward science. Chapters one and two of this thesis should help explain this ambivalent view.

(11) In the leadership of his survey, Lieutenant George Wheeler was the exception to the rise of the scientist, but the general work his survey conducted otherwise conforms to the new pattern of exploration.

(12) Goetzmann offers this theme throughout his discussion of the Great Surveys. See *Exploration and Empire*, pp. 430-576.

(13) William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery*. (New York: Viking Penguin, 1986), pp. 408-09.

(14)Goetzmann, *Exploration and Empire*, pp. 467-69, 480-81.

(15)The best example of the Hayden Survey's popularity lies in the wide newspaper coverage given to its work. Survey members and professional journalists covered the expeditions for a variety of newspapers throughout the nation. See Bonnie Skell Hardwick, "Science and Art: The Travel Writings of the Great Surveys of the American West After the Civil War," (Ph.D. dissertation, University of Pennsylvania, 1977), pp. 154-55.

(16)The question of character applies directly to Hayden, a man highly criticized by some of his peers and whose condemnation has since been repeated by historians. See, in particular, Wallace Stegner, *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West*. (Lincoln: University of Nebraska Press, 1953), pp. 126, 187, 205-07. The controversy generated by charges concerning Hayden's scientific competency and the true contributions of his survey remains unfairly skewed largely because no biographer has come forth to champion his cause. Several potential Hayden biographers have as yet been foiled by the dearth of primary source materials concerning his life. The absence of any Hayden diaries, the small number of personal letters, and the relative scarcity of other sources have frustrated several attempts to fully evaluate Hayden's career and character. Pending publication of a biography, any further revision of his reputation will probably rely on new information from related studies. In this thesis I will make no attempt to judge Hayden's historical legacy. My focus is limited to his survey.

(17)The most prolific of the survey correspondents, besides Peale, were Charles Aldrich, Robert Adams, Jr., and Ernest Ingersoll, all of whom contributed regularly to specific newspapers. Hardwick, p. 155.

(18)Hardwick's study is limited to the literary significance of the great Survey literature. The historical value of these writings in terms of Western exploration is beyond the scope of her dissertation.

(19)Recently published bibliographies show that Western historians continue to view exploration as a corollary, rather than distinct, topic of inquiry. This position necessarily relegates scientific exploration to a minor, neglected sub-category. A bibliographical essay by Gordon B. Dodds combines exploration in its traditional association with the fur trade. See Michael P. Malone, ed., *Historians and the American West* (Lincoln: University of Nebraska Press, 1983), pp. 57-76. Exploration is included with general travel accounts in another Western bibliography. Dwight L. Smith, ed., *The American and Canadian West: A Bibliography* (Santa Barbara: Clio Press, 1979), pp. 29-39. In Roger L. Nichols, ed., *American Frontier and Western Issues: A Historiographical Review* (Westpark, Conn.: Greenwood Press, 1986), pp. 217-35, the work of Western explorers is mentioned only in relation to diplomacy and expansion. The role of discovery is ignored completely in Jon Tuska and Vicki Piekarski, eds., *The Frontier Experience: A Reader's Guide to the Life and Literature of the American West* (Jefferson, N.C.: McFarland, 1984).

(20)The "Goetzmann trilogy" includes, in addition to the works previously cited: *Army Exploration in the American West, 1803-1863* (New Haven: Yale University Press, 1959). These three works provide the beginning for any current study of 19th century American exploration, but they lack the substantive scientific information to stand as definitive sources on scientific exploration.

(21)For Charles Willson Peale's role as popularizer of science see: Daniel J. Boorstin, *The Lost World of Thomas Jefferson*, 2nd ed., (New York: H. Holt, 1948), p. 19, and Goetzmann, *New Lands, New Men*, pp. 95-96. The term "closet naturalist" in its broadest sense refers to a naturalist whose chief interest lies in classifying, rather than collecting, specimens.

Chapter One Notes

(1)An extensive body of literature depicts nearly every conceivable aspect of the expedition.

