ENCHANTED ENCLOSURE
Designed and built by Army Engineers, the Entrance Arch at Gardiner was dedicated by President Theodore Roosevelt in 1903.
ENCHANTED ENCLOSURE:
THE ARMY ENGINEERS and
YELLOWSTONE NATIONAL PARK

A Documentary History

by Kenneth H. Baldwin

Historical Division
OFFICE OF THE CHIEF OF ENGINEERS
UNITED STATES ARMY
Washington, D. C. 1976
FOREWORD

Yellowstone National Park has been an important part of our natural heritage for more than a century; even so, some of the men who preserved this great work of nature for the enjoyment of mankind have yet to receive full recognition. Members of the U. S. Army Corps of Engineers were among the first to explore the park area and to urge that it be set aside and protected. Engineers were also responsible for designing, building, and maintaining the system of scenic roads which opened the wonders of Yellowstone to the public.

In *Enchanted Enclosure*, Dr. Baldwin has brought together for the first time original reports which tell the story — often a dramatic one — of the dedicated service of the Engineers to the cause of conservation. His book should appeal to the general reader as well as to the specialist.

WILLIAM C. GRIBBLE, JR.
Lieutenant General, USA
Chief of Engineers
THE AUTHOR

Professor Kenneth H. Baldwin, a specialist in Nineteenth-Century American Literature, is Chairman of the English Department in the Humanities Division of the University of Maryland, Baltimore County. He holds a Ph.D. degree from The Johns Hopkins University.
ACKNOWLEDGMENTS

The author is deeply indebted to all the members of the Office, Chief of Engineers, U. S. Army, who aided in the preparation of this volume. Special thanks are due to Robt. W. Blakeley, whose interest and support made this study possible; to Jesse A. Remington and Lenore Fine, who gave generously of their time and historical knowledge; to Dorothe M. Grand, who edited the manuscript; to Agnes D. Riedel and Ruth E. Steers, who typed the final copy; and to Carl E. Anderson, who designed the book and oversaw its publication.

Professor Baldwin is solely responsible for interpretations made, conclusions drawn, and any errors of omission or commission.
CONTENTS

I. INTRODUCTION ....................................................... 1
II. TERRA INCognITA: THE RAYNOLDS EXPEDITION OF 1860 .................. 5
III. THROUGH THE GREAT GEYSER BASIN: THE BARLOW EXPEDITION OF 1871 .............. 15
IV. TWO-OCEAN WATER AND TOGWOTEE PASS: THE JONES EXPEDITION OF 1873 ........... 45
V. THE RUDE HAND OF MAN: THE LUDLOW RECONNAISSANCE OF 1875 ................... 67
VI. THE GRAND LOOP: A LEGACY OF DAN C. KINGMAN ......................... 85
VII. LABORS OF LOVE: THE PROJECTS OF HIRAM M. CHITTENDEN .................... 95

NOTES ........................................................................... 111
MAPS

Valley of the Upper Yellowstone, 1859 - 60 .................................................. 7
Yellowstone Lake and the Valley of the Upper Yellowstone River, 1871 ......................... 17
A Military Reconnoissance, North Western Wyoming, 1873 ........................................ 49
Upper Geyser Basin, 1875 ........................................................................ 69
Yellowstone National Park, 1888 ....................................................................... 87
Yellowstone National Park, 1915 ....................................................................... 97
### ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Arch at Gardiner</td>
<td>Frontispiece</td>
</tr>
<tr>
<td>William F. Raynolds</td>
<td>4</td>
</tr>
<tr>
<td>Jim Bridger</td>
<td>9</td>
</tr>
<tr>
<td>Teton Range south of Yellowstone</td>
<td>12</td>
</tr>
<tr>
<td>John W. Barlow</td>
<td>14</td>
</tr>
<tr>
<td>Mammoth Hot Springs, 1871</td>
<td>18</td>
</tr>
<tr>
<td>A Mud Geyser along the Firehole River, 1871</td>
<td>20</td>
</tr>
<tr>
<td>Castle Geyser, 1883</td>
<td>21</td>
</tr>
<tr>
<td>Tower Falls, 1883</td>
<td>23</td>
</tr>
<tr>
<td>William A. Jones</td>
<td>44</td>
</tr>
<tr>
<td>Grand Canyon and Lower Falls of the Yellowstone</td>
<td>50</td>
</tr>
<tr>
<td>Yellowstone Lake</td>
<td>52</td>
</tr>
<tr>
<td>The original Baronett Bridge</td>
<td>53</td>
</tr>
<tr>
<td>William Ludlow</td>
<td>66</td>
</tr>
<tr>
<td>Lower Falls of the Yellowstone</td>
<td>72</td>
</tr>
<tr>
<td>Elk snowbound in Hayden Valley</td>
<td>74</td>
</tr>
<tr>
<td>Giantess Geyser, 1871</td>
<td>82</td>
</tr>
<tr>
<td>Dan C. Kingman</td>
<td>84</td>
</tr>
<tr>
<td>First road through Gibbon Canyon</td>
<td>89</td>
</tr>
<tr>
<td>Old Mount Washburn road</td>
<td>90</td>
</tr>
<tr>
<td>Road from Mammoth Hot Springs to Swan Lake, bridging</td>
<td>91</td>
</tr>
<tr>
<td>Golden Gate near Kingman Pass</td>
<td>91</td>
</tr>
<tr>
<td>Hiram M. Chittenden</td>
<td>94</td>
</tr>
<tr>
<td>Corkscrew Bridge on the Sylvan Pass road</td>
<td>100</td>
</tr>
<tr>
<td>Chittenden Bridge across the Yellowstone</td>
<td>102</td>
</tr>
<tr>
<td>Golden Gate Viaduct</td>
<td>105</td>
</tr>
</tbody>
</table>

### ILLUSTRATION AND MAP CREDITS

- **Army Audio-Visual Agency**: page 66.
- **National Archives**: Frontispiece and pages 7, 9, 12, 14, 17, 18, 20, 49, 50, 52, 69, 72, 74, 82, 87, 102, 105.
- **National Park Service, Yellowstone National Park**: pages 21, 23, 53, 89, 90, 91, 94, 100.
- **U. S. Military Academy Archives**: pages 44, 84.
I

Introduction

When Charles W. Cook returned from an exploration of the future Yellowstone Park in 1869, he submitted a description of the marvels which he had encountered to *Lippincott's Magazine*. His manuscript was returned with a polite rejection: "Thank you but we do not print fiction." A year later *Scribner's Monthly* published two articles on Yellowstone by Nathaniel P. Langford. One reviewer declared "that 'this Langford must be the champion liar of the Northwest,'" and more than one reader reminded the editor "that his prospectus had guaranteed a moral tone." ¹

Incredulity was the usual reaction to early reports of the Yellowstone region. This attitude was hardly surprising. In his history of the Mormons, published in 1852, Lt. John W. Gunnison presented a view of the Yellowstone wonderland as related to him by the famous mountain man, Jim Bridger:

He [Bridger] gives a picture, most romantic and enticing, of the headwaters of the Yellowstone. A lake, sixty miles long, cold and pellucid, lies embosomed among high precipitous mountains. On the west side is a sloping plain, several miles wide, with clumps of trees and groves of pine. The ground resounds with the tread of horses. Geyser spout up seventy feet high, with a terrific, hissing noise, at regular intervals. Waterfalls are sparkling, leaping and thundering down the precipices, and collect in the pool below. The river issues from this lake, and for fifteen miles roars through the perpendicular canyon at the outlet. In this section are the "Great Springs," so hot that meat is readily cooked in them, and as they descend on the successive terraces, afford at length delightful baths. On the other side is an acid spring, which gushes out in a river torrent; and below is a cave, which supplies "vermilion" for the savages in abundance.²

To any one unfamiliar with the area, Bridger's words could have called to mind the fantastic topography of Xanadu depicted by Coleridge in "Kubla Khan." Yet, as Hiram Chittenden pointed out, many prominent features of Yellowstone were recognizable in Bridger's account — Yellowstone Lake, the Grand Canyon, the falls, the geyser basins, Mammoth Hot Springs, and Cinnabar Mountain.

Throughout the greater part of the nineteenth century, Yellowstone existed in the public mind as just another tall tale. Well past the Civil War it remained an "enchanted enclosure," its secrets protected not only by disbelief but also by the rugged mountains surrounding it. Explorers, trappers, and gold-seekers tended to bypass the area which Indians called "the summit of the world." The red men generally avoided Yellowstone; only the Sheepeaters, a small, hermit-like band of Shoshone inhabited the future park, and ancient Indian trails which crossed it showed infrequent passage.³

Thus Yellowstone was the last important region of the West to be explored. It was the "outer space" of its day, a relic of earlier ages when fantastic volcanic and glacial forces formed the Western half of the United States. Commentators have frequently argued that the early names assigned to certain Yellowstone features — Hell Roaring Mountain, Devil's Cauldron, Satan's Arbor, and the like — were a special tribute to the infernal aspects of the landscape. But the satanic nomenclature was more than matched by the depicting of geyser and hot springs as "temples," "sanctuaries," and "sacred places." Confronted with a spectacle such as Yellowstone, man reached for a vocabulary — demonic or Arcadian — to designate the extraordinary and to express his feelings at coming face to face "with something commensurate to his capacity for wonder."⁴

Credit for the national park idea belonged to no one individual. According to tradition, Cornelius
Hedges, a member of the Washburn - Langford - Doane Expedition of 1870, was the first to suggest saving Yellowstone for the people. But Hedges' proposal, made during a campfire conversation, reflected not merely one man's philosophy but an attitude of the age. The dedication of Yellowstone as the first national park in 1872 was primarily a testament to the romantic movement. "In a sense," one writer noted, "the parks were our first massively endowed works of art." Long before Yellowstone was officially explored, George Catlin, Ralph Waldo Emerson, and Henry David Thoreau argued, independently, for "a Nation's Park," "magnificent parks," and "natural preserves." The relationship of romanticism to the creation of Yellowstone National Park was clearly identified by an authority on western explorations:

"As late as 1860, what was called science was still an attempt, pre-Darwinian in nature, to comprehend ... a vast system that was the mind of God. The search was for unity, totality, oneness with the whole "Kosmos." Immensity -- sublime, endless, empty immensity with here and there an Indian or a buffalo as allegorical nature god -- was most often depicted by the explorer-artists of the day. ... Man, especially civilized man, whenever he did appear, was usually only a figure in the foreground, almost insignificant in the face of the immensity of nature and nature's wonders. This philosophy, or point of view, characterized the entire romantic era and indeed carried over into the post-Civil War years, culminating finally, at its happiest and best, in the creation and preservation of such natural wonderlands as Yellowstone Park and Yosemite."

In an age of expansion, the creation of Yellowstone Park was a signal victory of the esthetic over the practical. "That," a park historian observed, "was the wonderful thing: that a hustling, restless, dollar-chasing young nation, with much of its population swarming like locusts over rich virgin land, should have been able to pause long enough to look into the future with such spiritual prudence; it had not happened before." Nevertheless, Yellowstone Park does owe a heavy debt to specific individuals and groups, and in the history of its discovery, preservation, and improvement no organization was more outstanding than the U.S. Army Corps of Engineers. Names of Engineers who made major contributions have been memorialized in natural and manmade attractions of the park: Raynolds Pass, Barlow Peak, Jones Creek and Pass, Kingman Pass, and Chittenden Road and Bridge. Other officers, who played smaller roles, left no names on the land; yet they, too, shared in the record of accomplishment and in the spirit of dedication that marked the Corps' involvement in Yellowstone. Among the figures in the annals of the park were these military engineers: Lieutenant Hiram M. Chittenden, whose reports of 1881 and 1882 helped to popularize the region; Gen. George L. Gillespie, a future Chief of Engineers, who in 1875 helped to focus attention on weaknesses in the Interior Department's stewardship. Moreover, the park's well-known road and bridge builders, Capt. Dan C. Kingman and Capt. Hiram M. Chittenden, were but the first and foremost of ten Engineers whose improvements transformed a nearly trackless wilderness into a true pleasuring ground.

This volume attempts to make known the more remarkable achievements of the Corps of Engineers in Yellowstone National Park by presenting excerpts from the journals and reports of six outstanding Engineer officers: Capt. William F. Raynolds, Capt. John W. Barlow, Capt. William A. Jones, Capt. William Ludlow, Capt. Dan C. Kingman, and Capt. Hiram M. Chittenden. Their individual exploits as explorers, conservationists, and engineers clearly emerge from their separate writings. Although differences in their achievements and personalities were striking, Yellowstone engaged the imagination of each man, in addition to eliciting his technical skill. Their writings are a rare combination of the practical and the visionary, the empirical and the poetic. Passages such as Captain Raynolds' description of a bucolic camp scene are common:

"While returning to the [wagon] train my first view of the camp struck me as one of the most singular beauty. The dark and varied outlines of the mountains formed the background to a landscape of wide extent and attractive features. In the centre, the circle of white tents and wagon covers reflected the bright rays of the sun, and the smoke of camp fires, the groups of men, and the grazing animals, added the charm of busy life to the scene; while, upon either hand, the striking contrasts were mellowed down by gently-sloping hills clad with verdure of all the picturesque tints of autumn." Raynolds was not alone in painting verbal portraits that evoked the atmosphere captured by such artists of the West as Thomas Moran and Albert Bierstadt. Indeed much of the descriptive terminology of the Engineers -- "picturesque," "grandeur," "majestic," "sublime" -- showed their precise knowledge of..."
romantic esthetics. A romantic bias toward idealizing reality was evidenced also by their tendency to anthropomorphize natural phenomena. Captain Ludlow's description of Giantess Geyser, in which he began by citing exact measurements and gradually built to a dramatic climax of Shelleyan prose, is a perfect example:

Again and again the geyser renewed its strength, sending out vast volumes of steam with a deafening roar that shook the whole valley, and occasionally snatching hold of a new reservoir of water and instantly ejecting it; each fresh access of wrath or travail being heralded by deep mighty thuds, as though some vast machinery were at work beneath. The exhibition of enormous power wasted in these prolonged spasms of blind rage was both fascinating and terrible, and the imagination, powerfully stimulated in the presence of such strength and fury, could not avoid imputing to the scene the attributes of gigantic passion and suffering. It seemed as though the geyser, madden by some inexpressible and mysterious torment, were imprisoned beneath and gradually exhausting herself in unavailing struggles to escape it by bursting the bonds that held her, the paroxysms of efforts being alternated with intervals of stupor, again and again overcome by her still unabated rage. 11

In the improvement work which followed the explorations, the Engineers never lost this respect for the power and beauty of nature. The roads they built were smooth and safe and some of their bridges were feats of engineering, yet all were designed to preserve the land as "nearly . . . as nature left it." 12 Many of their works were classic models of organic architecture carried out with both the tourist and the landscape in mind. By improving Yellowstone without impairing it, the Corps proved itself an ideal guardian of the natural wonderland willed to the nation.

When the National Park Service assumed control of Yellowstone in 1918, the Corps' endeavors there ended. But, even today, the Engineers continue to foster the national park idea by providing hundreds of recreation areas at their manmade lakes. And their Yellowstone legacy is still viable. In 1860, when Captain Raynolds reached the bluff overlooking the Yellowstone River, he gazed into a wide valley and poignantly forecast that "the sight was one which, in a few years, will have passed away forever." 13 It is a happy irony that his own Corps proved him wrong by helping to save the pristine wilderness which so struck Raynolds. His work and that of his brother Engineers did much to spread knowledge of the park, open it to the general public, protect its wildlife and natural wonders, and enable modern tourists to share the awe experienced by pioneers of an earlier age.
William F. Raynolds, 1820 - 1894.
II

Terra Incognita:
The Raynolds Expedition of 1860

When he left St. Louis for the Upper Missouri and Yellowstone country in May 1859, Capt. William F. Raynolds was a stranger to the West. A graduate of the U. S. Military Academy and a veteran of the Mexican War who had served on the Northeastern Boundary and Great Lakes Surveys, the 39-year-old Topographical Engineer sensed his “entire want of previous preparation” for exploring unknown reaches of the Rockies. The territory assigned to him was vast, “more than double the area of Great Britain,” and his mission was complex: to ascertain, “as far as practicable, everything relating to... the Indians of the country, its agricultural and mineralogical resources... the navigability of its streams, its topographical features, and the facilities or obstacles which the latter present to... the Indians of the country, its agricultural and mineralogical resources... the navigability of its streams, its topographical features, and the facilities or obstacles which the latter present to... the Indians of the country, its agricultural and mineralogical resources...” In spite of unfavorable weather, forbidding terrain, gold fever within his party, desertion by a valuable Sioux guide, a minor mutiny, and the constant threat of Indian attack, Raynolds was generally equal to the challenge. His detailed report and journal recorded only one grave disappointment — his failure to view the Yellowstone marvels recounted by John Colter, Jim Bridger, and other frontiersmen.

In the spring of 1860, after wintering in Wyoming, Raynolds’ sizable party, which included Lt. Henry E. Maynadier as key assistant, Jim Bridger as guide, and Ferdinand V. Hayden as naturalist, headed for the junction of the Wind River and the Popo Agie. There, on 24 May 1860, Captain Raynolds and Lieutenant Maynadier separated, intending to reunite at the Three Forks of the Missouri on the last day of June. Lieutenant Maynadier was to descend the Big Horn River and skirt the Absaroka Range of the Rockies, while Captain Raynolds attempted to ascend the Wind River to its source and thence cross to Three Forks, thus cutting almost diagonally across the future park area. Had Raynolds succeeded, he would have been the official discoverer of Yellowstone National Park. However, as excerpts from his report graphically reveal, he failed to negotiate the “aesthetically magnificent, but practically foreboding” mountains near Two Ocean Pass, hampered in his efforts not only by a steep basaltic ridge and deep snow but mainly by his superiors’ order that he be north of the British Boundary by 18 July to observe a total solar eclipse. Reluctantly, Raynolds gave up his original plan and proceeded to the Three Forks by heading west and passing down the valley of the Madison. Between them, Captain Raynolds and Lieutenant Maynadier completely encircled the park area without entering it, and had “to content [themselves] with listening to marvellous tales of burning plains, immense lakes, and boiling springs, without being able to verify these wonders.”

Field duty in the Civil War and serious illness prevented Raynolds’ completing his report until 1867. Meantime, westward migration caused such a great demand for his map that it was published separately in 1864. Showing features of the upper Yellowstone Valley — among them, “Yellowstone Lake” and “Falls of the Yellowstone Lake” and “Falls of Yellowstone” — the map was based on Bridger’s descriptions. Despite Raynolds’ failure to traverse the area, his expedition was a landmark in the history of Yellowstone National Park. As Chittenden noted, Raynolds’ report was “the latest authentic utterance concerning it prior to the date of actual discovery” as well as the “first official recognition in any form of the probable existence of extensive volcanic phenomena in the region of the Upper Yellowstone.” Raynolds was correct in assuming as he gazed north into “the most interesting unexplored district” in the country, the region he and his party could not penetrate, that although it remained terra incognita for the moment, its mysteries would “at no distant day... be fully revealed.”
Detroit, 1867

Beyond [the tributaries of the Yellowstone River west of the Big Horn] is the valley of the upper Yellowstone, which is, as yet, a terra incognita. My expedition passed entirely around, but could not penetrate it. My intention was to enter it from the head of Wind river, but [a] basaltic ridge... intercepted our route and prohibited the attempt. After this obstacle had thus forced us over on the western slope of the Rocky mountains, an effort was made to recross and reach the district in question; but, although it was June, the immense body of snow baffled all our exertions, and we were compelled to content ourselves with listening to marvellous tales of burning plains, immense lakes, and boiling springs, without being able to verify these wonders. I know of but two white men who claim to have ever visited this part of the Yellowstone valley — James Bridger and Robert Meldrum. The narratives of both these men are very remarkable, and Bridger, in one of his recitals, described an immense boiling spring that is a perfect counterpart of the Geysers of Iceland. As he is uneducated, and had probably never heard of the existence of such natural marvels elsewhere, I have little doubt that he spoke of that which he had actually seen. The burning plains described by these men may be volcanic, or more probably burning beds of lignite, similar to those on Powder river, which are known to be in a state of ignition. Bridger also insisted that immediately west of the point at which we made our final effort to penetrate this singular valley, there is a stream of considerable size, which divides and flows down either side of the water-shed, thus discharging its waters into both the Atlantic and Pacific oceans. Having seen this phenomenon on a small scale in the highlands of Maine, where a rivulet discharges a portion of its waters into the Atlantic and the remainder into the St. Lawrence, I am prepared to concede that Bridger's "Two Ocean river" may be a verity. Had our attempt to enter this district been made a month later in the season, the snow would have mainly disappeared, and there would have been no insurmountable obstacles to overcome. I cannot doubt, therefore, that at no very distant day the mysteries of this region will be fully revealed, and, though small in extent, I regard the valley of the upper Yellowstone as the most interesting unexplored district in our widely expanded country.

Wednesday, May 30 [1860] — Passing over the hills from our last night's camp (on Otter creek), we reached the valley of Wind river after travelling about a mile. We made four crossings during the day's march, this being necessary to follow the most feasible road.

Toward the close of the day we crossed a high spur, from the summit of which we obtained a fine view of the valley. To our front and upon the right the mountains towered above us to the height of from 3,000 to 5,000 feet in the shape of bold, craggy peaks of basaltic formation, their summits crowned with glistening snow. Upon our left smooth ridges clad with pine rose to nearly equal height, while behind us lay the various-hued bluffs, amid whose singular and picturesque vistas we had for days been journeying. Through the valley, in the centre, the stream could be seen placidly winding its way, a subduing element in the grandeur of a scene whose glories pen cannot adequately describe and only the brush of a Bierstadt or a Stanley could portray on canvas.

About the middle of our day's march we passed the last of the "washed lands." Above that point large boulders cover all the surface of the hills, those upon the north being basaltic and on the south granite. Our camp is on the south fork of the stream about two miles above the Upper forks, and at the base of the mountains. From this point we propose crossing the dividing line to the waters of the Pacific. It was my original desire to go from the head of Wind river to the head of the Yellowstone, keeping on the Atlantic slope, thence down the Yellowstone, passing the lake and across by the Gallatin to the Three Forks of the Missouri.

Bridger said at the outset that this would be impossible, and that it would be necessary to pass over to the head-waters of the Columbia, and back again to the Yellowstone. I had not previously believed that crossing the main crest twice would be more easily accomplished than the transit over what was in effect only a spur, but the view from our present camp settled the question adversely to my opinion at once. Directly across our route lies a basaltic ridge, rising not less than 5,000 feet above us, its walls apparently vertical with no visible pass nor even canyon.