(2)Donald Jackson, *Letters of the Lewis and Clark Expedition, with Related Documents, 1783-1854*, 2 vols. (Urbana: University of Illinois Press, 1978), pp. 61-66.

(3)*Ibid.*

(4)Douglas Botting, *Humboldt and the Cosmos*, (New York: Harper and Row, 1973), p. 155. On the climb they reached 20,702 feet in elevation.

(5)*Ibid.*

(6)*Ibid*, p. 202. Humboldt spent the following thirty years compiling this information into a privately printed 30 volume collection, *Voyage de Humboldt et Bonpland, 1799-1804* and his scientific master piece, *Cosmos*.

(7)J.H. Parry, *Trade and Dominion*, (London: Weidenfeld and Nicolson, 1971), p. 244.

(8)*Ibid.*

(9)Leonoor Swets Ingraham and William F. Willingham, eds., *Enlightenment Science in the Pacific Northwest: The Lewis and Clark Expedition*. (Portland: Dynaphics, 1984), p. viii. Louis Antoine de Bougainville's circumnavigating voyage that left France in 1766 with a naturalist and an astronomer on board was probably the first of these expeditions to include science as a specified concern.(Goetzmann, *New Lands, New Men*, p. 36.) But it was the voyages of Captain James Cook that boosted scientific discovery to an important position. The objectives of his journey in 1769 included observing the transit of Venus from Tahiti, in addition to mapping islands in the Pacific and searching for the mythical southern continent, *Terra Australis Incognita*.(*Ibid*, p. 51) On all three of his major expeditions, Cook carried naturalists who accumulated a vast sum of scientific information.

Cook's voyages firmly established the link between science and global exploration.

(10)Goetzman, *New Lands, New Men*, p. 52. Humboldt gave a powerful impetus to this movement, but of course it had already begun. Though rarely noted in studies of American Western exploration, a wide variety of naturalists from several nations had explored areas in the Trans-Mississippi West before Lewis and Clark. As early as 1741, a Frenchman, Fabry de la Bruyere, under orders from his royal governor, explored along the Arkansas River with one purpose to observe the natural history of the region.(A.P. Nasatir, *Before Lewis and Clark*, 2 vols. (St. Louis: St. Louis Historical Documents Foundation, 1952), pp. 28-29) Most of this early scientific exploration was in the Pacific Northwest. George Vancouver's survey of the northwest coast from 1791 to 1795 included a naturalist appointed by the Royal Treasury, Archibald Menzies. Despite claims of the lack of Spanish naturalists in the West, science had an important role in any of Spain's expeditions to the Pacific Coast region.(A prominent historian of early exploration claims that Spain had little interest in science objectives of exploration. Samuel W. Geiser, *Naturalists of the Frontier*, (Dallas: University Press, Southern Methodist University, 1948), p. 17.) Stimulated by Enlightenment thought as much as England and France, the Spanish crown sent scientific expeditions to examine its empire.(Iris H.W. Engstrand, *Spanish Scientists in the New World*. (Seattle: University Press, 1981), pp. 4-5) Many skilled naturalists accumulated a mass of scientific information in California and the Northwest.(Warren L. Cook, "Spain and the Northwest Coast," in Ingraham, p. 1) In 1792 the botanist from the Royal Scientific expedition to New Spain, Jose Longinos Martinez, led an overland scientific expedition from *Baja California* through *Alta California*. Upon reaching Monterey, their northernmost point, the expedition had collected 30 boxes of botanical, zoological, and mineralogical specimens.(Engstrand, p. 138) A voyage in search of the Northwest Passage in 1791, led by Alejandro Malaspina, included a systematic scientific exploration along the coasts of Northern California, and present-day Oregon and Washington. On this expedition, an accompanying naturalist, Tadeo Haenke, contributed, among other scientific discoveries, the first scientific description of the redwood tree.(Ibid, p. 73) Thus, Lewis and Clark's scientific labors in the West followed directly an already established pattern.

(11)Humboldt's proteges included two German naturalists, Heinrich Mollhausen and Frederick Wilhelm, who had studied directly under him and who would do important work in the West. Goetzmann, *Exploration and Empire*, p. 289.

(12)Ibid, p. 312.

(13)Botting, p. 126.

(14)Charles Coleman Sellers, *Mr. Peale's Museum: Charles Willson Peale and the First Popular Museum of Natural Science and Art*, (New York: W.W. Norton and Company, 1980), pp. 164-165.

- (15) Goetzmann, *New Lands, New Men*, p. 95.
- (16) Sellers, *Mr. Peale's Museum*, p. 19.
- (17) *Ibid*, pp. 123-41.
- (18) John C. Greene, *American Science in the Age of Jefferson*, (Ames, Iowa: Iowa State University Press, 1984), pp. 54-55.
- (19) Sellers, *Mr. Peale's Museum*, p. 161.
- (20) *Ibid*, pp. 143-47.
- (21) Boorstin, *The Lost World of Thomas Jefferson*, p. 100.
- (22) *Ibid*, p. 37.
- (23) *Ibid*, pp. 36-37.
- (24) Richard A. Van Orman, *The Explorers: Nineteenth Century Expeditions in Africa and the American West*, (Albuquerque: University of New Mexico Press, 1984), pp. 81-82.
- (25) Boorstin, *The Lost World of Thomas Jefferson*, pp. 23-24.
- (26) Van Orman, pp. 81-82.
- (27) Boorstin, pp. 23-24.
- (28) *Ibid*, pp. 23-26.
- (29) Jackson, *Letters of the Lewis and Clark Expedition*, pp. 16-18, 21, 23-25.
- (30) Sellers, *Mr. Peale's Museum*, p. 171. Also, Paul Russell Cutright, *A History of the Lewis and Clark Journals*, (Norman: University of Oklahoma Press, 1976), p. 11. Lewis and Clark's journals are still kept at the American Philosophical Society.
- (31) Donald Jackson, *Thomas Jefferson and the Stony Mountains: Exploring the West from Monticello*, (Chicago: University of Illinois Press, 1981), p. 304.
- (32) There are no extant letters from Jefferson that demonstrate any participation by Peale. See Jackson, *Letters of the Lewis and Clark Expedition*, pp. 128-129.
- (33) Paul Russell Cutright, *Lewis and Clark: Pioneering Naturalists*, (Urbana: University of Illinois Press, 1969), p. 27.
- (34) Sellers, *Mr. Peale's Museum*, pp. 186-87.

(35) Peale's Museum received two live grizzly cubs from Zebulon Pike's Red River expedition and a large number of specimens collected on the Long Expedition. Jessie Poesch, *Titian Ramsay Peale, 1799-1885, and His Journals of the Wilkes Expedition*, (Philadelphia: American Philosophical Society, 1961), p. 10.

(36) The museum gradually developed in Peale's home, but as his collections increased he moved the exhibits to Philosophical Hall in 1794 and later expanded into the State House.

(37) James P. Rondha, "Lewis and Clark and Enlightenment Ethnography," in Ingraham, p. 12.

(38) Sellers, *Mr. Peale's Museum*, p. 18.

(39) *Ibid*, pp. 161-63.

(40) *Ibid*, p. 2.

(41) These works include: *Systema Naturae*, published in 1736; *Philosophia Botanica*, in 1751; and *Species Plantarum*, in 1753.

(42) Lynn Barber, *The Heyday of Natural History, 1820-1870*, (Garden City, New York: Doubleday, 1980), p. 55.

(43) Van Orman, p. 66.

(44) Jackson, *Thomas Jefferson and the Stony Mountains*, p. 134. Also, Sellers, *Mr. Peale's Museum*, p. 36.

(45) Barber, p. 65.

(46) Jackson, *Thomas Jefferson and the Stony Mountains*, p. 32.

(47) *Ibid*, p. 33.

(48) Rondha in Ingraham, p. 6.