On the opposite side of this are the head-waters of the Yellowstone. Bridger remarked triumphantly and forcibly to me upon reaching this spot, "I told you you could not go through. A bird can't fly over that without taking a supply of grub along." I had no
VALLEY OF THE UPPER YELLOWSTONE
FROM THE MAP
OF
RAYNOLDS EXPEDITION, 1859 - 60
reply to offer, and mentally conceded the accuracy of the information of "the old man of the mountains."

After dinner Dr. Hayden and myself rode out to the basaltic ridge, being anxious to examine it more minutely. Passing down the stream about a mile we effected a crossing, but not without getting both our horses mired and ourselves drenched, the results of over-confidence, as we had become so accustomed to hard bottom that we plunged into the stream without a thought of finding mud, and with difficulty avoided serious consequences from our mistake.

On reaching the North fork we found it impossible to effect a crossing, though the stream was only a few rods wide, until we had travelled up it for not less than six miles. Here we found the faint traces of an old lodge trail, which led us to a point at which the bottom was firm enough to enable our horses to obtain a passable footing. The North fork, for 10 or 12 miles above the upper forks, flows through a marsh about a mile in width, which at no very distant day has been a lake, and, in this marsh and the hills immediately surrounding, the stream seems to rise.

After the last crossing we rode rapidly over the hills, passing some of the finest grass yet seen, and finding snow upon all sides. Upon setting out we had selected a perpendicular crag that we determined to reach, and at length we arrived at a point from which we supposed we should be able to do so without further trouble. The cliff was not more than a mile off, but between us and it we found a deep ravine filled with a thick growth of scrubby pines, which was impenetrable at such a late hour in the day. We were, therefore, compelled to retrace our steps without effecting our object. I felt well paid, however, for the afternoon's work, as we obtained a fine view of the crest of the mountains entirely around the head of Wind river, forming a natural amphitheatre which cannot be excelled.

Throughout our entire ride we saw abundance of buffalo "signs," showing that they had been here recently, and tending to confirm a statement I have frequently heard that the Snake Indians keep the buffaloes penned up in the mountain valleys, and kill them as their necessities require. Our camping ground for the night would be upon the remains of numerous lodges and hundreds of lodge poles cover the ground, and it is evident that a camp at this point would effectually "pen" anything not winged that should chance to be in the valley above it.

Game is certainly abundant in the valley, and during our return ride we came upon an immense animal feeding amid the long grass at a distance of but 250 or 300 yards. We supposed it to be a buffalo, but upon its seeing us and rising we discovered that it was an enormous bear, whose equal for size I have never seen. As we were armed only with revolvers we did not molest it, nor did it seem in the least disconcerted by our presence. Antelopes are also numerous, and we saw many bands of at least 40 or 50. From the marshes close by immense flocks of ducks and geese were constantly rising.

We reached camp at dark, and just before a drenching shower, after a brisk ride of over 20 miles. The regular day's march had been 14½ miles.

Thurs., May 31 — We started at 7 o'clock, elated at the prospect of making our next halt upon the Pacific slope of the mountains. Bridger said that our camping ground for the night would be upon the waters of the Columbia, and within five miles of Green river, which could be easily reached. I therefore filled my canteen from Wind river, with the design of carrying the water to the other side, then procuring some from Green river, and with that of the Columbia making tea from the mingled waters of the Gulf of Mexico, the Gulf of California, and the Pacific — a fancy that the sequel will show was not gratified.

Our route bore up the point of a spur that reached the valley at our camp, and in some localities the road was rather steep, but on the whole our progress was good, and we advanced nearly three miles and ascended about 1,000 feet in the first hour. Then following the ridge, we had a gradual ascent and a tolerable good road for three or four miles among stunted pines, reaching at last a large windfall, which it was necessary to pass directly through, a programme involving much labor and the liberal use of the axe.

We then commenced another rapid ascent and soon found ourselves in the snow. By making our horses take the lead by turns we forced our way through, and finally stood upon the last ridge on the Atlantic side of the dividing crest. A narrow but deep valley separated us from the summit, the snow in it being too deep for an attempt even at crossing.

Turning to the left to avoid this ravine, and picking our way through thick stunted pines, we soon found ourselves floundering in the snow. Bridger, for the first time, lost heart and declared that it would be impossible to go further. To return involved retracing our steps fully half way to the Popo-Agie, then turning north into the valley of the Big Horn, and perhaps following the route of Lieutenant Maynadier, to the Three Forks of the Missouri — a course plainly inadmissible until every other hope had failed.

I therefore determined to reconnoitre myself, and if possible find some escape from our dilemma. Dismounting, I pushed ahead through the snow, which was melting rapidly, and rendered travel both
Jim Bridger, 1804 - 1891.
difficult and perilous. At times the crust would sustain my weight, while at others it would break and let me sink, generally up to the middle, and sometimes in deep drifts up to my shoulders. In some instances I was able to extricate myself only by rolling and stamping, and in many places I was compelled to crawl upon my face over the treacherous surface of the drifts. After great labor I found myself alone on the summit of the Rocky mountains with the train out of sight.

An investigation of the topography of the surrounding mountains convinced me that if the party could reach this point the main difficulties of the passage would have been surmounted, and I therefore started to return and pilot them through. Following my own tracks for nearly a mile I came upon them, and found that they had followed me slowly.

My attendant, who was leading my horse, stated that he should think they had advanced two or three miles since I left them, making the distance I had pushed forward alone some three or four miles. I found myself very much exhausted, and my clothes saturated with snow-water, but I succeeded in guiding the party through and at last reaching the summit of the crest. The descent upon the south side was gradual, but very difficult, the snow being deep, while at the few points at which it was gone the ground was a perfect quagmire, and it was not until we had advanced some six miles from the summit that we found a scanty supply of grass upon which we could encamp in the midst of pines and snow.

The day's march was by far the most laborious we have had since leaving Fort Pierre [South Dakota, the starting point of the expedition]; and wet and exhausted as I was, all the romance of my continental teaparty had departed, and though the valley of Green river was in plain sight I had not the energy to either visit or send to it.

Our last night's camp was at an elevation of 7,400 feet above the sea. The summit of this pass is very nearly 10,000 feet, and our camp to-night is 9,250 feet, so that the whole day has been spent in an atmosphere so rarified that any exertion has been most exhausting.

The weather has been a mixture of smiles and tears. Two or three flurries of snow passed over us attended with thunder, while at times the sun shone out brightly, renewing our life and vigor.

To the left of our route and some 10 miles from it rises a bold conical peak, 3,000 or 4,000 feet above us. That peak I regard as the topographical centre of the continent, the waters from its sides flowing into the Gulf of Mexico, the Gulf of California, and the Pacific ocean. I named it Union peak, and the pass Union pass.

Friday, June 1 — I was anxious to give our poor animals all the opportunity to graze that was possible, and did not, therefore, leave camp until nearly nine o'clock. We are now on waters flowing westward and into a branch of Lewis fork, which Bridger says is known to the trappers as Gros Ventre fork, the Gros Ventre Indians having been commonly in the habit of passing by this valley in their annual trips across the mountains.

The ground was frozen when we started, just hard enough not to bear our horses, and the poor beasts breaking through the crust into the mud, had as difficult travelling as could be well imagined. About a mile from camp we crossed a little rivulet not more than 18 inches wide, flowing between perpendicular banks four or five feet high. We endeavored to make the animals jump across, but four of them got in and had to be lifted out.

The valley soon became quite narrow, and the stream commenced a rapid descent over a rocky bed. Winding our way down the hill-sides over the rocks or through the mud, some four miles, we reached a bold clay bank 75 or 100 feet high, the foot of which was washed by the stream. A narrow bridle-path led over it, along which our pack animals passed in safety, but the odometer wheels could not be kept upright even with the aid of ropes, but rolled over, carrying the mules with them, bringing up, at last, at the water's edge, where we left them for the time.

At the end of only a six-miles' march, we encamped upon a small tributary of Gros Ventre fork, having descended about six hundred feet, carrying us below the greater part of the snow and into pasturage that was much better than at our previous camp, though by no means good, the new grass not having yet started. Two or three snow-storms passed over us during the day, although the sun was shining at the time.

After getting into camp, the odometer wheels were sent after, and brought in by making a long detour on the south side of the stream.

My guide seems more at a loss than I have ever seen him, and after reaching camp he rode in advance to reconnoitre, and returned saying, "it would be necessary to make a short march to-morrow," which I do not regret, as our animals are greatly broken down.

Saturday, June 2 — The ground was covered with snow this morning. The sun shone out brightly when the herd was brought up, but, by the time we were prepared to start, snow was again falling rapidly. Crossing the stream, which is here about forty feet
wide and two and a half deep, we continued down Gros Ventre fork, our course being north of west. The road was better than any before found on this side of the mountains, but the rapidly falling and melting snow caused mud that retarded us somewhat.

After a march of but three miles, Bridger advised a halt, as he did not know of another good camping ground within accessible distance. The grass is now almost gone, as he did not know of another good camping ground within accessible distance. The grass is improving in quality, and I hope the rest of the Sabbath will be of essential benefit to our broken-down animals. Our object now is to keep as near to the dividing crest as possible and recross, as soon as we shall be able, to the headwaters of the Yellowstone.

The animal life of this region differs essentially from that on the Atlantic slope. Even in Wind River valley many birds new to us were seen, and Dr. Hayden and his assistants have been very busy collecting specimens of all kinds. Three or four squirrels previously unknown to us, double that number of birds, and a large and new species of rabbit have been obtained. Yesterday, Bridger shot a “mule deer,” and the day before our hunter killed one on the eastern side of the crest of the mountains, a locality out of their usual geographical limit.

Sunday, June 3 — We passed the day quietly in camp. The sky has been cloudy, and we have been visited by occasional showers.

Monday, June 4 — Our course to-day has borne nearly northwest, and we are no longer following the course of the stream, but crossing the ridges separating its different branches. The road was found to be almost impassable. The snow had scarcely gone, while the ground was perfectly saturated with water. The depth of the mud, and the exhausted condition of the animals, made marching almost impossible.

A spirit of insubordination and discontent was also manifest among the men, showing itself openly in their apparent determination to abandon all further efforts to bring along the odometer wheels, which they permitted to turn over five times in about half a mile. It was with the greatest difficulty that I succeeded in enforcing discipline and inducing the men to continue the faithful discharge of their duties. A long march was plainly out of the question, the spirit of the party, the condition of the beasts, the state of the roads, and the scarcity of grass, all forbidding it. We halted therefore for the night after advancing all but eight miles.

Tuesday, June 5 — We left camp at 7½ a.m., starting off rapidly to the northwest across the spurs running down to Gros Ventre fork. The hill slopes were not as steep as those passed over yesterday, and had it not been for the mud the road would have been good. As it was, the animals labored hard, sinking over the fetlock at every step. A month later in the season, however, there would probably be no especial difficulty encountered in travelling here, the late rains being chiefly responsible for our troubles. Crossing one or two inconsiderable streams, at about 10 miles from our morning’s camp we reached the valley of what was supposed to be another branch of Lewis river, but which subsequently proved to be a northern fork of the Gros Ventre. Here the mud became far more impassable than before, while our labors were greatly augmented by occasional banks of snow through which we were compelled to force a way.

After travelling some two miles in this valley, further progress in it became impracticable, and an attempt was then made to push on along the side of the mountain. There, however, among the pines the snow was found in impassable banks, while the open ground between presented even more obstruction than the snow itself, the soil being loose, spongy and saturated with moisture, so that the animals were constantly and helplessly mired.

I counted at one time 25 mules plunged deep in the mud, and totally unable to extricate themselves. To go on was clearly impossible, and, as we were now above grass, to remain here was equally out of the question. The only course left, therefore, was to return, and we retraced our steps for about two miles, and pitched our tents at a point where our animals could pick up a scanty subsistence.

After getting into camp Bridger ascended the summit of a high hill to obtain an idea of the country, and returned after dark with far from a favorable report. Nothing but snow was visible, and, although he seems familiar with the locality, it is evident that he is in doubt as to what it is best that we should next attempt. As I am exceedingly anxious to reach the upper valley of the Yellowstone, after a full discussion of the question in all its bearings with him to-night, it has been determined to make to-morrow a thorough examination of the mountains and pick out some path by which we may, if possible, find our way across them, and accomplish our purpose.

Wednesday, June 6 — Leaving the party in camp, I started with Bridger this morning, in accordance with our last night’s arrangement, to ascertain if it was possible by some means to cross the mountain range before us. Following up the stream we soon reached the limits of our yesterday’s labors, and seeing a westerly fork which apparently headed in a low “pass” that looked promising, we determined to explore it.

Before reaching this fork we experienced great trouble in picking our way around snow drifts and
The towering Teton Range in northwest Wyoming is just south of Yellowstone Park.
through mud. After leaving the main stream the ground rose rapidly and the hillsides were covered with a dense growth of stunted pines, under which we found snow in abundance. Some of the banks were not so deep as to prevent our horses from plunging through them, but others had to be trodden down before we could effect a passage. The labor was of course excessive, but by perseverance the summit was at length reached.

Bridger immediately declared that we were on the wrong route and that our morning's labor had been wholly useless. This was evident by the course of the ravine upon the other side of the ridge, which tended so far to the southward as to show that the drainage was still towards the Pacific, and that we had expended our efforts in climbing a spur. We therefore returned to the valley and ascended the main stream, which carried us further to the eastward, and at first looked much less promising than the other.

After forcing our way through the snow-banks along the banks of the stream for about a mile, we reached a point where, for three-quarters of a mile above, the valley was comparatively wide, being bordered by steep cliffs, cut in deep gorges, filled with snow. The neighboring hillsides were clad with snow, and the level valley was covered to a uniform depth of from eighteen inches to two feet, without the slightest appearance of ever having been crossed by man or beast.

Bridger at once seemed to recognize the locality, saying, "This is the pass." Our own exhaustion, however, as well as that of our horses, was too great for any further attempts to-day, and we therefore returned to camp, determined to make another and final effort to reach the summit to-morrow.

*Thursday, June 7* — I started this morning with a party of nine, all told, to make the last attempt to find a solution of the difficult problem imposed upon us. My companions were the guide, Bridger, Dr. Hayden (naturalist), Mr. Hutton (topographer), Mr. Schonborn (artist), and four men. One of the mules, however, fell into the stream soon after starting and was nearly lost, and we were compelled to send it back to camp, with its rider.

The rest of the party pushed on in our tracks of yesterday, without special trouble, till we reached the valley discovered at the close of our labors of the previous day. Here we encountered great obstacles. The deep snow in the numerous gorges rendered progress along the hillside impossible, and compelled us to keep close to the stream in the valley, the descent into which was accomplished with much trouble. Our route here was crossed by side gullies from two to four feet in depth, entirely invisible beneath the uniform surface of the snow, and into which we tumbled, and out of which we floundered in a style at once ridiculous and exhausting. We partially remedied this, at last, by probing the depth of the snow ahead by rods, and by this simple expedient saved ourselves much labor and annoyance. We ultimately reached the upper end of the valley, and by a steep climb over the snow scaled the last ascent and stood again upon the dividing crest of the Rocky mountains.

It did not require long to decide that further progress was impracticable. From the southward we had already passed over ten or fifteen miles of snow, but then we knew that there was a limit to it easily reached. To the north, or the direction in which our route from this point would lie, the view seemed almost boundless, and nothing was in sight but pines and snow. To bring the party to where we stood was next to impracticable, but this I had determined to attempt, if there were any hopes of getting through the snow on the Yellowstone side of the mountains. My fondly cherished schemes of this nature were all dissipated, however, by the prospect before us, as a venture into that country would result in the certain loss of our animals, if not of the whole party.

I therefore very reluctantly decided to abandon the plan to which I had so steadily clung, and to seek for a route to the Three Forks of the Missouri, by going further to the west and passing down the valley of the Madison. After taking in our fill of the disheartening view we returned to camp, to commence the execution of our new project on the morrow.
John W. Barlow, 1838 - 1914.
III
Through the Great Geyser Basin:
The Barlow Expedition of 1871

In the early 1870's indifference to the uncharted wilderness near the headwaters of the Yellowstone gave way to enthusiasm as the marvelous tales of trappers and traders were confirmed. Accounts brought back by the privately organized Folsom–Cook–Peterson exploration of 1869 raised interest to a high pitch and led to the famous semiofficial Washburn–Langford–Doane Expedition of 1870. Publicized through the brilliantly written report of Lt. Gustavus C. Doane and the popular lectures of Nathaniel P. Langford, the discoveries of Henry D. Washburn and his party prompted the government to field two major expeditions in 1871. One, sponsored by the U. S. Geological Survey, was under the leadership of Ferdinand V. Hayden, who had accompanied Raynolds some years earlier. The other, commanded by Capt. John W. Barlow, chief engineer of the Military Division of the Missouri, had orders from General Sheridan to explore and map the Yellowstone region.

An 1861 West Point graduate who was thrice brevetted during the Civil War and a future Chief of Engineers, Barlow went west in 1870, fresh from river and harbor duty on Lake Champlain. Like Raynolds, he entered Yellowstone as a first-time explorer. His party, which included another Engineer officer, Capt. David P. Heap, a topographer, a photographer, and a draftsman, worked in tandem with Hayden's, sharing the same military escort and following the same route much of the way. The combined expeditions set out from Fort Ellis, near Bozeman, Montana, the staging area for the Washburn party in 1870, and approached the park from the north entrance at Gardiner. Chittenden traced the subsequent movements of the two groups:

At the very outset of their journey they branched off from the Washburn route at the mouth of the Gardiner River, and, by ascending this stream, discovered the wonderful formations now known as Mammoth Hot Springs. From this point, the parties traveled eastward to Tower Creek; thence over Mt. Washburn, and past the Canyon and Falls, to Sulphur Mountain, Mud Geyser, and the Lake; thence by a new route across the mountains to the Upper Basin; thence east across the mountains again, past Shoshone Lake [labeled Madison Lake on Barlow's map] to Yellowstone Lake; thence around the head of this body of water to its outlet; thence across the country, by separate routes, to the mouth of Soda Butte Creek; and thence down the East Fork [Lamar River] to Baronett Bridge (which had been built only a few months before), and out of the park by way of Mammoth Hot Springs.

Although the two parties jointly uncovered many marvels, including Mammoth Hot Springs, Barlow separated from Hayden at certain key points and broke new ground. While on his own, he discovered Heart Lake and Fairy Falls, named Mounts Sheridan, Hancock, and Humphreys, made the first recorded sighting of a number of geysers, and explored virgin territory around the headwaters of the Snake River and along the East Fork of the Yellowstone. His map of the entire region, based on triangulation and astronomical observation, was by far the most accurate to date. When he and Hayden turned homeward in the late summer of 1871, the discovery of Yellowstone was virtually complete.

A direct result of their combined endeavors was the Act of 1 March 1872, which set Yellowstone apart "as a public park or pleasuring ground for the benefit and enjoyment of the people." Although neither man published his official findings before the vote was taken, both men helped push the legislation through Congress, Hayden by lobbying in Washington, Barlow by rallying support in the Midwest. Exemplifying Barlow's effort was a
supplement, featuring highlights of his forthcoming report, carried by the Chicago Evening Journal on 13 January 1872. Hailed as “remarkable” and “highly interesting,” accounts of his visit to “the land of wonders” lent momentum to the movement for the first national park.

Despite the loss of his specimens and photographs in the great Chicago fire, Barlow’s report, printed as a Senate document in the spring of 1872, was a solid scientific achievement. And although Barlow deferred to the earlier prose of Lieutenant Doane in several instances, his own style was such a pleasing blend of the technical and the artistic, especially in the section devoted to a “General Description of the Great Geyser Basin,” that later writers often deferred to him.

REPORT

Chicago, 1872

On reaching the mouth of Gardner’s River, or Warm-Stream Creek, as it is also called, coming in from the southwest and joining the Yellowstone fifteen miles above the middle canyon, we left the trail and followed this valley without crossing the stream.

A few miles above the mouth of this river, a boiling hot torrent of water [Mammoth Hot Springs], some six feet wide, and a foot in depth, pours out of the hill-side, perfectly clear, though steaming hot. It is probably the outlet of a vast subterranean reservoir of hot water, which supplies the numerous boiling springs upon the mountain-sides above. Near this hot brook are several warm mineral springs, beside which a few invalids had formed a camp, for the purpose of testing their healing properties.

A system of hot springs of great beauty, flowing from the top and sides of a large hill of calcareous deposit, and called Soda Mountain, is found five miles up the left bank of Gardner’s River. Here, at the foot of this curious white mountain, we encamped, and remained until the 24th [of July, 1871], examining the wonderful spring formation of this region, and the country around it. The central point of interest is the Soda Mountain, occupying an area of a hundred acres, and rising like the successive steps of a cascade, to the height of over 200 feet above the plateau at its base. The upper surface is a plain, composed of many hot springs, constantly sending up volumes of vapor slightly impregnated with sulphurous fumes. The sides of the hill down which the waters of these hot springs flow have become terraced into steps of various heights and widths, some twelve inches in dimension, while others are as many feet. In each terrace there is generally a pool of water, standing in a scalloped basin of gypsum, deposited at the edges by the water as it becomes cooler. These basins are often tinged with pink, gray, and yellow colors, giving to the whole a very beautiful effect.

The rock in all directions has evidently been deposited in the same manner as the Soda Mountain is now being built up. When the formation ceases from a change in the course of the water, the rock becomes friable and disintegrates. After a time vegetation springs up and covers the surface. Many of the basins have the size and shape of bathtubs, and were used by members of the party for bathing purposes. The temperature varies in the different pools from fifty degrees all the way up to one hundred and eighty, so there is no difficulty in finding a bath of suitable temperature. A few of these springs are strongly mineral, though most of them are sufficiently pure for cooking and drinking purposes. Near the base of this hill a remarkable column of rock is seen standing 60 feet in height, and nearly vertical; this is probably a defunct geyser. In many places small upheavals have occurred, the rock has been rent open, allowing an escape of steam and gas jets, whose formations in the hot regions beneath can be heard through these openings. The action of these subterranean waters has, of course, worn out caverns in the rocks beneath, leaving the crust sometimes thin and frail; caution should therefore be exercised in exploring these places. Numerous caves and holes were found in the adjacent hills. I penetrated to the depth of 50 feet in one of the former, and found myself in a vaulted dome 30 feet across and 40 feet high. On the far side was a deep well, dark and gloomy, into which I threw masses of rock, but did not venture to explore it personally. The views from this camp are extremely picturesque, combining every variety of mountain scenery, having rocky gorges, in which are usually found mountain streams breaking into cascades and falls at frequent intervals. The opposite bank of Gardner’s River is very steep, nearly precipitous, and surmounted by a wall of basaltic columns.

During our stay at this camp I made a circuit of the high red-topped mountain to the west of the springs, near which Mr. Everts, who was lost in the Yellowstone Basin the previous summer, was picked up by the men who went in search of him. The mountain stands in a fork of a branch of Gardner’s River, having a canyon on two sides, through which
SKETCH OF THE YELLOWSTONE LAKE AND THE VALLEY OF THE UPPER YELLOWSTONE RIVER.