(49) Sellers, *Mr. Peale's Museum*, pp. 161-63.

(50) Goetzmann, *Exploration and Empire*, p. 6.

(51) Rondha in Ingraham, p. 6.

(52) Barber, pp. 50-52.

(53) Loren Eiseley, *Darwin's Century: Evolution and the Men Who Discovered It*, (Garden City, New York: Doubleday, 1958), p. 62.

(54) Barber, pp. 217-219.

- (55)George H. Daniels, *Science in American Society*, (New York: Alfred A. Knopf, 1971), p. 220.
- (56)Sellers, *Mr. Peale's Museum*, pp. 102-03.
- (57)Greene, *Science in the Age of Jefferson*, p. 27.
- (58)Sellers, *Mr. Peale's Museum*, p. 101.
- (59)Greene, *Science in the Age of Jefferson*, p. 409.
- (60)Ibid, pp. 128-129.
- (61)Howard S. Miller, "The Political Economy of Science," in George H. Daniels, *Nineteenth-Century American Science: A Reappraisal*, (Evanston, Illinois: Northwestern University Press, 1972), p. 98.
- (62)Greene, *Science in the Age of Jefferson*, p. 409.
- (63)Ibid, pp. 46-47.
- (64)Ibid, pp. 10-11.
- (65)Sellers, *Mr. Peale's Museum*, p. 2.
- (66)Joseph Ewan, ed., *Biographical Dictionary of Rocky Mountain Naturalists*, (Utrecht, The Netherlands: Frans A. Stafleu, 1981), pp. 25, 163.
- (67)Goetzmann, *Exploration and Empire*, p. 49.
- (68)Sellers, *Mr. Peale's Museum*, p. 236.
- (69)Ibid, p. 235.
- (70)Ibid.
- (71)Goetzmann, *New Lands, New Men*, p. 273.
- (72)Poesch, pp. 31-35. Long has also been blamed for delaying settlement on the Great Plains by calling the area the "Great American Desert."
- (73)Ibid.
- (74)Ibid.
- (75)Greene, *Science in the Age of Jefferson*, pp. 410-411.
- (76)Ibid, p. 414.
- (77)Carol Faul and Henry Faul, *It Began With a Stone*. (New York: John Wiley and Sons, 1983), p. 157.

(78)George P. Merrill, *The First One Hundred Years of American Geology*, (Washington: Government Printing Office, 1906), pp. 61-62.

(79)Faul, p. 157.

(80)Alexander Phillip Maximilian, Prince of Neuwied, was the most prominent of the many traveling naturalists who came to the West to study its natural history. Ewan, p. 149.

(81)Greene, *Science in the Age of Jefferson*, pp. 275-276.

(82)Sellers, *Mr. Peale's Museum*, p. 262.

(83)Miller in Daniels, p. 98.

(84)Sellers, *Mr. Peale's Museum*, p. 17.

(85)Ibid, p. 165.

(86)Goetzmann, *New Lands, New Men*, p. 299.

(87)Goetzmann, *Army Exploration*, pp. 13-14.

(88)Ibid, p. 12.

(89)Ibid, pp. 70-74.

(90)Ibid, pp. 83, 87, 98.

(91)These scientists included James Hall, John Torrey, Spencer Baird, and Charles Girard. Ibid, pp. 203-205.

(92)The primary Pacific Railroad Surveys, which explored along different parallels in 1853 and 1854, were led by I.I. Stevens, Lt. John W. Gunnison, Lt. Amiel Weeks Whipple, Lt. John G. Parke, and Capt. John Pope. Ibid, pp. 278-292.

(93)George E. Watson, "Vertebrate Collections: Lost Opportunities," in Herman J. Viola, ed., *Magnificent Voyages: The U.S. Exploring Expedition, 1838-1842*, (Washington, D.C., Smithsonian Institution Press, 1985), pp. 43-44.

(94)Goetzmann, *New Lands, New Men*, p. 273.

(95)Sellers, *Mr. Peale's Museum*, p. 283.

(96)Greene, *Science in the Age of Jefferson*, pp. 318-319.

(97)Ibid. Also, Barber, p. 212.

(98)Greene, *Science in the Age of Jefferson*, pp. 26, 45.

(99) Daniels, *Science in American Society*, p. 213.

(100) Ibid, pp. 208-210.

(101) Ibid.

(102) Goetzmann, *New Lands, New Men*, p. 291.

Chapter Two Notes

(1) "Cosmos" is the title of Humboldt's five volume study that sought to explain the features of the physical universe. Botting, pp. 235, 257.

(2) Bert James Loewenberg, "The Reaction of American Scientists to Darwinism," *American Historical Review* 38 (July 1933): p. 689.

(3) Goetzmann, *Exploration and Empire*, p. 425. Scientific exploration had an important place in the development of the theory of evolution. Darwin's travels in South American and Alfred Russell Wallace's studies in Indonesia had led to independent formulations of the same theory.

(4) Daniels, *Science in American Society*, p. 235, and Loewenberg, p. 689.

(5) Weston J. Naef, *The Era of Exploration: The Rise of Landscape Photography in the American West, 1860-1885*, (Boston: Albright Knowx Art Gallery, 1975), p. 60.

(6) Goetzmann, *New Lands, New Men*, p. 400.

(7) Ibid.

(8) Goetzmann, *Army Exploration*, pp. 307-08.

(9) Daniels, *Science in American Society*, p. 269.

(10) Ibid, p. 270.

(11) Ibid, pp. 267-268.

(12) Goetzmann, *New Lands, New Men*, p. 300.

(13) Goetzmann, *Exploration and Empire*, pp. 309-310.

(14) Ibid.

(15) Goetzmann, *Army Exploration*, pp. 423-425.

(16) Ibid.

(17) Faul, p. 196.

(18)Richard A. Bartlett, *Great Surveys of the American West*. (Norman: University of Oklahoma Press, 1962), p. 12.

(19)Ferdinand Vandiveer Hayden, *First, Second, and Third Annual Reports of the United States Geological Survey of the Territories*, (Washington: Government Printing Office, 1870), p. 105.

(20)Ibid, p. 106.

(21)Ibid, p. 201-251.

(22)Ferdinand Vandiveer Hayden, *Fifth Annual Report of the United States Geological Survey of the Territories*, (Washington: Government Printing Office, 1872), p. 7.

(23)Ibid, p. 3.

(24)Albert Charles Peale, "Titian R. Peale," *Philosophical Society of Washington Bulletin*, 14 (1905): 317-326.

(25)John C. Greene, "The Development of Mineralogy in Philadelphia, 1780-1820," *Proceedings of the American Philosophical Society* 113 (1969): p. 238.

(26)George H. Daniels, *American Science in the Age of Jackson*, (New York: Columbia University Press, 1968), p. 110.

(27)Hayden, *Fifth Annual Report*, p. 13.

(28)Albert Charles Peale, *Diary of 1871*, Transcript in J.V. Howell Collection, Coe Library, University of Wyoming, Laramie Wyoming, p. 4.

(29)Ibid, p. 4.

(30)Clarence King's Fortieth Parallel Survey paid particular attention to mining. Goetzman, *Exploration and Empire*, p. 437.

(31)Albert Charles Peale, "Preliminary Report of Dr. A.C. Peale on Minerals, Rocks, Thermal Springs, etc., of the Expedition," in *Fifth Annual Report*, p. 165.

(32)*Philadelphia Press*, 14 July 1871, p. 2.

(33)Peale in *Fifth Annual Report*, p. 172.

(34)Ibid, p. 165.

(35)Ibid, p. 168.

(36)Ibid, p. 174.

(37)Ibid, pp. 165-204.