ROUTE OF CAPTS. J. A. BARLOW and D. B. HARRIS, CORPS OF ENGINEERS, IN THEIR RECONNAISSANCE OF THAT REGION DURING THE SUMMER OF 1871.

Drawn by John Beals

In charge of the party. 1871

Capt. J. W. Powell, Corps of Engineers
Mammoth Hot Springs, taken by pioneer photographer William Henry Jackson in 1871
these streams flow in beautiful cascades, with one or two considerable falls. I made this trip in company with Dr. Hayden and one or two others. Though our climbing over rocks and through thickets, and crossing mountain-torrents, proved very fatiguing, we felt well repaid for our labor in observing the grand scenery upon our route. Many fine specimens of geological formation were observed, one of the most beautiful being fan-shaped basaltic formations in great abundance. Skirting the canyon to the south of the mountain for two miles, we crossed, but found the ascent so steep that we were compelled to cling to projecting rocks in many places to prevent sliding back to the bottom. On reaching the plateau beyond, our breath and strength were nearly exhausted. We now ascended to the top of the mountain, leaving our horses about half way up, and continuing the journey on foot. Here a magnificent view of the Yellowstone Valley was obtained, with its mountain ranges stretching away in the distance, southward, to the limit of vision. Also of the country lying west toward the Gallatin River. In that direction is a valley almost level, slightly rising toward the mountains on either side, with a beautiful, clear stream winding through the center, whose current was so gentle that its direction could not, as yet, be determined. Grass and flowers covered the hill-side, interspersed with occasional groves of balsam, cedar, and spruce. High cones of volcanic origin rise here and there in all directions, some of them probably fifty miles distant. The lofty peaks directly west, beyond the valley just mentioned, were probably near the sources of the West Gallatin. This region appears almost inaccessible. Continuing the circuit of the mountain, we returned to camp by way of its north side. Here we encountered another canyon as wild and precipitous as the other, and affording still more beautiful scenery. A clear cut, hundreds of feet in depth, through the mountain's base, allowed the passage of a small stream, which about midway rolled down a slightly inclined and rocky slope, then spread out into a pretty cascade of a hundred feet in height. More desperate climbing followed, and we reached an elevated plateau whose side to the east had, at some time, dropped off, leaving a sheer precipice of seven or eight hundred feet in height upon which we were now standing. Passing further northward we encountered, previous to reaching camp, several spouting hot-springs, throwing up boiling water to the height of several inches.

On reaching camp I learned that one of the cistern barometers had broken while hanging upon a tree, without apparent cause. Toward evening I enjoyed a bath among the natural basins of Soda Mountain. The temperature was delightful, and could be regulated at pleasure by simply stepping from one basin to another. They were even quite luxurious, being lined with a spongy gypsum, soft and pleasant to the touch. I walked over a part of the hill by the faint light of the new moon, which gave to its deep-blue pools of steaming water a wild and ghostly appearance. The photographer has taken numerous views of these springs and the country in their vicinity, which will serve to convey a much more definite idea of their beautiful formation than can be given by any written description. A special survey was made of the locality, and careful observations taken of its latitude and longitude.

While at this camp one of the men killed a large brown bear and three cubs. The latter were brought in and served our mess with delicious steak for several meals.

July 24 — Resumed the march, following up the southern branch of Gardner's River. The trail for the first four miles proved very rough, the sides of the valley coming down close to the stream, and very steep. At the end of this gorge a fine water-fall was discovered about 75 feet in height, beyond which the valley became less rocky. I ascended the ridge on the left, hoping to reach the summit of the divide overlooking the Yellowstone Valley several miles to the eastward. After reaching several summits I still discovered higher ones beyond, but finally ascended the last one, and was rewarded by a grand view of an immense extent of mountain scenery. In all directions were seen sharp basaltic peaks, beautifully set off with large fields of snow lying in their upper gorges; quiet, secluded valleys, well timbered hill sides, pretty lakes and mountain streams. Over the whole the sun was shining with great brilliancy, but never oppressively in these elevated regions.

I fell in with Dr. Hayden, whom I found examining this ridge, and together we continued in a southeasterly direction parallel with the valley below, through which our trains were moving. We had proposed ascending this valley as far as practicable, then to strike across the country and meet the Yellowstone opposite the mouth of the East Fork [Lamar River]. While we were pursuing our investigations, one of the doctor's assistants came up and reported that his train, with the general escort, had gone into camp some two miles south of the point where he found us, but that my train had not come up. I went to the doctor's camp and learned that none of my party had arrived except Captain Heap and Mr. Hine, who had followed the trail of the doctor's party. A messenger sent by Captain Tyler came back, finding no traces where my party had left the trail. I then decided to go myself in search of them. After considerable examination it was discovered that they had obeyed their instructions, deviated from the direction taken by the doctor's
A mud geyser along the Firehole River photographed by Jackson in 1871.
Castle Geyser, 1883. From a watercolor by John H. Renshawe.
Continuing eastward and passing into a small canyon, limestone rock cropping out at their summits. Yellowstone. A plain though rough trail led down the upon a height overlooking the valley of the Black-tail Deer Creek. The ridges are unusually stony, cool streams finding their way northward into various intervals by ravines and water-courses, with here and there a meadow, over which the animals had apparently become so scattered that all traces of their footsteps were lost. The country, until we near the river, consists of rolling prairie, dotted with groves of spruce and pine, and well watered with numerous cool streams finding their way northward into Black-tail Deer Creek. The ridges are unusually stony, limestone rock cropping out at their summits. Continuing eastward and passing into a small canyon, rendered gloomy by approaching night-fall, and following over a divide for a few miles, we emerged upon a height overlooking the valley of the Yellowstone. A plain though rough trail led down the mountain-side. The descent was steep and long, through groves of poplars and other small trees, along a nearly vertical hill-side, apparently over frightful chasms, rendered weird and gloomy by approaching darkness. We began to despair, almost, of ever finding the camp, and felt there might be a possibility that we were following a fresh Indian trail. We were soon set at rest, however, as a short time after dark we reached the foot of the mountain and found camp located in a pretty meadow, with a clear stream running through it. The river was about a mile and a half distant. I had ridden thirty miles though the train had marched but seventeen.

The next day was spent in a trip across the Yellowstone, by way of a pack-train bridge recently constructed for the accommodation of parties visiting some new mines about forty miles to the east of this point, on the head-waters of Clark’s Fork. The banks of the river here are one hundred feet apart, while a pier resting upon a ledge of rock jutting out from the west side divides the bridge into two spans, the main one being about sixty feet, and composed of heavy pine timbers of that length. A path on either side has been graded down to the bridge, that on the opposite side having been cut from the face of the cliff, the rock of which is composed of soft, shelly, and partially disintegrated slate. The bridge is located just above the mouth of East Fork, a considerable stream, and in seasons of high water is not far below the magnitude of the main river. It finds its sources many miles to the east and southeast, among some of the loftiest peaks of the Rocky Mountain range, and drains, with its numerous tributaries, a vast extent of country. From its extreme source to its mouth, it is probably fifty miles in length. An elevated, rolling country, several miles in extent, lies in the angle of the two rivers. It is intersected by numerous streams fed from the melting snow in the mountains above. In this area were three or four small lakes or ponds literally covered with ducks. Near its center stands a mountain of remarkable appearance, nearly square, with precipitous sides, known as the “Square Butte.” I crossed the river, and, passing south along its bank, obtained a view of the canyon of the Yellowstone, which here is very beautiful. Its walls are composed of volcanic conglomerate capped with basaltic columns. Many of the pinnacles remain, towering hundreds of feet in height, having about the proportions of an ordinary sewing-needle. In many places below are observed steam-jets rising from near the river’s edge, while, indications of sulphur deposit are very numerous. Farther up, I was able to descend to the river’s bed opposite the mouth of Tower Creek, coming in from the west. This stream is named from numerous tower-like pinnacles reaching up many feet above its bank. Here were some fine specimens of brimstone deposit from hot sulphur jets along the banks of the river. On the other side were numerous warm springs, which I did not visit.

The trout in this part of the river are exceedingly fine and added much to the variety of our mess. Back from the river to the east the country rises rapidly and soon becomes extremely rugged. High barren peaks are seen rising one above the other, far off to the east and south. I ascended the range to the height of 3,000 feet above the river, and judged that many of the peaks beyond were a thousand or 1,500 feet higher. On these mountains I picked up numerous specimens of petrifactions and some fine pieces of agates and rock crystal. On returning to camp I learned that the other party had passed during the day and had proceeded on as far as Tower Creek, some four miles above.

I broke camp on the morning of the 26th at half-past 7; sent the train over the trail taken the day before by Dr. Hayden, and then, in company with Captain Heap, I made an examination of the river’s bank and the falls of Tower Creek. The views from the bank of the river on this side were even more interesting than those obtained yesterday. The fall is exceedingly picturesque, and, when seen from below, the stream appears to drop from among a number of tower-like rocks, some of them extending upward more than a hundred feet above the crest of the falls. The fall itself is a sheer descent of 156 feet into a shallow basin. The water then rushes away through a rocky and rapidly descending channel, forming numerous cascades in its course to the river below.

A thick growth of pine and hemlock covers the
Tower Falls, 1883. From a watercolor by Renshawe.
sides of this gorge. Regaining the trail, which led through moderately open timber, Captain Heap and I pushed on as rapidly as possible, but soon losing all signs of the advance party, Captain Heap returned to pick up the trail. I went forward and soon regained it. I then continued over a beautifully undulating country covered with rich verdure and decked with wild flowers of every hue, many of them unknown in the Eastern States. Yet the elevation here is so great (7,000 feet) that frosts occur every night during the year. The vegetation does not seem to suffer from these summer frosts, the effect upon grass and flowers being apparently but that of dew. The path led to still higher elevations and eventually crossed a mountain range called the “Elephant’s Back” [now the Washburn Range], forming a part of the rim of the Yellowstone Lake basin. It is this ridge which, cut through by the Yellowstone below the great falls, forms that stupendous canyon, 2,000 feet in depth. A road could easily be constructed through some one of the numerous passes in this range, avoiding the severe climbing necessary by this route. Much timber would have to be removed, however, from these passes before even pack animals could get through. On this expedition the most annoying and sometimes insurmountable obstacles met with were masses of fallen timber. The trail led within a mile of the highest peak of this range, called Mount Washburn. I wished to obtain a view from this eminence, and with some difficulty succeeded in leading my horse to its extreme top. The summit is composed of broken masses of volcanic rock, literally smoothed or leveled off by the force of the wind, which sweeps with terrible violence over these elevated regions. I had observed large areas of snow several hundred feet below the summit of this ridge, but, upon the peak, I doubt if, even in winter, the wind will permit snow to remain.

From this point mountain peaks were observed in all directions, while the Yellowstone Lake, though twenty miles distant, seemed to lie at my feet. The valley of the river can be seen following the general direction of the mountain-chain to the east, a stern volcanic range of sharp peaks, many of them having the form of the Egyptian pyramids, though, of course, of a much greater magnitude. One large mountain of this range had been a landmark for two days, bearing a strange resemblance to a human profile turned toward the zenith. I named it “Giant’s Face.”

The summit of Mount Washburn is 9,000 feet above the sea, while many of those to the east of the Yellowstone are apparently 2,000 feet higher. I intended making a sketch of the horizon line of country, as seen from this mountain, but so fierce a gale was blowing at the time that I found it utterly impossible to use my drawing materials.

I descended by the opposite side into a precipitous gorge or canyon a thousand feet deep, having to drag my horse down some of the worst places. There was no vegetation, no soil, nothing but volcanic rock, in some places solid, but much of it loose and broken, affording no footing whatever, and compelling the horse to slide for several yards at a time. On one occasion I discovered that I was following the trail of a bear to his den. Soon after emerging from this canyon I became engulfed in an immense pine forest which seemed interminable. In this forest were many open glades covered with grass and flowers. In one of these, quietly reposing, I discovered three fine elk, which, upon my approach, disappeared into the thick underbrush before I could bring my carbine to bear upon them. I had descended the mountain far to the east of the trail, and now taking the direction of the sun I succeeded in traversing the forest and regaining the trail which I had no difficulty in following. A ride of some five miles soon brought me to camp. While in the forest I came upon a valley of chalk-white rock, evidently an old system of warm springs; several small ones were still in operation, giving a perceptible warmth to a small stream flowing through the valley and filling the atmosphere with an intense odor of sulphur.

We had now reached the vicinity of the great falls of the Yellowstone, which should be classed among the most interesting and beautiful of the earth. Lieutenant Doane minutely and graphically describes them in his report, and compares them most favorably with all others on this continent. I viewed them both by moonlight after arriving at camp, and on the following morning. I should describe the upper fall as the embodiment of beauty, the lower one that of grandeur. At the crest of each the river narrows to less than a hundred feet, while its depth correspondingly increases. Above the upper fall the river rapidly descends over a series of cascades, gaining great velocity, whence, upon reaching the brink of the precipice, the whole volume is thrown outward and divided almost at once into drops which aggregate into conical shapes, their apexes projecting forward, not unlike an array of comets. These soon lose their individuality and gradually blend together, forming a dense white mass, which descends in a fall of 115 feet, spreading out at the bottom with the grace and beauty of a lady’s ball-room costume. A point of rocks jutting out just in front of and slightly below the crest of the fall, affords a convenient spot for observation, whence the whole beauty of the scene can be taken in at a glance. Here the canyon of the Yellowstone finds its beginning in a beautifully wooded gorge between two and three hundred feet in depth, through which the river flows swiftly, though
smoothly, over its rocky bottom, to the crest of the lower fall half a mile below; the river then emerges from between its rocky banks and makes its prodigious leap of 350 feet into the depth of the great canyon. It is no small undertaking to descend the steep and slippery side of the canyon, even to the crest of the fall, while the yellow, volcanic and nearly vertical walls of the gorge beneath bid defiance to the most expert climber. The depths below are filled with hot springs; the rock is soft and crumbling, affording no secure footing, while the river rushes away in a perfect torrent over innumerable cascades and ripples, causing eddies and whirlpools which would dash to atoms any unlucky adventurer who should be so unfortunate as to find himself ingulfed in its waters.

About 400 yards below the lower fall a fine view is obtained from a high projecting promontory. Coming in from the west between the upper and lower falls a small stream flows over several ledges of rocks, giving rise to a number of beautiful cascades, from which the creek derives its name. These are extremely beautiful, though insignificant in comparison with the greater wonders so near at hand. One of these little falls drops into a cavern nearly concealed by overhanging cliffs, thence descending from a low ridge of rocks into a pool of great depth. A portion of the water passes through a crevice, or small tunnel, and darts out through the main fall of the cascade below, giving it a most singular appearance.

After regaining the trail I hurried on up the river to overtake the train on its way to the Mud Volcano, some ten miles above. I soon came to the wreck of a pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury. The pack-mule, which had made a false step in getting over a fallen tree, and had rolled, end over end, down the hill. His pack, consisting of the photographer's apparatus, escaped without serious injury.

Many small streams, coming in from the distant mountains, and a rolling prairie of several miles extent, were crossed during this day's march. I discovered a hillock composed of pebbles of obsidian, somewhat resembling coal-cinders. Toward the western verge of this prairie a hill of white rock was discovered which, upon investigation, proved to be another of the "soda mountains," as they are called by the hunters. Approaching nearer, I found jets of smoke and steam issuing from the face of the hill, while its other side was hollowed out into a sort of amphitheater, whose sides were steaming with sulphur fumes, the ground hot and parched with internal fires. Acre after acre of this hot volcanic surface lay before me, having numerous cracks and small apertures at intervals of a few feet, from whence were expelled, sometimes in steady, continuous streams, sometimes in puffs like those from an engine, jets of vapor more or less impregnated with mineral substances. I ascended the hill, leaving my horse below, fearful that he might break through the thin rock-crust, which in many places gave way beneath the tread, revealing caverns of pure, crystalized sulphur, from which hot fumes were sure to issue. These crystals were very fine, but too frail to transport without the greatest care. A large boiling spring emitting strong fumes of sulphur and sulphurated hydrogen, not at all agreeable, was also found here. The water from this spring, over-running its basin, trickled down the hill-side, leaving a highly-colored trace in the chalky rock. Upon the opposite side was found a number of larger springs. One, from its size and the power it displayed in throwing water to the height of several feet above the surface, was worthy of notice. Near this was a spring having regular pulsations, like a steam-engine; giving off large quantities of steam, which would issue forth with the roar of a hurricane. This was, in reality, a steam volcano; deep vibrations in the subterranean caverns extending far away beneath the hill could be distinctly heard. In searching through the thick mass of timber west of this region for other curiosities, Captain Heap and I became almost locked up in a labyrinth of fallen timber, so dense and so inextricably interlaced, that it was with the greatest difficulty we finally found our way out again. The country, from this point to the Mud Volcano, was mostly rolling prairie, intersected with several streams flowing into the river, some of them having wide estuaries and adjacent swampy flats covered with thick marsh-grass in abundance. Ducks are usually found in these sluggish streams, as well as in the little lakes so numerous throughout this whole region. We camped on the bank of the river, in the immediate vicinity of the mud geysers. These being the first specimens of the true geyser yet seen, we examined them with much curiosity.

July 28 — Remained at this camp throughout the day examining the springs, and crossing the river on a raft for the purpose of ascertaining if the same phenomena existed on the opposite side, several steam-jets being visible among the hills beyond.

The central point of interest here is the Mud Volcano, which has broken out from the side of a well timbered hill. It has a crater 25 feet across at the top, gradually sloping inward to the bottom, where it becomes about half this diameter. Its depth is about
30 feet; the deposit is gray mud, nearly a pure alumina, and has been thrown up by the action of the volcano at no very distant period. The rim of the crater on the down-hill side is some 10 feet in height, and trees 50 feet high and 100 feet distant are loaded with mud thrown from this volcano. The surface of the bottom is in a constant state of ebullition, puffing and throwing up masses of boiling mud, and sending forth dense columns of steam several hundred feet above the surrounding forests. This column of steam can be seen for many miles in all directions. Some 400 yards from this crater are three large hot springs of muddy water, one of which proved to be a geyser having periods of active eruption about every six hours. The phenomena attending these eruptions are as follows: Soon after the violent period passes, the water in the pool gradually subsides through the orifice in the center, the surface falling several feet. The water almost entirely disappears from sight, when it gradually rises again until the former level is reached, during which occasional ebullitions of greater or lesser magnitude occur; great agitation now ensues; pulsations at regular intervals of a few seconds take place, at each of which the water in the crater is elevated higher and higher until finally, after ten minutes, a column is forced up to the height of 30 or 40 feet. During this period waves dash against the sides of the surrounding basin; vast clouds of steam escape; a noise like the rumbling of an earthquake takes place; suddenly, after about fifteen minutes of this commotion, the waves recede, quiet is restored, and the waters sink gradually to their lowest limits. They soon rise again and repeat the same operation. The water from this geyser does not flow away, as the spring occupies the center of a basin 60 yards in diameter and 12 feet in depth; a channel from this basin, however, serves to conduct off any excess of surface-water that may flow in from the hill-side above.

The supply of water is diminished by a constant loss of vapor, and, if not re-supplied, the spring in time dies out. Evidence of extinct springs are quite numerous in this vicinity. Close by are a great many very small boiling-mud pits, a plastic material resembling mortar in color and consistency, worked smooth by constant mixings which it has received for an indefinite period. To the north of the geyser are numerous sulphur jets, small rills from which were depositing a sulphurous slime along their channels. The warmth and mineral properties of this material give rise to a rank vegetation.

At the head of a small ravine still further to the northward is a cavern extending fifteen feet into the side of a hill, and about six feet across at the opening. It is lined with variegated colors deposited from the vapor constantly issuing from its extreme depths, while the channel of the small stream leading down the ravine is also colored by a similar deposit from the escaping waters. The amount of steam forced out from this cavern was immense, causing great agitation of the water within, and giving rise to a roaring and splashing sound as of heavy waves breaking upon a rocky shore.

There are many ponds, varying in size from an ordinary sitting-room to a half acre in extent, all warm or hot, some of them boiling and giving off dense masses of steam, usually in regular pulsations. I enjoyed a steam bath at the mouth of the cavern-spring. The water was much too hot for bathing, and the stones upon which I stood would have burnt my feet but for the precaution of keeping on my shoes.

A slight pungent odor, not strong enough to be offensive, pervades this entire region. I found little of interest to repay me for the labor of crossing the river. The raft was swept rapidly down the current, and soon got beyond the depth of our poles, and only by dint of severe paddling were we able to cross and return. Captain Heap and myself were the only persons who ventured upon the raft, and upon our return no one followed our example. Four or five small mud-craters were discovered giving off steam and occasionally sending up small quantities of thick mud, some of which was sufficiently pure and fine to serve for the manufacture of porcelain or china ware.

July 29 — Sounds resembling a human voice calling for help were heard at intervals through the night; it is supposed they proceeded from the throat of a species of panther, called the American lion. I saw the skin and claws of one of these animals at Bottler's Ranch, which had belonged to a formidable specimen of this genus. I judged that an encounter with one would not be altogether safe. In size it must have been somewhat under that of the lions usually seen in menageries, though from the appearance of its head and claws it must have nearly equaled them in strength and fierceness.

After witnessing the morning eruption of the mud-geyser, which occurred at 6-o'clock and lasted nine minutes, attended with the usual phenomena, we continued our march to the Yellowstone Lake, about eight miles distant. The trail proved generally easy, skirting the river, which now becomes much broader, with gently sloping banks and broad grassy meadows. It seemed almost incredible that so tame and quiet a scene could be found in the midst of a region usually so wild and terrible. Just before reaching the lake we crossed a broad prairie extending several miles to the northward, and a continuation of the one met with on our march from the falls to the mud-springs. We crossed this prairie after emerging
from a fine grove near the river, and found ourselves near the beach of the Yellowstone Lake. A beautiful picture is this clear blue sheet of water nestling among the snow-peaks of the highest mountain-range on our continent. The rim of this lake-basin is composed of a mountain range varying from nine to eleven thousand feet in height above the sea, and inclosing an area of about one thousand four hundred square miles. Beyond this rim the water-slopes descend in all directions, and furnish the sources of the principal rivers of the continent. Four of the most important tributaries of the Missouri, viz, the Big Horn, the Yellowstone, the Madison, and the Gallatin, carry the melting snows from these mountains northward, and then through the Mississippi Valley to the Gulf of Mexico, more than three thousand five hundred miles. The Snake River, having its sources actually interlaced with those of the Yellowstone and Madison, traverses in its westward course nearly a thousand miles before it mingles its waters with those of the Columbia on its way to the Pacific Ocean.