- (38) Ibid, pp. 176-77.
- (39) Ibid, p. 181.
- (40) Ibid, p. 186.
- (41) Ibid, pp. 199-204.
- (42) Goetzmann, *Exploration and Empire*, pp. 508-509.
- (43) Albert Charles Peale, "Report of A.C. Peale, " in *Sixth Annual Report of the United States Geological Survey of the Territories*, (Washington: Government Printing Office, 1873), pp. 99-187.
- (44) Ibid, p. 139.
- (45) Ibid, p. 174.
- (46) Ferdinand Vandiveer Hayden, *Seventh Annual Report of the United States Geological and Geographical Survey of the Territories*, (Washington: Government Printing Office, 1874), p. 1.
- (47) Ibid.
- (48) Ibid.
- (49) Ibid, p. 2.
- (50) Ibid, p. 1.
- (51) *Philadelphia Press*, 22 September 1874, p. 2.
- (52) Ferdinand Vandiveer Hayden, *Ninth Annual Report of the United States Geological and Geographical Survey of the Territories*, (Washington: Government printing Office, 1877), p. 36.
- (53) Ferdinand Vandiveer Hayden, *Tenth Annual Report of the United States Geological and Geographical Survey of the Territories*, (Washington: Government Printing Office, 1878), p. XIII.
- (54) *Illustrated Christian Weekly*, 23 September 1876, p. 460.
- (55) Peale in *Seventh Annual Report*, pp. 301-05.
- (56) Ibid.
- (57) *Illustrated Christian Weekly*, 23 September 1876, p. 460.
- (58) *The Mining Industry*. See Goetzmann, *Exploration and Empire*, pp. 445-456, 480.

(59) John Wesley Powell, *Report on the Lands of the Arid Regions of the United States*, (Washington: Government Printing Office, 1878).

(60) Goetzmann, *Exploration and Empire*, pp. 566-567.

Chapter Three Notes

(1) Van Orman, p. xi.

(2) Ibid, p. 99.

(3) Earl Spencer Pomeroy, *In Search of the Golden West, the Tourist in Western America*, (New York: Alfred A. Knopf, 1957), p. 7.

(4) Frank L. Mott, *A History of American Magazines, 1865-1885*, 3 vols. (Cambridge, Massachusetts: Harvard University Press, 1938), pp. 58-62.

(5) Barber.

(6) Ibid.

(7) Philip Marshall Hicks, "The Development of the Natural History Essay in American Literature," (Ph.D. dissertation, University of Pennsylvania, 1924), p. 123.

(8) Mott, pp. 104-111.

(9) Hicks, p. 105.

(10) Wallace, *The Great Reconnaissance: Soldiers, Artists, and Scientists on the Frontier, 1848-1861*, (Boston: Little, Brown and Company, 1955), pp. 171-72.

(11) John Allen, "'Of this Enterprise': The American Images of the Lewis and Clark Expedition," in Ingraham, p. 34.

(12) J. Gray Sweeney, "The Artist-Explorers of the American West, 1860-1880," (Ph.D. dissertation, Indiana University, 1975), pp. 114-115.

(13) Van Orman, p. 103.

(14) Ibid, p. 180.

(15) Ibid, pp. 101-102.

(16) Hardwick, pp. 169-70.

(17) Ibid, p. 156.

(18) Ibid, pp. 129-130.

(19) Letters Received, Records of the Hayden Survey, Record Group 57, United States Geological Survey, National Archives, Washington, D.C.

(20) Van Orman, pp. 26-30, 40-44.

(21) Ibid, p. xxxiii.

(22) Carroll Lane Fenton and Mildred Adams Fenton, *The Story of the Great Geologists*, (Freeport, New York: Books for Libraries Press, 1945), p. 229. Also, Van Orman, p. 175.

(23) John Wesley Powell, *The Exploration of the Colorado River and its Canyons*, (New York: Flood and Vincent, 1895).

(24) Van Orman, p. 100.

(25) Goetzmann, *Army Exploration*, pp. 205-06.

(26) Ferdinand Vandiveer Hayden. *Sun Pictures of Rocky Mountain Scenery*, (New York: J. Bien, 1870).