Again, the Green River, rising but a few miles from the sources of the others, seeks the deserts of Colorado, and after innumerable windings in those deep canyons, at length, after a course of one thousand five hundred miles, reaches the Pacific through the waters of the Gulf of California.

The dividing point in this central region of the continent is Union Peak, situated south of the Yellowstone Lake, its extreme height being nearly 14,000 feet above the sea.

We located our camp at the edge of the bluff, some 20 feet above the beach below. A cold stream furnished us with water, and numerous fallen trees afforded us plenty of wood, while the fine meadows of the adjacent prairie supplied excellent grazing for the animals. The lake is very irregular in outline, and about twenty miles across. Several high promontories project from the southern and western shores far out into the lake, greatly diminishing its apparent extent, and forming several large bays and inlets. With the exception of the northeastern angle, heavy masses of timber cover the lake shores quite down to the water's edge, rendering its circuit attended with great difficulty. On the eastern southern sides the mountain ranges are continuous, while to the southwest and west breaks appear, through which issue many of the sources of the Snake River. In the latter direction, some ten miles from the lake, stands a very conspicuous peak, its outlines sharp and conical, and at this distance appearing almost covered with snow. This proved to be, upon subsequent investigation, 10,500 feet in height.

The water of the lake is cool and tolerably pure at this point, but, being somewhat impregnated with vegetable matter, we preferred the mountain stream for drinking and cooking. The fish found in the lake above the falls are very numerous, all of the same variety, namely, a fine large species of trout; but, as many of them have long white worms in their flesh, we discontinued catching them. The fish did not seem to suffer from the effect of the worms, whose existence was probably due to the influence of warm or chemical springs found in many parts of the lake.

July 30 — The party remained in camp at the lake. I attempted to cross with a small force to the opposite side of the river for the purpose of examining the eastern shore of the lake, and had a small raft constructed of pine logs sufficiently buoyant to sustain four men and as many horse-equipments. The horses were expected to swim. The river here at the outlet of the lake was deep, 400 yards wide, and the current swift. After several ineffectual attempts to get the animals across, the exploration was made on foot, the raft answering its purpose very well. We went as far south as Pelican Creek, about one mile from the mouth of the river. A long sand-bar here reaches out into the lake, the resort of numerous water-fowls. A large portion of the side of the mountain to the east is composed of white rock, evidently another vast warm-spring formation. One of our horses was taken sick to-day, with indications of poisoning. The attack, however, did not prove to be fatal.

The nights are beautiful in this valley. This evening's full moon, as it rose above the mountains beyond the lake, was reflected across to my camp in a broad belt of golden light as brilliant as the moon itself.

The thermometer descends from six to ten degrees below the freezing point, and yet the morning's sun melts the frost-work on the most delicate flowers without causing their bloom to fade or their leaves to wither.

July 31 — I started to-day at 8 a.m. for the valley of the Madison, to examine the basin of the great geysers. From the representations of one of my packers I had determined to retrace my steps on the trail, back toward the Mud Springs about five miles, and then crossing the open prairie ten miles to the west, and after examining a system of boiling springs on its western verge, to strike directly over the dividing ridge, and through the unknown forest lying beyond. By this route I would have open country more than half the way, while by taking a more direct course the route would be through dense forests the entire distance. Dr. Hayden, with two or three of his party, proposed to accompany me, but, just before starting, changed his mind, and, piloted by two hunters whom we had met the previous day, and who were journeying towards the head-waters of the
Madison upon a trapping expedition, started an hour before I was ready, by what they supposed to be a shorter route, entering the woods at once. On leaving the trail along the river’s bank, I crossed a low ridge and entered upon a broad, smooth valley, leading nearly due west. This valley was occasionally intersected by ravines, in which were usually found cold mountain-streams of pure water. It was covered with grass and wild flowers in great profusion. Twenty-seven varieties of the latter have been already counted. Ten miles west of the river we came upon a very hot stream, formed from the overflow of a large system of springs in some respects more interesting than any we had yet encountered. One, with a curious crater, was constantly throwing up boiling water to the height of several feet. The crater is of calcareous rock, 6 feet in diameter, and bears a strong resemblance to a human ear. A beautiful branch joins this stream from the northwest, cool, and highly impregnated with alum. The water from these springs is remarkably clear and colorless, except that from a single one which had the bright color of gamboge. On both sides of the hot stream the ground is a soft, hot marsh, very dangerous to examine, and it is only in the immediate vicinity of the largest springs, where a rocky deposit has been formed, that one is entirely safe. A steam-jet flowing beneath the surface of the water into the stream, at one point presented a very interesting appearance and gave off a very novel sound, something like that made by the spindle of a spinning-machine.

Beyond these springs our course lay through a small but wild and pretty canyon, having five gates fifty feet in height, at intervals of about one hundred feet. Continuing two miles further up this winding ravine we reached a forest, where we encountered some difficulty from undergrowth and masses of fallen timber. For the first three miles, however, the wood was comparatively open and our progress easy. Then we came upon an immense area covered with sulphur-vents, each hillside containing thousands of these little crystal chambers, which, upon being broken into, sent forth quantities of sulphurous steam. In passing through the orifice from below, this vapor had been sublimated into beautiful crystals of pure sulphur, varying in dimensions from the size of a needle to the thickness of the finger, while some were even larger. The country presented the appearance of a vast lime-kiln in active combustion. The crust of soft white rock was exceedingly thin, requiring great caution in picking a route for the animals. We were soon on the crest of the divide between the waters of the Yellowstone and the Madison, and it became necessary to push on in order to reach water and grass before night-fall. The thick underbrush and fallen timber now became almost impassable, while the rough surface of the mountain, cut into sharp gorges, with rugged, precipitous sides, rendered anything like a straight course out of the question. The pack-animals suffered terribly; their packs were constantly disarranged and frequently torn open from severe contact with trees, and it often became necessary to cut our way through some of the worst places. Toiling on in this manner for five miles, but still making some progress toward the Madison Valley, we were overtaken by Dr. Hayden. In company we descended the mountain and eventually reached a branch of the Madison, where we camped for the night. This stream, we afterward ascertained, joins the Firehole River — the main eastern fork of the Madison — some eight miles further down. It is here fifteen feet wide and four feet in depth. The divide crossed to-day was not high — only about a thousand feet above the valley on either side. The distance was twenty-five miles.

*August 1* — We discovered a brimstone valley about two miles up the stream, in which were a great many hot springs flowing into and raising the temperature of the creek. There are many of these brimstone basins, their general characteristics being about the same. I took the temperatures of many of the springs in this one, which were recorded as follows: Small white sulphur spring, temperature 128°; another, 5 feet across, with black deposit, 172°; a small bubbling spring, 170°; the hottest found in this basin, 199°. One beautiful spring, with light yellow deposit, 182°. These were the principal springs found in this basin. In addition to the springs, and covering the side of the valley, were numerous steam-jets issuing from little apertures, which were always found to contain beautiful specimens of crystalized sulphur.

I moved camp in the afternoon at half past 4 o’clock, following the course of the stream in a southwesterly direction, passing numerous hot springs from 140° to 190° of temperature, impregnated with various mineral salts, principally iron, alum, and sulphur.

A mile from camp we passed two very large springs, 20 and 40 feet across respectively. Another mile brought us to a warm creek, which I followed up, thinking there might be geysers towards its source, but found only another of the numerous brimstone basins. We soon struck a good trail, which led down the stream, crossing and recrossing as the necessity of the country demanded, and finally passed through a deep canyon with steep rocky walls on either side. After traveling about eight miles we came to the junction of the valley with that of another stream coming in from the south, which subsequent investigation proved to be the Firehole, or, more properly, the river of the geysers.
junction of the two valleys was a sharp conical butte, evidently of spring formation, as were also the extreme heights of the ridges between which we had been traveling.

Just beyond this butte the nearly level valley of the Firehole River appears some two miles across and three miles in length. At the southern extremity of this plain a high terraced hill was seen throwing up vast clouds of steam with occasional jets of water, while in many other directions, among the trees and on the sides of the valley, numerous steam columns were visible. The plain was covered with a whitish spongy soil, checked into squares in drying, showing evidences of having been recently overflowed. As it appeared boggy we passed around it to the eastward and ascended the large white hill composed of calcareous deposit, our horses occasionally breaking through its thin covering.

In returning to the point from which we entered this valley we rode directly across the plain, and found that it was marshy only in appearance. Half a mile back from the valley I found the train just unpacking in a beautiful park of firs with a broad meadow just in front. No artificial arrangement of trees could have been more perfect. I learned that one of the escort (Private Canter) had not come in with the rest and was probably lost. As I had given instructions to the whole party that, in case any one lost his way, he should return to the previous camp and there wait to be sent for, I did not feel very anxious regarding him. I gave the sergeant directions to return at daylight to the previous camp where the man would undoubtedly be found.

_August 2_ — Canter did not come in during the night; Sergeant Blade and Private McConnel went in search of him at daylight, and found him at the old camp.

The group of hot springs or geysers forming the terraced hills of the south is very interesting, consisting of a large number of springs, ranging in size from a mere point to a hundred feet in diameter. Some are geysers having regular periods of activity, throwing up columns of water to the height, in some cases, of 30 or 40 feet. Many of the small ones seemed constantly active, but eject water only a few feet above the surface. One small geyser has periods of action every fifteen minutes, throwing a column of water 30 feet high. Another, with an irregular but cases, of 30 or 40 feet. Many of the small ones

worked ready for the molder. This clay was pure white, and capable of producing the finest porcelain. The clay of several other springs near by was beautifully tinted in pink and orange colors. The water from the geysers is nearly pure, though holding in solution silicates of lime and magnesia, which are slowly deposited at the craters in beautiful bead-like drops of infinite shape and variety. The craters are all low, showing their recent origin, being elevated but from 2 to 6 feet above their orifices, though the hill, which has been formed by the united efforts of all, rises 100 feet above the plain below. There are about a hundred thermal springs in this system, the largest being at the extreme height of the elevation. It is of a bright-blue color, 30 feet in depth, with rocky caverns beneath, the temperature being nearly up to the boiling-point. This is a geyser, having periods of action every twelve hours. Previous to an eruption the surface of the spring gradually rises about six inches, and expands over an adjacent pool, the whole covering about half an acre. Steam-bubbles issue from the caverns beneath, the temperature rises, larger jets of steam escape, accompanied with the bubbling up of the water. After an hour's preparation of this character a sudden rush of an immense and powerful mass of steam occurs, which carries with it a column of water to the height of 30 to 60 feet, spouting out in all directions, and descending in a shower upon the surrounding rock to the distance of 30 or 40 feet from the crater. The eruption lasts three-quarters of an hour, and a large quantity of water is discharged.

Between the present camp and the Firehole Valley is a group of beautiful springs, which in a country where these curiosities are not so common would receive much attention. One 4 by 5 feet in diameter, and 50 feet deep, is surrounded with a hard rocky rim. The water was a clear blue, whose temperature was 190°. Close by was a large spring, 10 by 20 feet across, having a soft slimy deposit impregnated with salts of iron, its temperature 126°; another, having a similar deposit, but formed in large sheets resembling raw hides in a vat. Across the plain to the west were found several mud-springs in a ravine near a small pond. Here tracks of deer, elk, and buffalo in great abundance were seen. Farther to the north was found another system of hot springs, shooting up plastic mud of a light gray color, having the consistency of thick cream. One of these springs was 100 feet across and contained ten craters, which threw up mud 8 feet high. The Firehole River at this point is a broad shallow stream from 100 to 200 feet in width, and about 2 feet deep. The bottom is hard lava, through which boiling springs bubble up in many places. The banks are often swampy, though in many places covered with calcareous rock deposited from warm springs. The creek upon which I encamped makes a
bend to the north and enters the river a mile below. I descended the river six miles to ascertain at what point another branch, supposed to come in from the west, joins it. I found no streams entering this river from either side in that distance. The valley gradually contracts, and, after four miles, becomes a canyon difficult of passage. I was now satisfied that I had entered the Firehole Valley below or to the north of the great geysers, and decided to move to the south in search of them. Leaving directions for camp to move across the plain about two and a half miles and locate near the geyser-hill before mentioned, I ascended the river a distance of a mile further, and came upon another group of interesting springs, in some respects more beautiful than any yet discovered. A hill, sloping 50 feet up from the river's bank, down which five streams of boiling water in porcelain channels of variegated colors, varying from bright saffron to a deep vermilion, rippled over cascades worn in the terrace formation of the rock. Upon the crest of this hill, from which the rock sloped in all directions, was found a spring or small lake just even with the crest, 200 yards in diameter and nearly an exact circle. The middle waters were deep ultramarine blue, while its concentric rings varied through nearly all the colors of the rainbow, being green, yellow, orange, and red. The edges for some distance down the slope were a bright vermilion. Masses of vapor were constantly rising from the surface of this lake. Between this large spring and the river a huge chasm in the rock was found 100 feet long and 30 feet broad, revealing another spring of most astonishing beauty. The rock had evidently fallen in and disappeared in a cavity of great depth, as the sides of the chasm, some 15 feet high, were rough and ragged, showing quite a recent fracture. The depth of this spring was immense toward the center. The waters were as clear as crystal, and the color of turquoise. The caverns seemed lined with silver, and these extended in several directions beneath the hill. From the surface of the water a vast cloud of steam was constantly rising, producing an effect upon the mind of something terrible and unreal, and at the same time very fascinating. Another large spring, of a clear green color, and several smaller ones, were found in this group.

August 3 — About ten miles west of our camp, beyond the river, and across several open patches of meadow containing numerous hot springs, where the water in many places spreads over low sunken ground, causing deep and dangerous warm marshes, stands a singular pair of buttes, almost identical in size and general appearance. A narrow ridge rising half way to their tops connects these mountains together. They are called the "Twin Buttes." In company with Dr. Hayden I ascended to the top of the first one, from which a fine view of the surrounding valley was obtained. These mountains are volcanic in their origin. An orifice at the base of a huge rock near the crest of the one I ascended still ejects a current of hot vapor, with a loud, hissing sound. The top of this butte was found to be 600 feet above the plain. I was disappointed in not obtaining a more extended view to the west, the trees in that direction growing quite to the top of the butte, allowing but a glimpse of the mountain range beyond. The west branch of the Madison is undoubtedly just over that range, a high, precipitous, and densely wooded ridge 1,509 feet in height, and very difficult of passage. To the east the view was less obstructed, and I was able to take in at a glance nearly the whole of the lower geyser basin, with its hundreds of boiling springs scattered through the valley, over an area of four miles in length by about two and a half in width.

A steep precipice was observed to the south, its face looking exactly north, from whose crest a tiny stream descended in a narrow and graceful fall. I determined to visit this fall, and after a great deal of rough climbing over rocks, through deep and thickly wooded ravines, reached its foot. Here were some of the largest pines I had seen, towering upward a hundred feet, as though ambitious to reach the crest far above. The fall proved upon measurement to be a clean descent of 250 feet, and dropped into a shallow and pretty basin at the foot by the cliff. I named this fall the "Fairy." On climbing to the crest I picked up some beautiful specimens of jasper and agate, and plucked some lovely flowers of an unknown variety on the brink above. I had a severe climb up a nearly vertical rock, and on reaching the top was completely exhausted. I found a more easy point by which to descend. A very pretty cascade was discovered a few yards above the brink of the fall.

August 4 — It rained last night, which is very unusual. The shower, however, was only a slight one, accompanied with a good deal of wind. A dense fog lay on the ground early this morning, but was soon dispelled by the rising sun. I sent the train up the river, with directions to proceed six or eight miles and go into camp, thus giving me an opportunity to explore the adjacent country for other thermal phenomena. A ravine to the southeast of the geyser-hill valley contains several large springs, which I had not yet examined. I took them in my route.

A lake of hot water, 100 by 200 feet in extent, was discovered; also a fine geyser, throwing water to the height of 50 feet. Beyond was a vast hot marsh, which I was obliged to skirt for a long distance, it being too soft to bear the weight of a horse. Here was discovered a very beautiful spring, having a scolloped curbing of rock 12 feet across, and surrounded by numerous pockets, in which were deposited a quantity of little pebbles as smooth as
polished marble. I procured quite a number of these; also some other specimens of deposit, enameled with silica. In the center of this plat, about two miles in area, stands a crater 15 feet high, upon a basin of about the same height. This is an interesting crater, throwing a small stream to the height of about 6 feet. It is rapidly going to decay, the supply of deposit not equaling the amount expropriated by the action of the elements. It is soft and crumbling, and steam issues from its sides in many places. Around this plain the trees have been killed by the action of hot water, often overflowing the basin. Their trunks, for several feet from the ground, are denuded of bark, and are crusted with a white deposit of silicious rock. Continuing on to the southwest, through thickly timbered and broken country, Captain Heap and I reached the river at the site of the beautiful group of springs seen two days before. From this point onward, the mountains, from 800 to 1,200 feet in height, close in near the river, narrowing the valley to about a quarter of a mile, many beautiful and curious springs and small geysers were found at frequent intervals all along the banks of the river. Any one of these would be a study in itself, was there none other to demand attention. A pair of twin geysers was particularly noticeable, one throwing out sudden gusts of steam, the other responding regularly with a spout of water, 20 feet in height, at an oblique angle. Following the trail of the party in advance, occasionally losing it in the marshes and fallen timber, we hurried on, crossing and re-crossing the river in several places. The stream here has a fine rushing current, from 6 inches to 3 feet in depth, 50 yards wide, and flowing over a smooth, rocky bottom. The valley is well wooded with spruce, pine, and cedar, and is intersected by several cold streams as well as numerous warm ones.

Three miles beyond the twin geysers was found a system of hot springs and geysers, extending across the river and covering an area of several hundred acres. One of the most interesting of this group is a minute geyser emitting jets of water at intervals of every three minutes, in two or three convulsive puffs, to the height of 30 feet. The peculiarities of this crater are very marked, it having an entanglement of roots just at its opening. These have become incrusted and partially petrified with silicious deposit, causing them to resemble frosted silver. At the west side of this river at this point are ten large springs, three or more geysers, and numerous smaller springs, some of which are probably geysers. One of the large springs was exceedingly beautiful, being 15 by 18 feet across and gradually decreasing in diameter toward the bottom. The transparency of the water, though of a deep-blue color, rendered every outline of its sides as clear as if it contained but air. At the center the depth must have been 40 feet or more. Around and near this spring were dozens of little springs sputtering and hissing upon their own individual account. One hundred yards south of this transparent pool is a remarkably fantastic crater, consisting of a huge fissure in the rock, around which has been formed by deposits a most curiously wrought net work of white mineral, resembling delicate tracing of frostwork. The river flows to the east, across which can be seen numerous steam-jets, while on this side are more than twenty between the large spring and the river. Many of the springs have double or twin craters. The rock in many places is thin and friable, and, upon being broken through, dark, smoking holes filled with boiling water or mud are revealed. It is not unusual to find springs within a few feet of each other, standing at a great difference of level; where both are boiling this is very remarkable. A triple geyser constantly in action deposits a substance resembling sponge, both in color and texture. Continuing up the stream we passed many single springs with lovely blue depths, also many steam-jets. In one large spring a pine tree had fallen, its whole top being submerged; the branches, cones, and needles were all completely incrusted with a rich coating of mineral, like frosted silver. It was fast becoming petrified, the wood already having partially changed into stone, being yet soft, having about the consistency of lard.

The valley now becomes wider, and soon another basin, containing an immense system of geysers, was entered. From their number and magnitude it seems probable that we had reached the Firehole Basin, described by Lieutenant Doane. Subsequent investigation proved this to be the case. This basin is two miles in length by about one-half mile in width, the river traversing it in a winding course, whose general direction is from southeast to northwest. The stream is very rapid, having a smooth bed of lava; is about 30 yards in width and from 6 inches to 3 feet in depth. The hills on either side are rocky and heavily wooded, rising from seven to twelve hundred feet above the valley, and nearly enclosing it. The scene, as we entered from below, was grand and imposing. Along both banks, and extending back into the forest, were numerous steam-jets rising in soft masses of cloudy vapor to the altitude of several hundred feet, while dotted over the whole extent of the basin were seen numerous columns of water in the form of fountains playing at various heights.

I found the camp located on the east side of the river, near a small pine grove, with good grass in the bottom. Soon after arriving a shout was heard near the hill-side, a hundred yards distant, and upon rushing out in that direction a huge mass of steam was seen issuing from a crater at the base of the hill,
accompanied by a column of water rising to a height far exceeding that of any geyser I had yet seen. This grand fountain continued to play for several minutes, when dying down, I approached to obtain a closer view of the aperture whence had issued such a powerful stream. A sudden gush of steam drove me away, following which the water was again impelled upward and upward, far above the steam, till it seemed to have lost the controlling force of gravity, and that it would never cease to rise. The roar was like the sound of a tornado, but there was no apparent effort; a steady stream, very graceful, and perfectly vertical, except as a slight breeze may have waved it to and fro. Strong and smooth it continued to ascend like the stream from a powerful steam fire-engine. We were all lost in astonishment at the sudden and marvelous spectacle. The proportions of the fountain were perfect. The enthusiasm of the party was manifested in shouts of delight. Under the excitement of the moment it was estimated to be from three to five hundred feet in height. Comparing it with the Fairy Falls, seen the day before, which measured 250 feet, I have no hesitancy in stating that this geyser played to the height of over 200 feet. It commenced at 5 p.m., and continued twenty minutes. Three days were devoted to the examination of the springs in this basin, viz., the 5th, 6th, and 7th of August, during which period a special survey of the valley was made, and the height of some of the important geysers measured.

The longer I remained the more firmly I became convinced that a thorough solution of the wonders of this valley can only be obtained by long and patient investigation during the whole season, by a corps of observers stationed at several points in the basin, whose duty it shall be to accurately record every phenomenon attending each spring. During my stay I was only able to study the most general features of a very few. There may be many geysers, some perhaps more powerful than those I saw, whose period of action failed to occur while my party were in the basin. Indeed, the "Giantess," described by Lieutenant Doane as being the most wonderful geyser in the basin, was not seen to play by any of my party; while the fine geyser near my camp, named by me the "Comet," was entirely unnoticed by the party visiting the valley last summer. I made careful preparations to measure the height of the latter should it play again, but though I remained three days, principally for that purpose, the following displays occurred in the night, the intervals of rest being about twenty-eight or thirty hours.

**GENERAL DESCRIPTION OF THE GREAT GEYSER BASIN**

Entering the basin from the north and following the bank of the stream, whose direction is about northeast, a series of rapids near together is encountered where the river makes a sharp bend to the southwest, at which point is found a small steam-jet upon the right. A warm stream comes in from the left, falling over a bank 10 feet in height. A short distance beyond a second rapid is found, and then another about 100 yards farther on, where the gate of the geyser basin is entered. Here, on either side of the river, are two lively geysers, called the "Sentinels." The one on the left is in constant agitation, its waters revolving horizontally with great violence, and occasionally spouting upward to a height of 20 feet. Enormous masses of steam are ejected. The crater of this geyser is 3 feet by 10. The opposite "Sentinel" is not so constantly active, and is smaller. The rapids here are 200 yards in length, with a fall of 30 feet, following the bank of the river, whose general course is from the southeast, through with many windings. Two hundred and fifty yards from the gate we reach three geysers acting in concert. When in full action the display from them is very fine. The waters spread out in the shape of a fan, in consequence of which they have been named the "Fan" geysers. A plateau opposite the latter contains fifteen hot springs, of various characteristics. Some are of a deep-blue color, from sulphate of copper held in solution, and have fanciful caverns, distinctly visible below the surface of the water. The openings at the surface are often beautifully edged with delicately wrought figures of scolloped rock. One variety deposits a red or brown leathery substance, partially adhering to the sides and bottom of the cavern, and waving to and fro in the water like plank. The size of these springs varies from 5 to 40 feet in diameter. One hundred yards farther up the east side of the stream is found a double geyser. A stream from one of its orifices plays to the height of 80 or 90 feet, emitting large volumes of steam. From the formation of its crater it was named the "Well" geyser. Above is a fine swamp of cold water, opposite which, and just above the plateau previously mentioned, is found some of the most interesting and beautiful geysers of the whole basin. First we came upon two small geysers near a large spring of blue water, while a few yards beyond is seen the walls and arches of the "Grotto." This is an exceedingly intricate formation, 8 feet in height and 90 in circumference. It is hollowed into fantastic arches, with pillars and walls of almost indescribable variety. This geyser plays to the height of 60 feet several times during twenty-four hours. The water as it issues from its numerous apertures has a very striking and picturesque effect. Near the "Grotto" is a large crater, elevated 4 feet above the surface of the hill, having a rough-shaped opening, measuring 2 by 10½ feet. Two hundred yards farther up are two very fine, large geysers,
between which and the “Grotto” are two boiling springs. Proceeding a hundred and fifty yards farther, and passing two hot springs, a remarkable group of geysers is discovered. One of these has a large crater, 5 feet in diameter, shaped something like the base of a horn, one side broken down, the highest point being 15 feet above the mound on which it stands. This proved to be a tremendous geyser, and has been called the “Giant.” It throws a column of water the size of the opening to the measured altitude of 130 feet, and continues the display for an hour and a half. The amount of water discharged was immense — about equal in quantity to that in the river — the volume of which during the eruption was doubled. But one eruption of this geyser was observed; its periodic times were not, therefore, determined. Another large crater close by has several orifices, and, with ten small jets surrounding it, formed, probably, one connected system. The hill built up by this group covers an acre of ground, and is 30 feet in height.

A hundred and fifty yards west of this are seven hot springs. Proceeding a hundred and fifty yards farther, and passing two hot springs, a remarkable group of geysers is discovered. One of these has a large crater, 5 feet in diameter, shaped something like the base of a horn, one side broken down, the highest point being 15 feet above the mound on which it stands. This proved to be a tremendous geyser, and has been called the “Giant.” It throws a column of water the size of the opening to the measured altitude of 130 feet, and continues the display for an hour and a half. The amount of water discharged was immense — about equal in quantity to that in the river — the volume of which during the eruption was doubled. But one eruption of this geyser was observed; its periodic times were not, therefore, determined. Another large crater close by has several orifices, and, with ten small jets surrounding it, formed, probably, one connected system. The hill built up by this group covers an acre of ground, and is 30 feet in height. Five hundred yards to the right, and partially concealed by an intervening growth of pines, stands a cone of white rock 40 feet high, which sends forth puffs of steam from a small orifice at its apex. It has probably been a splendid geyser, but now nearly extinct.

The deposits constantly forming at the mouth of the craters must eventually close the opening, necessitating the discharge of the water at some other point, and the geyser then becomes either a warm spring or a steam fountain.

From the cone a valley radiates westward, in which a number of interesting springs are found, one having a beautiful curbing of rock, built up in silicate scollops of a perfect pattern. Another has a basin 15 feet deep, its sides covered with obsidian pebbles, while a third has its cavity extending beneath the surface of the ground in the form of a cavern. In the timber between the latter springs and the river are found numerous evidences of extinct geysers. The rock is of the same formation, and broken here and there into sharp ravines and fissures, from whence steam and heated gases are constantly issuing. Two hundred yards above the “Giant,” and near the river bank, is found a fine hot spring of deep water, 15 by 25 feet in diameter. Between the latter and the river are six small jets, with bubbling water beneath. Immediately opposite, on the east bank, is a broad plateau containing five large and small springs, and two boiling springs, one of the latter 40 feet in length. This throws a fountain from one end to the height of 60 feet, at irregular intervals for the space of ten minutes. Just above the latter, on the edge of the river’s bank, are three minute springs, furnishing pretty rills a few inches wide, some 5 or 6 feet below. A hundred and fifty yards west of this are seven hot springs, from 10 to 20 feet across. In the river at this point is a small island, 100 feet in length, with a few pine trees at either end. Between the foot of the mountain and the river the east plateau widens out to 600 yards. Near the large bend in the river, on this plateau, sheltered by a small grove of pine, our camp was located. To the east is situated a very large blue spring, deep and clear, and in the vicinity are found numerous small holes, some bubbling, many discharging steam, and others quiescent. At the base of the mountain, farther south, is situated the “Comet” geyser, which gave us the grand display soon after reaching the basin. The crater of this geyser is very beautiful, though but slightly elevated above the general sloping of the plateau; it might easily be overlooked, should it not happen to play during the visit of an examining party. There are three openings, all of which are apparently connected with the reservoir below. One, a very small aperture, emits puffs of steam similar to the exhaust-pipe of a steam-engine. The large one, in the center, 6 feet across, boils violently during an explosion, but does not throw water to a great height.

The third opening is the geyser proper, from which a towering column ascends to the astonishing height of 200 feet. It is 12 by 18 inches in diameter, somewhat narrowed as it descends, and is of great depth, smooth and straight. These cavities are all lined with delicate deposit of rock, beautifully eamed with silica, in appearance as delicate as frost-work, but hard and strong, requiring the assistance of a hammer to detach fragments obtained as specimens. This deposit usually assumes a spherical form, the outer surface being incrusted with minute beads. Just south of this geyser are three large hot springs nearly in the same line. Near the river’s bank, on this part of the plateau, are found eight hot or boiling springs, differing in temperature and appearance. One of these occupies the extreme point of a projecting promontory, and is in a state of constant ebullition. It deposits a saffron-colored crater 6 feet in diameter, of rare intricacy and beauty. A small one close by, 6 inches across, bears a strong resemblance to a shell. Opposite the latter is a small pearly-gray spring, 4 feet in diameter. Above the promontory the river flows to the northwest for 300 yards, above which point it again changes its course. The second point is marked by an old water-worn cone, fast crumbling away. Between camp and the large blue spring to the eastward is a curious mud-spring, the surface of which is 4 feet below the ground. It is 4 by 6 feet in diameter. The mud is a fine variety of blue clay, boiling-hot. A curious system of steam jets issues from the marshy ground just beyond. Directly opposite this and across is a violent little boiler, constantly shooting up water to
the height of from 3 to 6 feet. Between the two angles of the river, deep, wide channels are being worn in the surface of the rock by streams of hot water flowing from the "Comet" geyser above. The second angle is also a promontory, and contains two geysers near its extreme point; also two large boiling springs, having saffron-colored curbs, rising several inches above the surrounding rocks.

Covering an acre and a half between the "Comet" and the river is a system of fifteen geysers and eight hot springs, varying from 6 inches to 6 feet in diameter; one of which is usually in action, there being scarcely a moment when all are quiet. Two or three of them are very beautiful fountains, with perfect basins of pure white rock, almost as fine as alabaster, while graceful jets of water shoot from their centers, 20 to 50 feet in height. A yellow stream from one flows through a golden-colored channel, from its orifice to the river. Exactly opposite the second promontory a small cone, 5 feet high and 6 feet in diameter, emits a steady flow of steam. Across the river, and 10 feet from its edge, an active geyser is seen, its crater 3 feet by 6 at the surface, and lined with a saffron-colored deposit. One hundred and fifty yards west of this spring, situated upon the crest of a hill, 40 feet above the river, is located the largest and most imposing crater in the basin. It is 325 feet in circumference, and composed of partially disintegrated strata of calcareous rock.

The turret on the tower is 125 feet in circumference, and rises 20 feet above the base. Broken and crumbling masses of rock at the top give a good idea of the battlement turret. The whole structure is graceful in its proportions and details, resembling an old castle somewhat dilapidated. Even the appearance of port-holes is given by small apertures at several points in the turret and base. This geyser has frequent periods of eruption, throwing off a large quantity of steam. The discharge of water is not great, being but a small stream rising to the height of about 60 feet.

At the base is another crater, 8 feet across, having a probable connection with the main vent, and serving to decrease its force. Another small jet is found about 10 feet distant. Fifty yards east of the castle-crater is a beautiful deep spring of very hot water, of great depth, having a raised and scolloped rim a few inches in height, and 20 feet in diameter. This cavity contains perfectly transparent water, though of a blue color, and appears to be a hundred feet in depth. A sounding-line was found to descend 45 feet. Several small steam vents are found near this spring. To the eastward, and lying between the castle and the extreme end of the valley, the ground is swampy and incloses a lake nearly 75 yards in length. The plateau on the eastern side of the river rapidly converges to a point between the river and the timbered hill-side. Here a small stream comes in, fed from a large spring in the mountain-side a half mile to the east. Crossing the stream, another large geyser system is found, and consists of a hill 50 feet high, deposited from the waters of four geysers, situated close together upon its conical apex. These craters are elevated a few feet above the general surface of the crest, and are in a constant state of ebullition, sending forth clouds of steam, and, occasionally, jets of boiling water. One hundred yards to the south is a small hill, containing but one crater at its summit, very irregular and intricate, and leading to an immense cavern beneath the hill. The waters below are quiet. This spring has probably undergone a change from a geyser to a simple hot spring. In time the dome above will crumble and fall in, revealing one of those deep-blue hot springs so numerous in the geyser basins.

Between the two large hills are three small active hot springs, or geysers, from 1 to 3 feet in diameter. Fifty yards beyond bubble and sputter five or six others of about the same magnitude. In this part of the basin new springs are apparently forming; the crust is thin and brittle, rendering investigation somewhat difficult. Here is a large spring of very irregular shape, about 50 feet in diameter, with a thin crust extending several feet over its edge. Passing east and leaving the river 200 yards to the right, several small bubbling springs are found, while upon the crest of the next hillock, 150 yards distant from the group of four geysers called the Chimneys, is another dead geyser, having a high dome and crater, which covers a quiet spring below. Continuing east, over a thin treacherous crust, a fine boiling spring is found on the left, and on the crest of another elevation; fifty yards farther is an active boiler, 6 by 10 feet across, with a curving 1 foot high and 3 feet thick built around it. On the same hill, and forming with this geyser the angle of a triangle, are two other deep springs, with craters, one 5 by 12 feet, the other 20 by 30 feet. One of these three is the Giantess, described by Lieutenant Doane as the most astonishing geyser in the basin. It did not play during either of the three days my party was in the valley, although it may have done so in the night. I am almost certain it played the last night of my stay, as I was awakened by the eruption of the "Comet," and heard, during its action, heavy concussions accompanied by vast
yards east of this group is a deep spring, 6 by 8 feet at the opening, filling a rocky cone 20 feet high and 400 feet in circumference. This has been a violent geyser, but seems to be so no longer. The cavity beneath is very wide, extending in all directions. The covering is of rock, a thin surface, in the form of a dome. There are a great many other springs in this part of the valley, a description of which would be nearly a repetition of what I have said regarding others. No two, however, are exactly alike. One large spring has a natural bridge across it in the center, the rock on either side having broken through.

The banks of the river here are steep and high, and have been elevated by the deposits from several springs still flowing, the water from which trickles down the sides in pretty rills of variegated colors. Upon the opposite, or western, side of the river, some three hundred yards from its bank, stands one of the most interesting craters of the entire basin. This magnificent geyser is the last of the system on leaving the valley to the south, and is situated upon a high eminence overlooking nearly its whole extent. The hill has been built up nearly a hundred feet above the river. The crater is a wonder of beautiful formation, rising by successive steps, or terraces, from its base, 480 feet in circumference, to a central apex 18 feet higher, where a huge fissure in the rock, 2 feet by 7, allows the escape of steam and hot water in a jet of grand and beautiful proportions. The formation of the surface of the upper part of the hill is a net-work of beads deposited upon curved surfaces of intricate design and beautiful coloring. The lace-maker might here find designs for his most exquisite fabrics in the delicate tracing formed round the edges of numerous pools of hot water, renewed every fifty minutes by the action of the fountain. These little pools are but a few inches in depth, are of various sizes, and lined with delicate gray on saffron-tinted porcelain. Around their edges are wrought shell-shaped scallops, which project over the water, having usually a contrasting color with the lining of the cells beneath. This deposit, so delicate and frail in appearance, is really as hard and strong as marble, and can be walked upon without injury. The opening of the crater is also very beautiful, formed of spherical masses of beads cemented together, and having the color of ashes of roses. These beautiful incrustations, from 12 inches to 4 feet in diameter, half way surround the crater, presenting a very beautiful aspect. The continuation of the aperture may be traced for 20 yards along the crest of the ridge, eastward, although now almost entirely closed up. Between its periods of action the crater remains empty for some time, but emits quantities of steam, with a rumbling and hissing sound. Just before the display occurs the water rises in the crater, a few convulsive gushes of water are thrown out, when, with an exhibition of mighty power, a column of water the size of the orifice majestically rises to the height of 138 feet. I obtained this measurement during one of its periods of action, though perhaps not its highest. The display lasts for five or six minutes, when the column becomes gradually shorter until it sinks entirely away, leaving a flood of hot water flowing down the hill-side to the river. Near by are two extinct geysers, their cones dilapidated and decaying under the influences of the climate, being no longer renewed by the hot-water deposits; one is entirely dead, while the other still emits some traces of steam from a small aperture at its apex. These cones are 250 feet in circumference and 10 feet high. Looking down the valley to the west, from the crater "Old Faithful," the view is superbly beautiful, and covers nearly the whole area of the geyser basin, with its thousand steam-jets and graceful fountains scattered so lavishly along both sides of the river, and surrounded with high inclosing hills clothed with rich foliage. No other locality, I think, can be found which combines so many attractions, both of climate and scenery. To the southward is another small valley, through which flows a stream one-half as large as the Firehole River, and which it joins two miles below. In this valley are also found numerous hot springs. These are not so remarkable as those already described. Among the most noticeable is a group of eight beautiful springs inclosed in a single rim of scolloped work 140 feet in length. The interior of this basin is lined with a rose-colored deposit. They are found upon the crest of an eminence, the sides of which have become incrusted with rocky deposits in all directions, and extending off into the adjacent forest, whose dead and withered trees bear evidence of the deadly effect of the hot water which has flowed among them.

Lieutenant Doane, from Fort Ellis, overtook my party while in this valley, bringing orders for the return of the general escort, except the six men previously detailed to accompany me, and six others, with Lieutenant Doane in command, who were to remain with Dr. Hayden's party. As we had seen no signs of Indians, this escort was considered quite sufficient. I had remained a day longer in this basin than I had at first intended, hoping to again witness a display of the Comet geyser and to obtain a photograph of this wonder, and also its exact height. I was disappointed, however, as the periods of action,
after the first, occurred in the night-time. "Old Faithful" and the "Giant" were both measured and photographed while in action. By comparing these with the "Comet" the height of the latter can be approximately estimated, and was, undoubtedly, 200 feet.

On the morning of the 8th I resumed the journey up the valley of the Firehole River, intending to reach the Yellowstone Lake and join Dr. Hayden, who had started the day before. The route above the geyser basin soon became very rough; the banks of the river converged to a canyon whose sides were nearly precipitous, and covered with a dense growth of pine springing from among masses or rock. As we were leaving the valley "Old Faithful" gave us a splendid display by way of a parting salute. We followed the eastern bank of the river, as it seemed less densely wooded, for three miles along the edge of a steep, rocky, and entangled canyon. We now came upon two lovely cascades flowing through a wild cut in the mountain. From a projecting rock Mr. Hine obtained a view of this beautiful gorge and cataract. The country gradually becomes elevated as we advance, and thickly timbered with pine and spruce, intersected with mountain streams of pure cold water. About mid-day we passed a pretty little lake, 500 yards long and 150 yards wide, surrounded with high overhanging hills, their wooded slopes extending down to the water's edge. We found game and Indian trails during a part of the way, but as they usually bore too much to the westward we had to select our route across the country by the compass alone. At one time we ascended the back-bone of a sharp ridge, covered with small obsidian pebbles. From the crest of this ridge a magnificent view of the surrounding country was obtained. The summit was 9,500 feet above the sea, and 800 feet above the valley below. Into the valley beyond we now descended, and soon reached the shore of a lake, probably the Madison [Shoshone Lake], some six miles in length by four in width. We followed the stony and narrow beach about two miles, as far as it afforded a practicable footing for the animals. The rocky mountain-side now coming quite down into the lake itself, necessitated our leaving the shore and ascending the mountain to the eastward. After severe climbing, the height was finally gained, and proved to be of about the same elevation as the ridge crossed just before entering the lake valley. After a tedious and weary march, or rather scramble, through thick forests, over rocky ridges and swampy ravines, our course usually to the eastward, we finally reached a more open valley, leading toward the lake. Upon following this for five miles we were gladdened by a glimpse of the lake through an opening between the hills. Night-fall now approaching, the sight of the lake was very grateful. Pushing on with renewed energy we soon heard two shots, somewhat to the left of our route. We changed our course to that direction, and, crossing a spur of hills, came out at Dr. Hayden's camp, near a group of warm springs on the Yellowstone Lake. We had traveled twenty-five miles in the mountains, probably ten miles farther than the direct distance. Here we found some letters, brought by Lieutenant Doane from Fort Ellis.

August 9 — I sent one of the packers and a member of my escort back to Bottler's Ranch this morning, with three pack-mules for the remainder of our provisions left there on our way up. These men are to return by the eastern shore and meet me in the Upper Valley of the Yellowstone, south of the lake. We are camped at the lake's southwest angle, near a large system of warm springs, and find an abundance of trout in the lake, which, like those previously taken in its waters, contain large white worms, rendering them unfit for eating. The hot springs here cover an area of forty or fifty acres, and extend 400 yards along the lake shore. They are similar in appearance to those heretofore described, though, in point of magnitude and number, generally inferior to those found in the Firehole basin. Their waters contain salts of iron and silica. One large spring, with an opening 5 feet by 7, is seen beneath the surface of the lake, near the shore, affording an opportunity for warm baths, which some of the party enjoyed. A small boiling spring near the shore is remarkable in having a bar across its opening, dividing the aperture into four equal parts. This arrangement served as a convenient clothes-boiler; the soiled articles being carried under the bar on one side, would come out washed at the other. One hundred yards back from the lake is an exceedingly interesting and intricate system of mud-springs, similar to those found in the Firehole basin. There are twelve or more craters, formed from the deposit of mud, varying in color from that of cream to light pink, the consistency of which is about that of soft putty. On exposure to the air the clay soon becomes as hard as chalk. It seems to be nearly pure alumina, containing small crystals of silver. Besides the active springs, there are found numerous hot-mud pools. There is great variety in the color and temperature of the warm springs forming the same group. This is general in all systems. The iron springs often deposit a reddish-brown substance, in flat sheets, floating on the water, and are generally less warm than the clear blue ones. The lake shore opposite the springs is composed of calcareous rock, brittle and easily acted upon by the waves, which have worn out deep caverns into which the rock is constantly crumbling. Few of the springs in this valley are now boiling, and no geysers are seen, though, from the appearance of several cones, I am
led to believe that a number existed here at some previous time. The morning was rainy and clouds prevented astronomical observations at noon. Soon after the weather became clear, and I decided to move camp across the next peninsula and reach before night the rim of the lake beyond. Following the beach three and a half miles and fording two small inlets, the water of which reached the sides of the animals, we left the lake and struck across to the southeast through the forest, finding the timber quite open. We encountered two parallel ridges, between which was a system of small lily-ponds very difficult to cross. They are probably connected with a long, narrow lake still further toward the end of the peninsula. Near these ponds I found Dr. Hayden's trail, who left the previous camp early in the day. The country now became much rougher and obstructed with fallen timber. The slope leading to the lake on the opposite side of the peninsula was found to be very abrupt and the descent somewhat difficult. It was accomplished in safety, and we found ourselves in a charming valley at the head of a sharp arm of the lake, several miles in length, and bounded by high, rocky bluffs on either side, the one beyond rising in a yellow volcanic ridge, fifteen hundred feet above the valley, the upper portion to the north being a sheer precipice.

August 10 — The weather last night was intensely cold, the mercury falling to 26°. The sun coming up bright and warm soon rendered the temperature agreeable. Dr. Hayden and I decided to separate here for a few days, he to take the line of the lake shore, while I purposed moving farther to the west, then following a course fifteen or twenty miles south of the lake, to meet him in the valley of the Upper Yellowstone.

To obtain a view of the country I was about to investigate, I determined to ascend the Yellow Mountain, towering immediately above our heads. Leaving Captain Heap to move the train in a southwesterly direction up the valley, and with directions to camp on the shore of a small lake supposed to lie about ten miles away in that direction, I, in company with Mr. Wood, set out to ascend the Yellow Ridge. The attempt was made from the north, and proved laborious, owing to the broken nature of the surface of the mountain, and the thick timber growing upon its lower slopes. It required two hours of tedious climbing to reach the summit, which was found to be 1,500 feet above the lake. A fine view, of many miles in extent, to the north and west, was obtained. This mountain forms a portion of one of several promontories jutting out into the lake. The great basin of the Yellowstone Lake lay spread out before me. Several other lakes, three or four miles in diameter, were observed to the west and southwest. There were four of these in sight from this mountain.