(27) Jackson, *Letters of the Lewis and Clark Expedition*, pp. 329-330.

(28) Ibid, p. 326.

(29) Faul, p. 195.

(30) *New York Tribune*, 30 December 1873.

(31) Hardwick, pp. 126, 185.

(32) Goetzmann, *Exploration and Empire*, pp. 535-37.

(33) Ibid.

(34) Hardwick, pp. 3-4.

(35) Goetzman, *Exploration and Empire*, p. 470.

(36) Bartlett, *Great Surveys of the American West*, pp. 118-119. Also, Merrill, *The First One Hundred Years of American Geology*, p. 526.

(37) Hardwick, pp. xxxvii-xiviii.

(38) Ibid, pp. 4-6.

Chapter Four Notes

(1) *Philadelphia Press*, 14 July 1871, p. 2.

(2) *Philadelphia Press*, 19 October 1871, p. 2.

- (3) Ibid.
- (4) *Philadelphia Press*, 15 July 1871, p. 2.
- (5) *Illustrated Christian Weekly*, 3 January 1874, p. 472.
- (6) *Philadelphia Press*, 13 September 1872, p. 2.
- (7) *Philadelphia Press*, 23 September 1875, p. 2.
- (8) *Philadellphia Press*, 19 September 1875, p. 8.
- (9) *Illustrated Christian Weekly*, 11 July 1874, pp. 329-30, 25 July 1874, pp. 352-53.
- (10) Ibid.
- (11) *New York Times*, 2 July 1877, p. 2.
- (12) *Illustrated Christian Weekly*, 9 October 1875, pp. 484-85, 23 October 1875, pp. 509-10.
- (13) Ibid, pp. 484-85
- (14) Ibid, pp. 509-10
- (15) Ibid.
- (16) *Illustrated Christian Weekly*, 10 June 1876, pp. 277-78, 12 August 1876, pp. 388-89, 26 August 1876, pp. 412-13, 23 September 1876, pp. 460-61.
- (17) Ibid, pp. 277-78.
- (18) Ibid, p. 388-89.
- (19) Ibid.
- (20) Ibid, p. 412.
- (21) Ibid.
- (22) Ibid, p. 460.
- (23) Ibid, p. 461.
- (24) *Illustrated Christian Weekly*, 23 September 1876, p. 460.
- (25) *Philadelphia Press*, 15 June 1871, p. 2.
- (26) *Philadelphia Press*, 19 October 1871, p. 2.
- (27) *Philadelphia Press*, 30 July 1872, p. 8.

- (28) *Illustrated Christian Weekly*, 25 July 1874, p. 352.
- (29) *Philadelphia Press*, 29 July 1871, p. 2.
- (30) John Logan Allen, *Passage Through the Garden: Lewis and Clark and the Image of the American Northwest*, (Urbana: University of Illinois Press, 1975). Though Allen refers specifically to the Northwest, his thesis applies to much of the West.
- (31) *Ibid*, pp. xxiv-xxv.
- (32) John Bakeless, ed., *The Journals of Lewis and Clark*, (New York: New American Library, 1964), pp. 178-179.
- (33) Reuben Gold Thwaites, ed., *Early Western Travels*, vol. VI, (Cleveland, Ohio: A.H. Clark Company, 1904-07), p. 99.
- (34) Donald McKay Frost, *Notes on General Ashley, the Overland Trail, and South Pass*, (Worcester, Massachusetts: American Antiquarian Society, 1945), p. 61.
- (35) *Ibid*.
- (36) Donald Jackson and Mary Lee Spence, eds., *The Expeditions of John Charles Fremont*, (Urbana: University of Illinois Press, 1970-1984), p. 440.
- (37) *Ibid*.
- (38) Naef, p. 204.
- (39) Nathaniel Pitt Langford, "The Wonders of the Yellowstone," *Scribner's Monthly* 2 (1871), pp. 1-7, 113, 128.
- (40) *Cincinnati Daily Gazettee*, 18 October 1871.
- (41) Ferdinand Vandiveer Hayden, "Wonders of the West--II: More About the Yellowstone," *Scribner's Monthly* 3 (1872), pp. 388-97.
- (42) Ferdinand Vandiveer Hayden, "Wonders of the Rocky Mountains: The Yellowstone Park. How to Reach it." In *The Pacific Tourist: Williams' Trans-Continental Guide of Travel, from the Atlantic to the Pacific Ocean*, Henry T. Williams, ed., (New York: Henry T. Williams, 1876).
- (43) Frederick S. Dellenbaugh, "A New Valley of Wonders," *Scribner's Magazine* 35 (January 1904) pp. 1-18.
- (44) Ferdinand Vandiveer Hayden, "The Great West." In *The Great West: Its Attractions and Resources*, Charles R. Brodix, ed., (Bloomington, Illinois: Charles R. Brodix, 1880).
- (45) *Illustrated Christian Weekly*, 1 May 1875, pp. 209-210.