I now formed the opinion, which subsequent investigation strengthened, that all these small lakes are tributary to the Snake River, which drains the territory lying southwest of the Yellowstone Lake nearly up to its verge. To the southwest is a very conspicuous mountain, a sharp, bold peak, rising far above all others in its vicinity, its sides whitened with numerous fields of snow, while immediately at its base lies one of the pretty lakes just mentioned. The Yellowstone Lake, with its many indentations and its several islands, was spread out at my feet. The lofty volcanic range of mountains bordering its eastern shore rose almost from its waters, while the valley of the river stretched far away to the north, disappearing behind the "Elephant's Back," forty miles distant. Immediately beneath the mountain was the long narrow arm of the lake, at whose extreme point we had camped the night before, while just beyond lay the broad peninsula which we had so recently crossed; its two ridges and the inclosed lake and ponds were plainly visible. The descent to the southwest was difficult, over masses and fragments of volcanic rock, sharp and in some places treacherous to the tread, greatly demoralizing the horses, which were of course led and sometimes driven down the worst places. Before reaching the trail of the party we encountered, in the valley below, dense masses of fallen timber. It was near this valley, last year, that Mr. Everts became bewildered on losing his horse, and wandered for thirty-eight days in the great basin before being picked up, subsisting upon roots and insects. The trail, after it was found, was not very plain, being so greatly scattered in some places that it was almost impossible to trace it. It led over a low divide, separating a small stream upon which we had camped, and which flows into the Yellowstone Lake, from the valley, descending towards the south, and whose waters flow into the Snake River. This valley eventually joins another coming in from the northwest, through which flows a warm creek supplied from a large group of springs along its borders. This stream is 20 feet across, 18 inches in depth, and empties into the small lake at the base of the high snow-covered mountain seen in the morning. The lake is about five miles in length and three in breadth; and from its shape is called "Heart Lake." Here I found the remainder of my party except Mr. Hine the photographer, and one enlisted man. These two had gone back upon the trail of the previous day to find the tripod of the camera, which was missed on arriving in camp.

August 11 — Mr. Hine did not come in during the night. I fear that he was unable to follow the trail and has therefore returned to the lake. I directed one of
the best men of the party to go back there and show
him the way to this camp. Taking Mr. Prout with me,
I climbed the mountain near whose base we were
encamped. Just at the foot of this mountain, near the
lake shore, are four or five boiling springs, one of
which is a geyser of considerable importance,
throwing jets of water, at frequent intervals, to the
height of 15 feet. The mountain is well timbered
about half way to its top, the remaining portion of its
slopes being bare, broken masses of rock, in many
places rising in vertical walls of several hundred feet.
We succeeded in taking our horses 1,600 feet above
the lake; then leaving them at the base of a nearly
precipitous ascent, several hundred feet in height,
climbed to the summit without their assistance. Soon
after leaving the horses I was obliged to abandon my
carbine, the steepness of the acclivity requiring the
aid of both hands. The rock of which this part of the
mountain is composed was constantly disintegrating
and sliding away in avalanches to the valley below.
Immense fields of snow filled the gorges of the
mountain, from which flowed icy-cold streams in
torrents through the lower ravines. In reaching the
summit, which was 3,000 feet above our camp, a
wide stretch of country was visible in every direction.
This mountain occupies about the center of the great
basin. On the opposite side of the crest is a line of
peaks, forming with this one nearly a circle round an
immense conical valley, having the appearance of an
extinct volcano.

The most striking object seen from this point of
observation was the Teton range of mountains to the
southwest, about sixty miles distant. This range rises
high above the broad extent of intermediate country,
which is drained by the numerous tributaries of the
Snake and the Madison, and extends southward in an
almost unbroken wall of steep and rocky cliffs,
terminating in three sharp spires, so tall and slender
that one is reminded of the mast of a ship. To the
north the Yellowstone Lake, the mountain ascended
yesterday, and the valley at its foot, were all
distinctly visible. The outlets of the numerous small
lakes in this portion of the great basin seemed to flow
to the southward into the Snake River. The geology
of this region is volcanic.

I gathered several specimens of rocks from this
peak to take back with me. The western slope of this
mountain is wooded with a scraggy growth of dwarf
pines, bent nearly to the ground by the force of the
west winds, and extending up the slope to near the
crest, terminate in a line exactly parallel therewith. I
passed westward along the connecting ridge to the
nearest adjacent peak, where additional observations
were taken. A fierce storm was now gathering among
the peaks of the Tetons, which would probably soon
cross the valley in this direction. I therefore
determined to return to camp, descending obliquely
across the face of the mountain, over immense tracts
of snow lying in some instances 1,500 feet below the
summit. These snow fields do not probably entirely
disappear during the summer, and are replenished
again early in September. This mountain I have
named Mount Sheridan.

Aner, the man I sent in quest of Mr. Hine and
private Lemans, returned without finding any traces
of them. I was now a good deal alarmed for their
safety, and determined to dispatch the whole
available party early in the morning in search of
them. The night came on wet and gloomy, an
unpleasant prospect for men lost in the forest.

August 12 — After a stormy night, the morning
proved wet, cold, and dreary, with torrents of rain
still falling. The day was spent in an organized search
for the two lost members of our party. Captain Heap,
with two men, went back upon the trail to the old
camp, with directions to follow their tracks, if
possible, until they came up with the men. With two
others I took a northwesterly course across the
country, hoping to find their trail, on the supposition
that they had gone to one of the lakes in that
direction. I followed the valley of the warm creek
flowing into the lake near our camp. This stream has
a rapid descent for two miles, and is fed by hundreds
of hot and boiling springs of the same general
character as those previously described.

I saw some traces of sulphur, and also indications
of geysers, though none were playing. Through the
day we had cold and sleety rains with occasional
squalls of snow or hail. Continuing round the
mountain to the lake lying at the foot of its westerly
slope, I examined the beach carefully for signs of the
lost people, but found none. This lake is about four
miles in length, north and south, and two in breadth;
is pear-shaped, with an outlet at its southern
extremity. After continuing the search until near
night, without finding any traces whatever of the lost
men, it became evident that they could not have
wandered so far away from the previous camp, and
that the other party would probably find them. This
supposition proved correct, as upon returning to the
camp I was greatly relieved to find the whole party
assembled again; the lost men having been recovered
by Captain Heap's party at the other camp, to which
they had just returned, after wandering two days in
the woods. They had suffered very little, having killed
a deer the second morning, which supplied their
immediate necessities.

The following four days were occupied in making
a circuit from this point around to the valley of the
Upper Yellowstone. During this journey the route lay
entirely among the various tributaries of Snake River.
Thus the whole of the great basin was in view from the view of a vast extent of country, bounded by the joining it from the east. We then followed up the masses of lava, as sharp as though just broken, and Gallatin Mountains and "Elephant's Back" on the north, the Yellowstone range on the east, the Wind River range on the south, and the Tetons on the west. This was a trout stream, the fish being very excellent, obliged to follow the rugged bed of the stream at the confluence of two fine branches of Snake River, their united currents flowing to the southwest. This was a trout stream, the fish being very excellent, though shy and difficult to catch.

A broad swampy flat, covered with willows, extends across the angle formed by the two streams, with very little good grazing. The next day we followed down the stream to the southwest for about three miles, to its junction with another branch joining it from the east. We then followed up the valley of the latter, which led in the direction of a prominent mountain, from whose summit I obtained an extensive view of the country far to the eastward. To the north of this mountain lay a sharp ravine, from which ran the branch of Snake River which we had left that morning, and flowing nearly due west at this point. Farther up, to the eastward, the valley of the stream widened out into a beautiful meadow, which point I proposed reaching that afternoon. While I was making these observations, however, the train passed directly across the ridge into the valley below, where it went into camp for the night. This was a mistake, by which I lost the trail and nearly cost me the unpleasant experience of spending a night alone on the mountain, for, upon descending from the summit, and after searching for the trail in the direction I supposed the train had taken, and finding no traces of it, I was beginning to realize that either the train or I had become lost. Just then I observed a light smoke curling upward from the deep ravine three miles below. This served to guide me to the camp.

While upon the summit of the mountain, which I named Mount Hancock, I enjoyed an unparalleled view of a vast extent of country, bounded by the Gallatin Mountains and "Elephant's Back" on the north, the Yellowstone range on the east, the Wind River range on the south, and the Tetons on the west. Thus the whole of the great basin was in view from the same point. The summit of the mountain, which is 10,400 feet above the sea, is composed of large masses of lava, as sharp as though just broken, and showing no signs of disintegration.

From our camp, at the bottom of the ravine, we proceeded up the narrow valley of the creek upon the following morning, finding the trail exceedingly rough, winding over projecting mountain spurs and frequently disappearing in the forests. We were often obliged to follow the rugged bed of the stream at places where the nearly vertical walls of the canyon were inaccessible. The bed-rock of this stream is fine gray sandstone, and resembles the Ohio building-stone. The stream is one of the principal branches of Snake River, has a rapid current, and is subject to severe freshets. At this season it was about 200 feet broad, and generally about 12 inches deep. The banks are from 1,000 to 1,500 feet in height and densely wooded, principally with spruce and pine. Traces of bituminous coal were found along this stream. Six miles of rough traveling brought us to a much higher elevation, where the ravine widened out into a fine valley, the same that I had seen from the top of the mountain the previous day.

From the ridge upon the left I obtained a view of the Yellowstone Lake. This ridge seemed to be the divide between the waters of the Yellowstone and those of the Snake. A small pond which I observed upon the ridge, when full to overflowing, would probably furnish water to both rivers. This ridge is about 1,500 feet above the lake and twelve miles distant to its nearest point. A column of smoke was observed several miles to the northeast arising from burning forests, showing the whereabouts of Dr. Hayden's party.

The animals of my train, particularly the horses, were now becoming a good deal worn, showing signs of breaking down, while the mules were severely afflicted with saddle-galls. The condition of the animals made short daily marches necessary, though the grass was generally good and water abundant. Continuing eastward we crossed some very fine valleys on the 16th, and began the descent of the mountain range separating the waters of the Snake from those of the Upper Yellowstone. This range, upon its lower slopes, is thickly timbered, though by following the crests of radiating ridges less timber was encountered than in the ravine. Glimpses of the Tetons were observed to the southwest from time to time, though until the crest of the ridge was reached but little of the surrounding country could be examined, owing to the intervening timber. On reaching the summit, however, some 1,100 feet above the last camp, the view in all directions was grander and more impressive than any I had before seen. I was completely surrounded with wild mountains, whose sides were precipitous rocks 1,500 to 2,000 feet in height. The valleys were canyons. The summits of the mountains spread out into rolling prairies in many places, bearing grass and flowers. Small lakes were seen at frequent intervals, their waters supplied from the immense fields of snow, which undoubtedly remain during the entire summer. Signs of game abounded, among which were found tracks of the grizzly and the black bear, mountain sheep, elk, and deer.
Descending the valley to the east we found a small cold stream flowing northeast, which joins the Upper Yellowstone a few miles below. Here we went into camp, and with Mr. Prout I ascended the opposite mountain on foot. This proved to be a spur from a vast plateau reaching back to the south, between two branches of the Upper Yellowstone. From this plateau the Teton range to the southwest was distinctly visible, also a high basaltic wall on the south and east. To the northwest a distant view of the Yellowstone Lake was obtained, through a gap in the mountains. To the northeast stood a remarkable tower, crowning the crest of a very high mountain and bearing a striking resemblance to a castle. The valley to the north is a broad open plain, nearly level with the Yellowstone River, winding among masses of dense willows. A small sheet of water, which is called Lake Bridger on the old maps, was seen in this valley. Returning to the camp across the plateau we encountered a large grizzly bear and cub. Not being armed or mounted we made a safe detour of the monster, and returned to camp.

On the 17th we moved down the valley, over a swampy and difficult country. The stream rapidly descends over a rocky bed, and finally plunges through a canyon, by which it enters the valley of the main river below. Passing to the left of this canyon, and descending a steep but thickly wooded terrace, we entered the valley of the Upper Yellowstone. This valley is nearly level, surrounded by conglomerate rock, so worn by the elements as to give them the appearance of basaltic formation. From this point to the Yellowstone Lake the distance is about eighteen miles, the valley being two and a half to three miles in breadth. The river here is, however, half as large as the Yellowstone below the lake, and is formed by the junction of five streams, which unite their waters near this point.

This part of the valley I named Five Forks. Between these streams are radiating mountain spurs rising 2,000 feet above the valley, adorned with upright columns and projecting terraces of great architectural beauty. Crossing the valley are several broad trails, which, it is said, were formerly used by the Indians in passing from the head-waters of Clark's Fork, on the Stinking River, to the valley of Snake River. It was my intention to have explored at least the principal branch of the Upper Yellowstone as far as practicable, but the condition of the animals was now such that I feared they could do little more than make the return march to Fort Ellis. Our provisions were just exhausted, and the arrival at this point of fresh supplies, sent for from the west side of the lake on the 9th instant, relieved my anxiety in that respect. These stores would, however, be no more than sufficient to last us to Fort Ellis, traveling as slowly as the poor condition of the animals rendered necessary.

From observations on the march through these mountains, and from information derived from the packers who accompanied me, I am led to believe that a practicable road possibly a railway can be constructed from the Yellowstone Lake south to Snake River in the direction of the Tetons. The connection, however, of the Upper Yellowstone with that of the Wind River would be attended with great difficulties. An attempt to follow the Yellowstone to its source, then to cross the lofty range of mountains separating it from the Wind River, would, I think, with pack-animals in good condition, be attended with success; and although no pass through this range in this vicinity has yet been discovered, it is possible that a narrow one may exist. A glance at the map will show a natural route for a railroad, connecting the Pacific lines, by way of the Yellowstone, were it not for the difficulties to be met at this one point.

The 18th and 19th were passed in marching from the valley of Five Forks down the Upper Yellowstone to its mouth at the lake. This valley becomes wider as we descend, and continues nearly level, the river winding from side to side among dense willows and swamps, and rendering it necessary in traveling to keep along the base of the mountain. The hills and the mountain-slopes above are all thickly clothed with timber. The small streams flowing into the river were invariably obstructed with numerous beaver-dams, which form a continuous chain of ponds through the smaller valleys. About half way down the valley I descended the ridge to the east, crowned by the castle-topped summit above mentioned. The walls of this rock were about 400 feet in height, vertical, and in some places inclining outward. I spent an hour trying to find a fissure through which I could ascend to its top, but without success. The elevation of the mountain at the base of the tower is 2,000 feet above the valley. The height of the loftiest pinnacle of the tower is probably 10,500 feet above the sea. The rock is composed, for a distance of 20 feet above its base, of conglomerate, the same as the material of the ridge below, while farther above are strata of fine hard sandstone, the extreme top being of lava. In the east side were two large caverns with arches supported by a pier of fine proportions. A rain-storm now coming on, I descended the mountain (this mountain was named Mount Humphreys) and encountered a small lake on the way. The storm increased, rendering the passage through thick undergrowth anything but pleasant. I finally reached camp on the lake-shore just beyond the mouth of the river, thoroughly drenched.

August 20 — We experienced last night the singular sensation of an earthquake. There were two shocks,
The country was not, however, remarkable, being as soon as possible. This march was made hurriedly. Steam in heavy and regular concussions. Lake, situated near a small rocky promontory called the mountain range beyond. Several streams, of no lake-shore, and make a junction with the other party having seen no evidence of Indians whatever, I Although I had little apprehension on that score, I deemed it prudent to continue the march along the shore of the lake, I ascended the mountain-slope rising to the east. Upon this slope I found numerous evidences of warm sulphur-springs, though none which were particularly noteworthy. In overtaking the train six miles from camp, I learned that the party were laboring under great excitement regarding Indians, the feeling being that a considerable party were in our vicinity, but were concealed in the forests awaiting a favorable opportunity to attack us. Although I had little apprehension on that score, having seen no evidence of Indians whatever, I deemed it prudent to continue the march along the lake-shore, and make a junction with the other party as soon as possible. This march was made hurriedly. The country was not, however, remarkable, being thickly timbered and rising rapidly from the lake to the mountain range beyond. Several streams, of no great magnitude, rising in the mountain range, were crossed during this day's march. We found the doctor's camp within four miles of the outlet of the lake, situated near a small rocky promontory called "Steamboat Point." This name is derived from a large and violent steam-vent, throwing out a vast volume of steam in heavy and regular concussions.

August 21 — Remained in this camp during the day, allowing the animals to rest after their hard march of the day before. A small party returned upon the trail to recover a mule which had strayed from the train yesterday. In this search they were successful, and returned with the mule toward night. Besides the large steam-vent, which is the distinguishing feature of this locality, there are many smaller ones and several sulphur springs. The rock is of volcanic origin, immense masses of which are distributed in wild confusion along the shore. Frequent earthquake-shocks were felt by the party while at this camp. At such times the large steam-vent became more active, sending forth increased masses of steam with the roar of a cataract.

On the 22d I left Dr. Hayden's party continuing their geological investigations at Steamboat Point, and moved down the east bank of the Yellowstone as far as the falls. The course lay along the lake beach for about two miles, upon which I gathered several interesting specimens of mineral. Leaving the beach, we crossed a small prairie to the northwest, and entered a dense wood. Here the fallen timber delayed our march about ten hours. Beyond this we crossed Pelican Creek, a small stream coming in from the northeast. Beyond this stream I found the country more open, with occasional groves and parks of meadow land. On reaching the bank of the Yellowstone a fine broad trail was found, upon which, through shady avenues of pines, our train traveled without difficulty. About 1 p.m. we arrived opposite the mud-spring and volcano, seen on our route up the river. The volcano was still sending forth its vast columns of steam far above the surrounding hills. Here on this side were several small rills of icy cold water, pouring from the side of the mountain in rapid streams as from a hydrant. On reaching the falls we went into camp on a small grassy plateau, fifty yards from the brink of the upper fall, and immediately above the rapids. Just below the fall I descended to the bottom of the canyon, 200 feet in depth. In this little canyon, just between the upper and lower falls, were caught some very fine specimens of trout. During the night the concussion caused by the falling water reminded me of the earthquake felt on the lakes a few nights previous.

August 23 — I determined to remain over here to-day for the purpose of exploring the grand canyon below the lower falls. I expected this to be an undertaking of great difficulty, and attended with some danger; but entering a sharp and narrow gorge or fissure in the side of the canyon, immediately below the great fall, I found the descent much easier than was anticipated. It proved to be very steep; but the rock being solid, with projecting angles, there was little danger to a careful climber. A slope of loose and finely broken rock, a hundred feet in height, moist from the falling spray, terminated the descent. Sliding to the bottom of this slope, I stood on the foot of the great fall, 350 feet below its crest, the walls of the canyon rising 700 feet. My first impression on beholding this fall from below was one of disappointment; it did not appear as high as I expected. The fall, however, was grand, and presented a symmetrical and unbroken sheet of foam, set in dark masses of rock, while rainbows were formed in the spray from almost every point of view. The steep rocks near the falls, constantly wet with rising mist, were covered with vegetation of an intensely green color. The river below runs with the velocity of a torrent, rushing down declivities, spinning round sharp angles, and dashing itself into spray at every turn. The walls of the canyon are composed of soft disintegrating rock, the prominent color being yellow, intermixed with various shades of gray and red. The
rocks are constantly crumbling down, leaving steep ridges and sharp pinnacles hundreds of feet in height, standing out from the walls. I found it impossible to follow the bed of the stream, the steep and slippery side affording no footing whatever, and crumbling at the slightest touch. A view of the canyon from any point is very impressive, particularly so from the foot of the great fall. After ascending from the canyon I followed its eastern crest several miles down, finding that the depth increased rapidly, owing to the rising ground on approaching the cut through the "Elephant's Back," and also to the descent of the river, down numerous cascades along its channel. The views at all times were grand and magnificent.

August 24 — We have suffered a few days past from the buffalo gnat, a small fly, which attacks men and horses, causing severe swelling and itching. We encountered them in the greatest numbers near the outlet of the lake, and brought some of them with us to this camp. They are the first insects that have given us serious annoyance.

From our camp at the falls we struck across to the northeast toward the valley of the East Fork, making only nine miles the first day, owing partly to a late start, caused by the straying of several animals just before packing. Our course was along the valley of "Sour Creek," so named from its perceptibly acid taste. The country was at first generally open, though soon after passing a ridge and valley covered with steam jets the hills became more heavily timbered. On reaching a fine valley with cold streams coming in from the southeast, I went into camp for the night, reaching a fine valley with cold streams coming in from the east. The horse of one of the escort gave out before ascending the crest of the divide, and had to be abandoned. We entered the valley at the junction of two branches of the East Fork, one coming in from the east, the other from the southeast. The valley at the forks of this stream is four miles wide, and is a rolling prairie, with groves of trees and thickets of willows along the river banks. The larger branch forks about three miles up, and still a few miles above breaks into numerous small streams, finding their source in the high mountain range to the east. Many peaks of this range are distinctly seen from this part of the valley. They are very conspicuous, rising probably more than 12,000 feet above the sea. I expected to have met Dr. Hayden's party in this valley, but saw his train depart down the river just as I descended the mountain. Numerous bands of antelope were seen skipping over the prairie while we remained in the valley.

August 26 — I had intended sending the train down the valley and across the Yellowstone River to-day, while I would overtake it, after ascending one of the mountain-spurs in this vicinity for observations upon the surrounding country. But as the morning broke dark and rainy, the latter part of my plan was abandoned, and I accompanied the train on its march down the valley. We kept along the foot of the hills, on the southern side of the river, avoiding swamps and stony places nearer the stream. The valley is from two to five miles wide, the soil generally poor, except immediately along the river's banks, where many of its terraces are fertile, and would probably answer well for general farming purposes. The mountains on either side continue down to the Yellowstone Valley, though broken by ravines, through which issue small mountain streams. The largest of these joins the East Fork near its mouth, coming in from the northeast, and is called "Slough Creek." We crossed the Yellowstone upon the bridge noted on my route up the river, and halted near the old camp at Meadow Brook. Here the tents were pitched and we remained
over the following day, allowing the animals to obtain food and rest. Two packers crossed the river and returned the next day, bringing with them the carcasses of an elk and deer. We were now provided with fresh meat for the remainder of the journey.

*August 28* — We set out upon the return to Fort Ellis by the same trail over which we passed more than a month ago. Ascending the mountain's side, familiar objects met the view at every step. We soon reached the little canyon at the crest of a mountain 1,400 feet above our camp of Meadow Brook. Making a cut-off here, we passed over a hill literally covered with agates, many beautiful specimens of which I gathered as I passed along. Thence across Black-Tail Deer Creek, down the canyon of Gardner's River, and, arriving at the “Soda Mountain,” camped at the foot of its eastern slope, in a small ravine containing a spring of cold water. A luxurious bath-tub has been hollowed from the slope of the rock, having both hot and cold water conducted to it, in which I took a delicious bath. My impressions of this mountain of springs, formed a month ago, were not quite realized now; still, it is very beautiful, and should be classed among the first natural curiosities of the region. As we passed down the valley the following day, to the little canyon of the Yellowstone, the trail seemed very easy. The hill-sides are barren, the grass dried up, and the contrast from the luxuriant vegetation of the lake basin was very marked.