(46) Ibid, p. 209.

(47) Ibid, p. 210.

Chapter Five Notes

(1) *Philadelphia Press*, 15 June 1871, p. 2.

(2) Stegner, p. 142.

(3) Daniel J. Boorstin, *The Exploring Spirit: America and the World, Then and Now*, (New York: Random House, 1975), pp. 6-7. Also, Van Orman, pp. xii-xiii.

(4) Goetzman, *Exploration and Empire*, p. 485.

(5) Ibid, p. 541.

(6) Hiram Martin Chittenden, *The Yellowstone National Park*, (Originally published in 1895; reprint ed., Norman: University of Oklahoma Press, 1964), pp. 53-55.

(7) Ibid, pp. 65-74.

(8) *Philadelphia Press*, 15 June 1871, p. 2.

(9) *Philadelphia Press*, 11 August 1871, p. 8.

(10) Ibid.

(11) Ibid.

(12) *Philadelphia Press*, 10 July 1872, p. 2.

(13) Ibid.

(14) *Philadelphia Press*, 13 September 1872 p. 2.

(15) *Illustrated Christian Weekly*, 11 July 1874, pp. 329-330, 25 July 1874, pp. 352-353.

(16) *Philadelphia Press*, 22 September 1874, p. 2.

(17) Ibid.

(18) Ibid.

(19) Ibid.

(20) *Philadelphia Press*, 14 July 1875, p. 8.

- (21) Ibid.
- (22) Goetzmann, *Exploration and Empire*, pp. 478-481.
- (23) Ibid.
- (24) Ibid, pp. 477-478.
- (25) Thomas G. Manning, *Government in Science: The U.S. Geological Survey, 1867-1894*, (Lexington: University of Kentucky Press, 1967), pp. 36-37.
- (26) Ibid.
- (27) Fritiof Fryxell, "Albert Charles Peale: Pioneer Geologist of the Hayden Survey," *Annals of Wyoming* 34 (October 1962), pp. 183-85.
- (28) Manning, pp. 30-31.
- (29) A. Hunter Dupree, *Science in the Federal Government*, (Cambridge: Belknap Press of Harvard University, 1957), p. 202.
- (30) Goetzmann, *Exploration and Empire*, pp. 580-591.
- (31) Ferdinand Vandiveer Hayden, *Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories*, (Washington: Government Printing Office, 1883).
- (32) Albert Charles Peale, Field Notebooks, Geological Survey Field Records File, Geological Division, Denver, Colorado.
- (33) Fryxell, p. 188.
- (34) Albert Charles Peale, "The World's Geyser Regions," *Popular Science Monthly*, 25 (1884), pp. 494-508. "Comparisons of Geysers," *Science*, II (1886), p. 101.
- (35) Albert Charles Peale, "Biographical Sketch of F.V. Hayden, M.D., with bibliography," c. 1889. Photocopy in J.V. Howell Collection, Coe Library, University of Wyoming, Laramie, Wyoming.
- (36) Ibid, p. 28.

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