William A. Jones, 1841 - 1914.
After Yellowstone Park was set aside as a national trust in 1872, it quickly became a focus of scientific interest and a goal of official junkets. Few tours of the later 1870’s and the 1880’s were authentic explorations, valuable though they were for explaining the natural phenomena of the region and for bringing both the problems and the potential of the park before the public. But at least one more exploration of the first order took place when Capt. William A. Jones reconnoitered the area in the summer of 1873, as part of a larger survey for military defenses in northwestern Wyoming. The purpose of his journey through Yellowstone was to discover, “if possible, a good route from the south, via the Wind River Valley and Upper Yellowstone, into Montana.”

Jones, who would return to the park in the early 1890’s to supervise construction and improvement of roads and bridges, was well trained for his first Yellowstone assignment. His prior service included field duty in the Civil War and a term as assistant professor of engineering at the U. S. Military Academy. As engineer of the Department of the Platte, he witnessed completion of the Union Pacific Railroad in 1869 and led an expedition into the Uinta Mountains in 1871. Reflecting his intellectual bent and geological expertise, the report of his expedition of 1873 included not only elaborate topographical maps and a general descriptive journal but also separate sections on physical geography, meteorology, and the new Yellowstone route to Montana. Appended to the report were detailed studies by two eminent scientists, botanist Charles C. Parry and geologist Theodore B. Comstock, who accompanied the expedition; an entomological résumé by J. D. Putnam; an analysis of mineral and thermal waters by Army Surgeon Charles L. Heizmann; and the astronomical observations of Jones’ assistant, Lt. Stanhope E. Blunt. All in all, it was a substantial contribution to knowledge.

Succeeding where others had failed, Jones found a passage through the high Absaroka Range near the head of Stinkingwater or Shoshone River. Entering the park near the creek that bears his name, he experienced the thrill of discovery. Considering how many previous explorers and adventurers had been thwarted by these imposing ridges Jones’ excitement is easily appreciated:

After the Indian guides, I was the first to reach the summit of the pass, and, before I knew it, had given vent to a screeching yell, which was taken up with a wild echo by the Indians; for there, seemingly at their feet, and several miles nearer than I had expected, was spread out a scene of exceeding beauty — Yellowstone Lake — embosomed in its surrounding plateau, and a mass of green forest extending as far as we could see. Slowly, and in single file, the remainder of the party came toiling and panting up, leading their animals, and, in spite of lack of breath, each gave the same involuntary yell as the wonder-land burst upon their view. Perhaps there was something that moved us in the broad and startling contrast between the dreary deserts, the sage-brush plains, the awful and majestic mountains, and that broad expanse of fresh, hazy, and sensuous beauty that looked up so invitingly at us from below; but there was also the proud feeling that we had crossed the “impassable” mountains.

After visiting the major wonders of the park, traveling by way of Mammoth Hot Springs, Tower Creek, Mount Washburn, the Grand Canyon, Mud Volcano, and the Lower Geyser Basin, then back to the lake by way of the Upper Geyser Basin, Jones again made history on his way out of the park. First, he verified the existence of Two-Ocean Water, a place where, as Bridger had for years insisted, water flowed
simultaneously to both the Atlantic and the Pacific. Moreover, Jones discovered a passage, Togwotee Pass, over the Continental Divide between the Snake and Wind Rivers. In crossing the mountains to the south of the park, he noted with pride that he had again conquered the “impassable barrier never scaled by white man or Indians.”

Inspired by the beauty and uniqueness of the area, Jones predicted that Yellowstone would eventually “become the most popular summer-resort in the country, perhaps the world.” His success in twice piercing the Absaroka Range would, in time, prove instrumental in opening the park to wonder seekers from every corner of the globe.

REPORT

Omaha, 1874

DESCRIPTIVE JOURNAL

Saturday, August 2 [1873] — Broke camp at 8:30 a.m. and marched 14.4 miles across the divide and into the Yellowstone basin, about one mile from the pass. The trail was excellent, except the short spurt of ascent into the pass, which was severe. This slope is on a friable volcanic sandstone, carrying but little soil, and smooth and bare in many places. The horse in the odometer-cart broke down completely at this spot, and the cart had to be left behind.

After the Indian guides, I was the first to reach the summit of the pass, and, before I knew it, had given vent to a screeching yell, which was taken up with a wild echo by the Indians; for there, seemingly at their feet, and several miles nearer than I had expected, was spread out a scene of exceeding beauty — Yellowstone Lake — embosomed in its surrounding plateau, and a mass of green forest extending as far as we could see. Slowly, and in single file, the remainder of the party came toiling and panting up, leading their animals, and, in spite of lack of breath, each gave the same involuntary yell as the wonderland burst upon their view. Perhaps there was something that moved us in the broad and startling contrast between the dreary deserts, the sage-brush plains, the awful and majestic mountains, and that broad expanse of fresh, hazy, and sensuous beauty that looked up so invitingly at us from below; but there was also the proud feeling that we had crossed the “impassable” mountains.

There was no time to be lost, however, and I ascended a neighboring peak in company with the theodolite-and-barometer observers, to do the important work that was now presented to us. From this point it could be seen that Yellowstone Lake lay in a broad and high rolling plateau, densely covered with trees; that from it, to the west and south, there are no mountains except Mount Sheridan and the Tetons, and that the country probably slopes off gradually in those directions into the basin of Snake River. We found fresh tracks of mountain sheep exceedingly numerous, but there was so much noise that they took the alarm in time to get out of sight. Two bears came down to witness our passage, but the hostile demonstrations of our Nimrods scared them away.

We reached the camp of the main party at sundown, when it appeared that Dr. Parry and the two white guides were missing.

I have named these mountains “The Sierra Shoshonee” [Absaroka Range], because the right to name them is clearly mine, as I have been the first to cross them and mark out their geographical position and extent. Professor Hayden has called what he has seen of them and their western border sometimes the “Snowy Mountains” and sometimes the “Yellowstone Mountains,” but he has also applied the latter name to a range lying south of Yellowstone Lake, that has no existence.

Sunday, August 3 — Owing to a miserable contretemps, this day was lost. The trail to the lake was not found by 2 p.m., so I had the train unpacked, and went into camp without making any move. This camp was in a small opening in the forest, near a very large, gushing spring, whose temperature was 38° F. There are also, close by, some bubbling gas springs from pools of water at 38° F., that have regular one-minute intervals between times of maximum action. The gas is sulphurous acid.

Grass was very scarce and poor about camp. Measures were taken in the morning to discover our whereabouts to the supposed lost members of the party, and the odometer-cart was brought in. At 2:30 p.m. I took four packers and went back to the old trail, which we rapidly followed down to the prairie on Pelican Creek that was open to the lake. Returned to camp at 6:30 p.m., where I found a note from Captain Noyes, informing me that he had made his way to the lake, and that the three missing persons were there, and not likely to suffer, as they had killed an elk.

Monday, August 4 — Broke camp at 9 a.m., and marched about eighteen miles, to the outlet of the Yellowstone Lake. The last of the three odometers
gave out to-day. About six miles from camp we came upon a lake of warm water, with a multitude of diminutive hot sulphur and gas springs on its eastern shore, and some large springs breaking out from beneath the water near this shore. It is the recipient of quite a stream of pure cold water from the mountains, and has an outlet into Yellowstone Lake. On the south side of the lake is a small mud-puff, steaming and fuming away, depositing various forms of sulphur. Two kinds of rock seem to be forming in its immediate vicinity; one a conglomerate from the surface-material. A careful study of the way in which rocks are decomposed and others formed from the resulting material by the hot steam and gases from the springs of this basin ought to throw light upon the dark subject of metamorphism.

On Pelican Creek, in the timber about six miles farther on, there is another system of depositing-springs, supplying a large mass of red earths and recently-formed rocks. An analysis showed the existence in those deposits of chromium, a rare mineral.

The trail down the mountain side was through a dense forest, very much obstructed with fallen timber. Along Pelican Creek is a strip of rolling prairie, with marsh close by the stream, while near its junction with the lake the greater portion of its valley is marsh. This prairie is the home of great numbers of field mice and moles, which have burrowed up the ground to such an extent that it is traveled over with difficulty. The same is true of a great deal of the open country in the Yellowstone basin. Along the north shore of the lake the timber is interspersed with many grassy openings.

**Tuesday, August 5** — I sent the pack-train to Fort Ellis for supplies. It was accompanied by Captain Noyes and the escort. Lieutenant Hall and a few men remained with us. There is very little, if any, danger from hostile Indians in the park at present. Small parties of Bannacks, Mountain Crows, or Snakes ("Sheep-eaters") might try to steal something, but they are arrant cowards.

As far as my observation went, good camping grounds for parties of ordinary size can be found almost anywhere in the basin.

At this camp a complete series of astronomical and hourly meteorological observations was instituted and continued during our stay.

Two p.m. found the beach sprinkled with explorers, spread out at full length, with strained eyes close to the sand, waiting for a crystal to "pop up." The sand is full of clear, sharp but diminutive crystals of different minerals, mostly silica. These crystals are perfectly shaped, and quite beautiful. They come from a porphyritic-trachyte with glassy feldspar and silica, that occurs among the igneous rocks of this region. Much of the quartz is amethystine. The north shore of the lake has a long, shallow, sloping beach of soft sand, very convenient for bathing. The temperature of the water varies between 50° F. in the morning and 65° F. in the evening. It is influenced considerably by the heat of the sun, but at any time is cold enough to break down the constitution of the strongest bather if persistently applied. I have ventured to name this place Crystal Beach for the benefit of future poets and sentimentalists.

We find, as others before us, that the trout of the lake are perfectly splendid in size and condition, but are full of parasitic intestinal worms, which leave the intestines and enter the flesh.

The forest here is made up almost exclusively of pine (*P. contorta*). Toward the lake their branches are stunted and bent upward toward the trunk, while on the north side (from the lake) they grow out long and free. The contrast is very noticeable, showing that the prevailing storms come from the south (southwest?). This is to be expected as the basin is all open toward the south and west, and is completely hemmed in by high mountains on all other sides.

**Thursday, August 7** — While breaking camp this morning a party of horsemen were discovered upon the other side of the river. They proved to be a party of officers from Fort Ellis.

After placing in a cache a lot of provisions and material, for which we did not have transportation, we started at 12 m. and marched fifteen miles to Yellowstone Falls. The river near the lake is not fordable, and generally between the lake and the falls is unfordable. Just below the mud volcano there is a ford that can be used late in the season. Our Indians stopped here, where they crossed the river to await our return upon the other side.

Two of my topographers started down the river upon a rude raft which they had constructed, expecting to get down to the falls before the main party. They were to sketch the stream and make soundings. Unfortunately about six miles below the lake they were swamped in some rapids, whose existence they had not discovered in time, and were obliged to abandon their raft, from which they escaped with much difficulty. They did not reach camp that night.

The trail is very good, about eight miles of it next to the falls being through open country. Some very fine springs occur opposite and a little below the mud volcano. Along the streams there is considerable marsh, and also along the river just above the rapids.

**Friday, August 8** — Decided to remain at this camp two days. We are following the trail of Captain Noyes, which here runs into the direst confusion,

47
branching off here and there, but each part always returning upon itself. They have evidently lost the trail and have been hunting for it. We had no guides who were conversant with the country about the lake, and I had trusted to our ability to pilot ourselves by the map of Captains Barlow and Heap, United States Engineers, who were here in 1871. I sent the guides out to find a continuation of the trail, and afterward visited the upper falls and examined the rocks in the canyon and about the falls with much care. With Lieutenant Blunt I went below the fall. This required some pretty nasty climbing along the water’s edge about the immediate approach, perhaps not so much from the actual danger as from the moral effect of the terrible torrent just below, which seemed to clamor and roar at the prospect of a misstep by the human intruders upon a smooth, slimy shelf of rock, scarcely wider than the foot, which had to be passed at one place. Ten or fifteen feet from the mass of falling water, just on its flank, and a little to the rear, farther progress became impossible, for here the loose debris which occurs at intervals along the torrent’s edge gives out, and one stands against the face of the vertical wall of the fall gazing into the cauldron of unknown depth, which the impinging water has worn into the igneous rock, softened and disintegrated by the heated gases and vapors from God’s awful laboratory beneath. By the barometer the height of this fall is 150.2 feet. Its beauty is really remarkable. The water contributes beauty of form and color, and the rocks grandeur, as from their vertical jointage they weather and are worn into vertical walls, sheer and straight, of tremendous height. Just before taking the leap, there is a sharp bend in the channel, which narrows considerably and wears out below, and to the right a huge semicircular precipice. The rocks are a porphyritic trachyte, and a loose conglomerate containing quite a large variety of igneous rocks. This conglomerate will repay future study.

We then went to the lower fall, but became separated on the way. He [Blunt] descended to the bottom of the canyon below, while my progress became obstructed at the verge of a precipice about 80 feet high, springing up from the seething waters close by the flank of the fall. The rocks, like those about the upper falls, weather vertically, and, from greater decomposition, into pinnacles and isolated slopes of debris lying thin on the softened and disintegrated surface.

I did not enjoy the sight of this fall at all, as my attention was constantly diverted to the steep and narrow gulch in the rock, at whose foot I stood, fearing that Lieutenant Blunt, whom I expected down every moment, might, by accident, start a loose stone from the debris, a mishap which would have inevitably knocked me into the waters below. Besides, there was just above me a huge drift of snow, and I began to feel certain that the time had come for it to be a small avalanche. I scrambled up the gulch with considerable difficulty, and soon found myself in camp with clothing thoroughly saturated from the spray about the falls.

During the early morning I had visited a mass of hot springs and gas-vents on the sides of a hill near camp. It seemed to me that I saw here evidences of the disintegration of the rocks by the hot waters, gases, and vapors from the springs.

I have noticed that whenever there is a mass of gaseous springs, either in action or extinct, if they come from a hill-side, the whole mass of rocks adjacent is disintegrated and of yellowish and white color.

Some of the party, while walking down the river along the edge of the grand canyon, stumbled across what is probably Captain Noyes’s trail. Progress in this direction had been considered impossible. It afterward appeared that he had pushed ahead, making his own trail, after having lost half of one day in looking for the old one, which had become indistinct.

Saturday, August 9 — I sent back to the cache for extra supplies, and taking a small party, including Lieutenant Blunt, Mr. Hitt, and Mr. Putnam, returned to the lower fall, where we descended to the bottom of the grand canyon. We could not approach nearer than about 100 feet from the fall. The water in the river is quite high for this season, and probably at a low stage a nearer approach can be made; but not much nearer, for soon the rocks at the water’s edge slope smooth and almost vertical into the torrent, and no debris can remain along the edge of such a tremendous current; besides, there is such a dense cloud of spray that nothing could be seen even if a nearer approach were made.

I have noticed no hot springs along the river between the falls, although there is abundant evidence of their former action; but immediately below the lower, or great falls, they are quite numerous, oozing and spouting from holes in the solid rock. Here I saw three that threw up slender columns (about half an inch in diameter) of very hot water, two or three feet high, like a fountain. The flow was continuous. A similar one across the river was just below the water’s edge, and is only seen as the waves recede. Down the river little columns and clouds of steam gave evidence of the existence of numerous others. I infer that there are many of these hot gas and water springs, active and extinct, along the channel of the river through the grand canyon. Other explorers report their existence wherever they have reached the bottom of it. Of those that we could
MAP

Military Reconnaissance

North Western Wyoming

Made under the direction of
Brigadier General E.O.C. Ord
Commanding Department of the Missouri

by

Captain W.A. Jones

1873
The Grand Canyon and Lower Falls of the Yellowstone River.
examine, the greater number issued from clean holes in the hard, smooth (water-worn), rock. Probably the material deposited from the water gets washed off, while the gases stain the neighboring rocks. One spouting spring, however, had built for itself quite a symmetrical bee-hive-shaped mound of silica.

By improvising a horizontal sight we set up the barometer at about the level of the bottom of the fall, after which we ascended to its crest. We were on the right bank, where there is a narrow ridge, very steep, with loose dirt on it, which leads down to the crest of the fall. We set up the barometer here, with the feet of the tripod in the water, at the only spot where the water's edge can be approached at all. The sharp ledge of rock here overhangs the precipice, and may fall off at some future day.

From this point one gets the fullest idea of the grandeur of the fall. The depth of the cut seems immense, and the effect is heightened by the tremendous vertical wall on the right, which has a sheer height of fully 500 feet. On the face of this mighty gash in the rocks the column of falling water dwindles and appears small, and this, perhaps, is the reason the effect of the fall is not so impressive from below, or even from the bottom of the canyon; the volume of water appears small in comparison with the great height and mass that encompass it. The fall is so great that the whole volume of water seems to break into drops and spray before it reaches the bottom, and the chasm for one-third of the height from the bottom is filled with a mass of white vapor which very much lessens the apparent height to the eye looking from below. But looking down from the crest, one gets the full effect of the great height. The chasm is so deep that the trees along the bank have but a slight effect in the beauty of the surroundings. The height of the great fall from our measurements (barometrical) is 328.7 feet. This differs from the results obtained by previous parties, but from the satisfactory manner in which our altitude work checked itself, I think it can be relied upon as a reasonable approximation. After examining the rocks from the top of the canyon above the upper fall to the bottom of that below the lower fall, with a view of arriving at an explanation of their origin and the attendant phenomena, I find that at the upper fall the rock is mostly a hard porphyritic trachyte, and Professor Comstock saw two or three dikes of trap. Higher up, and outcropping between the falls, a layer of coarse, soft sandstone (conglomerate), apparently horizontal, and distinctly stratified, occurs. It carries a good deal of obsidian in coarse grains, and its debris covers a good deal of the country on both sides of the river. Below this, and to the bottom of the upper canyon, occur an amygdaloidal conglomerate; a very coarse conglomerate (rather breccia), containing reddish-brown sandstone and obsidian, with well-marked cleavage; a coarse, friable stone, made up of grains of spherulitic obsidian; and the hard porphyritic trachyte observed above the fall. Between the falls I observed no marked change in the character of the rocks. A yellowish color appears just above the lower fall, but it is only on the outside, and is evidently a stain. About and in the Grand Canyon the rocks are nearly all tinged a brilliant yellow, and along the walls are weathered largely into pinnacles with their summits tinged reddish brown. Everywhere that I broke the rocks the fracture showed clearly that the yellow color was only a tinge, and revealed their igneous character, and I tested some of the most marked specimens. I found the same hard porphyritic trachyte and granular obsidian rock that occurs above. Close by the hot springs in the canyon the trachyte carries the strongest tinge of yellow (sometimes whitish), and is sometimes converted into a cellular rock, the imbedded crystals having evidently been destroyed.

I therefore suggest, in explanation of this phenomenon, that during a former period, when Yellowstone Lake covered a much more extensive area than now, the line now occupied by the river below the lake, especially from the falls downward through the Grand Canyon, became the line of escape for the hot gases, vapors, and chemical waters from the volcanic depths below: that their action softened and disintegrated the rocks until the waters of the lake could wear them away and form the present river-channel. There is evidently a sudden break in the quantity of this action at the falls, with its maximum effect below; consequently the Grand Canyon commences in a very marked manner. This view is further supported by the fact before alluded to, that generally where these hot springs come out of the side of a hill, that side is excessively eroded and the rocks stained yellow. In the deep traverse gulches that lead into the Grand Canyon from the east, there is an excessive quantity of thermal and gaseous spring action. In many of these spots I have noticed what appeared to be solid rock, with the greatest similarity of outward contour to the undoubted igneous rocks close by, into which the finger could be thrust with ease, although the interior would be found very hot. A further examination than I had time to make would prove whether or not these are igneous rocks disintegrated by heat and chemical action, as I am much inclined to believe.

As the jointage is vertical, or nearly so, the walls of the canyon weather vertically.

Notwithstanding the remarkably extensive evidences of volcanic action, we have seen nothing yet that could be satisfactorily identified as an extinct crater.
Mount Sheridan provides a background for this photograph of Yellowstone Lake.
The original Baronett Bridge, built in 1871, was the first bridge built across the Yellowstone River.
Deer-flies (a kind of horse-fly), mosquitoes, and gnats are very numerous below the lake, and future travelers should be well supplied with netting, both for themselves and animals. They are not troublesome at night, owing to the cold. In other mountain localities they disappear with the extremely cold nights of July, but here, in the vicinity of the hot springs, they find plenty of warm rocks to roost upon when the nights are cold, so they can live on for an indefinite lateness of season.

Sunday, August 10 — Started on the march at 10 a.m., with the pack-mules very heavily loaded. The trail, for a considerable distance, follows close to the canyon through a dense wood, and is quite difficult. Marched twelve miles to Orange Creek. Much of the cargo had to be thrown off on the way, to be sent back for on the following day. The chief difficulty was in getting through the thick timber, which had not been sufficiently cleared away.

Monday, August 11 — Remained in camp. Provisions are getting low; sent back to the cache for what was left there. One of our cooks was lost in the forest, and remained out over night. I felt much worried, because it is a serious thing for a man to get lost in these forests as there are no landmarks visible from which he can determine his position.

Tuesday, August 12 — Sent parties out to the highest neighboring points to fire signals, and also sent out a guide to make a circuit around camp and find, if possible, the trail of the lost cook. Rain had been falling all night, and was still falling. Our efforts were successful, and the poor fellow came in about 10 a.m. in a pitiable plight, having had neither fire nor food. Rain was falling so hard that it was not considered advisable to move camp. It cleared up, however, by 1 p.m., when, with Lieutenant Hall, I started, with a few pack-mules and such of the cargo as was not required for immediate use, to carry it forward on the trail as far as possible. Our means of transportation were so limited that it took us two days to make one march. We moved fourteen miles to the East Fork divide, and returned to camp by sundown, leaving the cargo under proper guard.

Hot springs are very numerous along this trail, and the whole atmosphere is saturated with their vapors to that extent that we were somewhat nauseated by them. The trail follows for a while an old Indian trail, which, becoming too difficult, Captain Noyes had evidently abandoned it, and tried to get around by the head of the sharp ravines. It led in a very tortuous manner through heavy forests and over very steep hills. Along the bank of the Grand Canyon, by bridging a few of these ravines and deep gulches, a very easy road could be made.

Wednesday, August 13 — Broke camp at 9 a.m., and marched twenty-eight miles, directly over the highest point of the East Fork divide, to the East Fork of the Yellowstone River [Lamar River], one mile from the bridge over the latter stream. Through the ranchman at the bridge we have news of Captain Noyes and the train. Knowing that we would be short of provisions before he could get back to us, he had made a very rapid march into Fort Ellis and would probably get back to us in five or six days.

While on the high summit of the East Fork divide we were greeted with quite a severe mountain storm. During the march along the trail among the numerous hot springs we were again nauseated as on the day before.

On Orange Creek, near our last camp, occurs a notable mass of springs that have so cut down and discolored the rocks that I named the locality Orange Rock Springs. Orange Creek is a wild mountain-stream, running at this point through a picturesque canyon whose walls are fully 200 feet high. From the bed and banks of the stream, and at the foot of the canyon walls, countless springs are issuing. The air is saturated with gases; the noise deafening, and the smell sickening. The spot has most of the physical characteristics of our best authenticated conceptions of hell; and one of our guides, who discovered it, did not tarry, for he felt certain that "the devil was not far off." The stream dashes over a series of rapids and cascades. The rocks are disintegrated and discolored with the greatest variety of hues — white, yellow, red, various shades of green, brown, and drab. Along the summit of the canyon walls lie huge blocks ready to drop off, while the foot of the slope is strewn with masses of fragments of the trachytic rock. On the northeast side, close by the water, is an exceedingly large jet of steam, escaping under such pressure from a narrow fissure that the noise is deafening. The steam smells of a sulphur gas, and is excessively hot. Close around it are three large hot springs with steam issuing from them, one of which is turbid white and quiet, while the other two are boiling and geyser-like. Very little water escapes from them by the surface into the stream. Directly across the stream, a little to the west, is a large boiling fountain spring, with an outlet whose channel is lined with silica. Besides, there are multitudes of small gas-jets, depositing sulphur in a variety of forms.

Where the trail crosses a small tributary of Broad Creek is another active mass of springs. Among them, one elliptical in shape and about 20 by 30 feet in opposite diameters, is quiet, has a whitish scum, and emits a sulphur gas. It has a slight overflow. Another of dark drab mud is 15 by 31 feet across, and is constantly in violent ebullition, throwing the mud 2 and 3 feet high. Steam and gas escape from it.
I decided to wait in this vicinity until the return of the train from Fort Ellis.

Thursday, August 14 — Sent back for the cargo left on the trail yesterday.

Across the stream, to the north from our camp, is a high ridge of granite, whose direction is not at first sight apparent. It runs across the creek close by camp, where it is quite low, and the surface debris can be seen for some distance to the south. A little east from us it shows two well-marked crags close by the south bank of the creek, which latter makes through it a sharp canyon commencing about two miles from its mouth. About 200 yards farther up it cuts through a layer of sandstone, carrying numerous fossil plants, which rest upon a bed of volcanic conglomerate. This latter crops out extensively along the stream above, and its debris is scattered over the rounded hills to the south. It is certainly peculiar. We have seen it in varied conditions and structure. All of the way across, from one side of the mountains to the other, at the Washakee Needles, and, in fact, everywhere that we have come in contact with these mountains, it can be recognized in the distance by its columnar and fantastic weathering, and somber brown, sometimes almost black, hue. It is made up of a smoothly-rounded debris of a great variety of volcanic rocks, in sizes varying from a pebble to enormous bowlders. I have seen these latter in position that were from 10 to 15 feet in diameter, and others that clearly came from it very much larger. Along this stream it carries large bowlders of granite and basalt. Being so near to the granite ridge just mentioned, I was doubtful about the source of the granite bowlders until I found a huge one in the bed of the stream with some of the matrix still clinging to it, and shortly afterward numbers of them stuck along a vertical wall of the conglomerate. It is probable that the blocks of granite strewn over the country south from camp are from this source, because they appear to be rounded from wear rather than from concretionary structure, while the granite of the ridge is lamellar, and gneissic in structure. A notable feature of the conglomerate is that it is frequently stained and its constituents sometimes thoroughly impregnated with a green mineral (silicate of iron), which might easily be mistaken for carbonate of copper.

As far up East Fork as can be seen from these granite knobs the valley is quite open, fairly timbered with spruce, pine, and aspen, and is clothed with excellent grass on the rolling country between the canyons where the stream cuts through some minor ridges. On these there are many ponds of stagnant water. To the north and northeast the mountains are very high and rugged.

Friday, August 15 — I started at 7 a.m. with a small party, carrying rations and bedding on our saddles, for the Great Hot Springs on Gardiner’s River, distant twenty miles down the Yellowstone. We made our nooning near a lovely fall of the east fork of Gardiner’s River, after traversing a beautiful country of high, rolling hills, well watered, with excellent grass everywhere, and wood scattered here and there in groves and masses. At the fall the rock is basalt, stained to a dull yellowish hue. The weathering about it and in the canyon below is quite similar to that about the Upper Falls of the Yellowstone.

A beautiful effect is produced about half-way down the face of the fall, where a horizontal dish-like ledge juts out from the wall. Some of the falling water rushes down and into the dish of the ledge, so that its impetus throws it up again at several points in low, heavy fountain-like jets, while another portion jumps clear over and beyond the ledge, in a thin transparent sheet whose convex surface looks exceedingly like a glass cover preserving the little fountains beneath from defilement.

We reached the springs at 3 p.m., and spent the afternoon looking over this very interesting and beautiful phenomenon. A settlement has sprung up here for the purpose of accommodating sight-seers and bathers. I have not much confidence in the bathing properties of the water.

Saturday, August 16 — Completed an examination of the springs and the surrounding country, and started back to camp, which we reached at 8:30 p.m. As the Great Hot Springs have been described and thoroughly photographed, I will only offer an explanation of their structure, as my views materially differ from any that I have yet seen advanced. The maximum temperature of the water given (164° F.) was obtained by Dr. Heizmann and myself by penetrating through the clouds of steam and over the hot and dangerous crust to the main fissure, from which the water was escaping with considerable violence. Looking back at this performance it seems foolhardy; for no one can tell, in such a mass of steam, whether the crust under their feet about the edge of the fissure is firm, or thin and overhanging, a common feature. These springs ... are the source of a small stream which empties into a sink near Gardiner’s River, a short distance above where the latter joins the Yellowstone. The water comes out at temperatures varying from 92° F. to 164° F.; the latter at the fissure, where the maximum quantity of water is escaping now, and is strongly impregnated with certain minerals, principally calcite, which latter it deposits profusely in thin layers upon exposure to the atmosphere. The springs originally came out at
the top of the hill above them, which I should judge to be fully 1,000 feet above those in action now.

The effect of the rapid deposition from the water is quite remarkable, there being formed by this agency level-topped hills, sometimes 200 feet high in successive terraces, one below the other down the slope of the hill — probably along a line of rupture in the rocks — their faces showing beautifully corrugated surfaces which imitate very closely the Meandrina coral, and display, while the water is flowing over in thin sheets, delicate and coarse tints of carmine, pink, rose, yellow, and brown.

The proof that the progress of these formations is from the top downward, and not from the bottom upward, as explained by Professor Hayden, is conclusive; at the top, the springs are all dead, and the deposits are decayed and almost hidden beneath vegetable loam from the dense forest that has overgrown them, while all of the active springs are at or near the bottom. He saw the dead remains at the top, but after observing closely their characteristics as hot-spring deposits, he falls into the strange error of saying: "But in what manner was it formed? I believe that the limestone was precipitated in the bottom of a lake, which was filled with hot springs, much as the calcareous matter is laid down in the bottom of the ocean at the present time. * * * The deposit was evidently laid down on a nearly level surface and the strata are horizontal."

After the water ceases flowing the surface bleaches snow-white or bluish-gray.

The process commences with the water running from one hole or fissure, . . . or several, under sufficient pressure to rise as a column to a height varying with the pressure, and from thence flowing off down the hill, with its surface covered with concentric ripples, caused by pulsations in the current; along the scolloped lines of these ripples lie the minimums of velocity in the flow, and the maximums of deposition of sediment; consequently, little wave-lines of ridges commence forming very soon, and, once started, another check to the velocity is introduced whose value is continuously increasing. This, in time, makes shallow pools, which are soon filled up with sediment, and in time the upper ones merge into one large one around and below the orifice, on a level with it and bordered by a scolloped rim, over which the water flows in a continuous sheet. The water flowing over this rim and downward, builds up, as the rim rises and advances outward, a steep slope with the maze of corrugations on its surface that result from its rapid throbbing flow. Any serious obstruction on this slope will bring about the formation of a secondary pool on the face of it, a feature of common occurrence. This process builds up a large hill, with the large shallow pools on top of it, but everywhere on its slopes and top-surface the slightest cause tends to produce the general results just described in miniature. Hence, on top we find the large pools whose surfaces are literally meshed with the scolloped rims before described, and the slopes are studded with little shallow basins with scolloped rims and corrugated sides, the hill itself in miniature.

It was along these rims that Dr. Heizmann and I made our way to the very edge of the largest orifice and took the temperature of the water in it. The spring thus builds for itself a characteristic mound of great beauty, both of form and color, which ultimately becomes its tomb.

For, in due course of time, the level surface about the orifice becomes raised so high that the water can no longer flow out and over it, whereupon the deposition gradually chokes it up with thin, cellular curved layers of calcite.

Now, if the cause of this action were continuous and of constant power, the spring would break out again in a favorable spot, and build up another mound of about the same height, and the process would be repeated so long as there remained any possible means of escape for the confined waters in that locality. But, although the cause is thus far continuous, the power is actually decreasing, as is evidenced by the extensive distribution of the dead relics of former volcanoes and the multitude of extinct and waning thermal springs; consequently, where the spring breaks out afresh, it must, in this case, be at some point lower down, as the line of rupture in the crust of surface-rock evidently runs downward toward Gardiner's River, and a new mound will be built up of less height than the last one. Sometimes small vents have broken out below the level of maximum action, producing a fountain-spring, throwing a jet of water nearly as high as the level of the principal spring. The deposition from this would produce a cylindrical column, with the top narrower and rounded . . . .

The "Liberty Cap" described by Hayden, and a similar column near it, are illustrations of this, and there are other examples higher up. If, instead of such an orifice, there should be a narrow fissure, a sharp, rounded ridge would result, of which there are numerous examples. Local circumstances may concentrate the force in certain small orifices or fissures, and thus keep up the action in a feeble manner at a level where the principal action is extinct. Thus there is now feeble action on three or four levels above the principal one, which at one place has produced an illustration of all the structural peculiarities on a diminutive scale.

Sometimes the water has found a vent lower
The amethysts seem to predominate. In the process varieties of quartz in very beautiful and perfectly miners at the bridge to a place called by them. This is the origin of the small spherical cells which are material came in.

It had been carbonized by heat before the fossilizing wood. Much of the latter is perfectly black, as though adjacent sections being plain, unpretentious petrified columns of silicification these trees generally become divided into short sections by cleavage planes at right angles of silicified wood. We were fortunate in finding some notably fine specimens of amethysts and yellow crystals of quartz. The containing-rock is the igneous conglomerate, before mentioned. In it, at this locality, are a good many silicified trees, the hollows of which are frequently lined, in short sections, with varieties of quartz in very beautiful and perfectly preserved crystal forms; rock-crystal, yellow, blue, amethyst, and opal, and many kinds of chalcedony. The amethysts seem to predominate. In the process of silicification these trees generally become divided into short sections by cleavage planes at right angles to their length. It is these sections that are occasionally hollow and lined with crystals, the adjacent sections being plain, unpretentious petrified wood. Much of the latter is perfectly black, as though it had been carbonized by heat before the fossilizing material came in.

Loaded with specimens and very tired, I reached camp a little after dark. Camp had been this day moved three miles across the river, to meet the train from Fort Ellis. Mr. John Baronett has built here a very substantial bridge across the Yellowstone River for the use of miners visiting the head at East Fork. It is only suitable now for pack-animals.

**Monday, August 18** — Pack-train in charge of Lieutenant Young arrived at 3 p.m. from Fort Ellis, with twenty days’ supplies for the escort and twenty days’ supplies for my working party.

**Tuesday, August 19** — Moved camp seventeen miles, across the Elephant’s-back Mountains [Washburn Range] to Yellowstone Falls. The trail proved very bad; many animals fell down hill, and there was considerable bad bog. The train was pretty badly used up, and two mules were lost; all this, too, after leaving half the cargo at the old camp to be sent back for. The odometer is again in use, having been repaired at Fort Ellis. Camped on Cascade Creek. Along the trail the country is pretty open north of the mountains, with excellent grass, plenty of water, and groves of trees. Across the divide the forest is quite thick, with small openings of meadow. There are three trails across the divide, and we unfortunately took the worst one. I made the ascent of Mount Washburn with a topographical party.

**Wednesday, August 20** — Sent back to the old camp for the cargo left behind yesterday. The lost mules were found. Lieutenant Kingsbury with the escort arrived at 2 p.m. from Fort Ellis; they had staid behind to get their horses shod. Captain Noyes had been taken sick and could not join us. He proposes to meet us at Camp Brown.

**Thursday, August 21** — We remained in camp, shoeing the animals and resting them. Rain fell during the whole day. Sent to the cache for the remainder of the cargo left there.

**Friday, August 22** — In camp; rained all day.

**Saturday, August 23** — Moved camp thirteen miles to the Hot Springs, on Warm Spring Creek, where it emerges from the timbered hills. The Indians were in camp on this stream waiting for us. Our party, with the exception of Captain Noyes, was now altogether again. The country along this creek, for about eight miles from Yellowstone River, is an open, rolling prairie, extensively burrowed by moles and field mice. About the springs the water of the creek and its tributaries is either hot or sour, frequently both. We found good water, after a little search, in a marsh above the springs, on the South Fork.

**Sunday, August 24** — Marched 13.3 miles across the divide between the Yellowstone and the Madison, to the Lower Geyser Basin, on Fire-Hole River; met two parties of sight-seers from Montana. The trail passes by a small lake, very near the summit, and
down a sharp but short hill, on the west side of the divide, and soon strikes the waters of the Madison. The size of this stream has been exaggerated; it is from two to three feet deep. A depth of 10 feet, as reported, would overflow its banks and the whole valley. Along this stream there is a good deal of marsh, meadow and many groves of timber. Good water can be easily found in the Geyser Basin by hunting for it.

**Monday, August 25** — Marched ten miles to the Upper Geyser Basin. The trail from the Lower to the Upper Geyser Basins is very bad from marsh; with a little trouble it could be carried along the hillside through the timber and made very good. Fire-Hole River is the principal East Fork of the Madison. Its waters in the Geyser region are generally quite warm, sometimes hot; just above Old Faithful, in the Upper Basin, it becomes cool and potable again.

The boiling water from the silica springs was used for cooking and found very convenient. The structure of the geysers or silica springs is quite similar to that of the calcite springs on Gardner’s River, except that the silica deposits slowly, while the calcite deposits rapidly, making a corresponding difference in the size and shape of the mounds formed. There is a good deal of silica (geyserite) about the springs in a soft, pasty condition from solution in the presence of alkaline salts, which ought to throw light upon the formation of chalcedony. Other explorers have devoted much of their time and attention to the description and explanation of these geysers and springs, to which, in my hasty visit, I have seen nothing to add. Further elucidation must be the result of careful observation and study, over greater periods of time than are at the disposal of exploring parties; besides, the question of getting back to Camp Brown is becoming rather serious; the pack-train is badly used up, from traveling excessively laden (the cargoes average over 250 pounds), over bad trails, and there is considerable doubt whether the rations will hold out while we are making our way through the “impassable” country at the head of Wind River, described by our forerunners.

The immediate difficulty, however, is that the Indians have failed to find the trail back to Yellowstone Lake. They seem to be nonplussed and are depending upon me, and this evening informed me that we were lost. The explanation of this is that they are “plains Indians” and are wholly unaccustomed to travel among forests like these, where all landmarks disappear. It will, therefore, be necessary to make a trail — no pleasant prospect in such a country, where one has so many people and animals dragging along after, to multiply the consequences of getting caught out in the dense forest without any camping place. An individual or an animal might easily stray a short distance from the trail and get lost, if there was any halting or confusion, and to get lost in this dense forest, where the hills are so rounded that nothing can be seen from their tops, would be a terribly serious matter.

**Tuesday, August 26** — Taking a picked party of Indians, the guide Smith, and the escort as pioneers to blaze and clear the trail, I started out early in the morning, with the intention of making a trail to Yellowstone Lake, if the old one could not be found. The train was to wait until 10 o’clock before starting. After a short and fruitless search I took out a compass, and giving the Indians the direction, told them to go that way all the time, and pick out the best way. This they did with great skill, but as our route lay directly across the water-drainage, the hills were frequent, and the trail pretty rough.

An Indian seems to have an instinct which enables him to pick out the best country to travel over, and to avoid natural obstacles.

Four p.m. found the advance party at the lake, at the spot we had set out for, but it was perfectly certain that the train would have to stop on the way. Fortunately there were suitable camping places along the trail. With empty stomachs, and saddle blanket lodgings, we made a large fire, and spent a remarkably long night in vain efforts at sleep.

**Wednesday, August 27** — The minimum thermometer last night registered 13° F., the greatest cold we have yet experienced. At 8 a.m. an orderly arrived with a message from Lieutenant Hall, commanding the escort, informing me that the mules of the train were so badly used up that it could not move today. Much of the cargo had been thrown off along the trail, and one loaded mule was lost. Later in the morning Lieutenant Hall himself arrived and further informed me of the state of affairs. The odometer-cart had worn out completely and was abandoned. The packers had gone back on the trail to gather up the cargo and find the lost mule. Sending all back to camp except the Indians, my orderly, and the guides, I remained to look up the trail ahead.

By noon, having gone without food since morning of the day before, the pangs of hunger overcame a violent prejudice and I ate some fish from the lake, worms and all. The Indians have been eating these wormy fish all along and I doubt whether there is anything injurious about them. I might have obtained something to eat from them, but there is a feeling in the average white man’s breast which prevents him from asking such a favor from an Indian. It is very unreasonable, but it is there. The Indian, on the other hand, asks favors from the white man, feeling within himself that all that the white man has belongs to him, and he is therefore only getting back his own.
He never returns thanks for such favors.

The principal difficulty on the trail yesterday was that it was not sufficiently cleared to allow the pack-mules to get through without getting frequently stuck between trees — a mishap in which a mule will waste strength enough to carry him and his pack several miles.

I have often been struck with the philosophical way that a packer proceeds from the grass that a mule eats to the work that it will do. In his eyes so much grass represents so much mule-work, and no grass represents pretty nearly no work, while it is true that very little work can be expected of a train of pack-mules that have not eaten pretty nearly their fill of grass or something else before starting.

_Thursday, August 28_ — The train came in during the morning and went into camp at the Hot Springs on the lake three miles ahead. The trail was good, but somewhat obstructed with timber along the shore of the lake. There is a first-rate trail along the west side of the lake, over which I would have sent the greater part of the expedition had I known of its existence, thus avoiding the Fire-Hole Basin, and our trials in getting away from it. It would have been perfectly easy to get a small party from that basin to the lake.

Along the west shore of the lake are numerous small streams with meadows and marsh.

The lost mule, with a cargo of flour, beans, and coffee, was not found yesterday, although the search was carried back to our camp in the Fire-Hole Basin. Word was left with some gentlemen visiting the geysers, who were coming across on our trail, to take this mule back to Fort Ellis in case it should find its way back to the trail before they came along. Our rations were too short to permit any more time to be spent in search and it was therefore abandoned. [The mule was found and turned in to the quartermaster at Fort Ellis.]

The flour belonged to the escort and is a severe loss, necessitating half rations of bread for them during the remainder of the trip.

At night the Indians in camp up the valley had a scalp-dance over two Sioux scalps that had been given by the Crows to two of the Indians with Captain Noyes's party going to Fort Ellis, who had visited the Crow agency. They invited everybody to join, which invitation was eagerly accepted by the young men of my party, the guides, packers, and soldiers. This dance gives every one a chance to sing and yell with all his might, and they literally made the welkin howl. There was considerable lung-power in action. The waves of sound were echoed back and forth from the woods and hills on either side of the narrow grassy valley, and came billowing to the lake with a tremendous effect, which was heightened by the lurid glare from the numerous camp-fires standing out in the darkness against the mass of black forest behind. The West Pointers in the party called it "Our twenty-eighth hop."

_Friday, August 29_ — I made arrangements for the main party to move along the south shore of the lake toward the river, and started at 11 a.m. with Professor Comstock and a topographical party to make the ascent of Mount Sheridan, about ten miles south of the lake.

The country is covered with a dense mass of timber on low rounded hills, with the fallen timber so bad as to make much of the country impassable for animals. There was no trail and no one who knew anything about the country. I went ahead, steering by the compass, going around the masses of fallen timber and picking out the highest ground and ridges to travel over. We were lucky enough to make camp at the foot of the mountain after a march of between three and four hours. We could not see it at all at starting, and only caught one glimpse of it on the way before we came directly upon it, and yet it towers to a height of 3,000 feet above the surrounding country.

_Saturday, August 30_ — Started up the mountain 7 a.m.; a very late start for such work. As there was no chance to reconnoiter, we had the ill luck to take the longest and most laborious line of ascent. The party becoming separated, to my great surprise I reached the summit first at 9:45 a.m., and the rest of the party an hour later. Thinking myself behind I had made great haste so as to reach the summit before the others were ready to come down.

Mount Sheridan is a high mountain mass, rising alone from the rapidly sloping hills of the Snake River drainage, just south of the Yellowstone divide. All the rocks seen were igneous, sometimes stained and decomposed from hot-spring action. Springs and feeble geysers being still in action along the streams from its north and east slopes.

To the east and southeast is a ridge of high timbered hills, which sweeps around to the northward and terminates in Promontory Point at the south end of the lake. To the south, as far as the Wind River range, about sixty miles distant, the country is a mass of high timbered ridges, formed by the erosion of the waters of Snake River, all rapidly sloping down to the eastern base of the Tetons, which lie south 10° west, about forty miles distant.

Westward, and from the Tetons, there are no mountains, only low, rounded, heavily timbered hills, as far as the eye can reach. To the northwest commence the high ridges of bald mountains which lie between the different tributaries of the Gallatin and Madison Rivers. Between Mount Sheridan and
the lake, the divide between the Snake and Yellowstone waters — the Continental Divide — is certainly not more than 300 feet above the lake, and in many places runs within a mile of the latter. It is a broad, comparatively low, gently rounded stretch of country, so flat on top that the opposite-shedding waters are frequently interlocked. It is dotted with lakes, some quite large, and carries a good deal of marsh and strips of meadow along the streams. All of the lakes in sight, except one, drain into the Snake River.

The divide between the waters of the Madison and the Yellowstone, above the falls, is a stretch of smooth hills, rising but little above the Yellowstone Basin, and having steep, rocky slopes only in few places. All of the country in the basin about Yellowstone Lake and extending far to the westward is very densely timbered, with only small openings along the streams and about the marshes.

There is a great deal of fallen timber, such as to sometimes completely obstruct progress, but I have observed that the most and the worst of it lies in the immediate neighborhood of water, either in lake, stream, or marsh, and can be very largely avoided by traveling high up on the hills and ridges. Along the shores of Yellowstone Lake a great deal of water is held in the numerous swamps which afford a constant supply to the multitude of small brooks feeding into the lake. There is, consequently, here an excessive quantity of fallen timber.

The huge mass of the Sierra Shoshonee Mountains closes in and around to the northward of the basin, showing a comparatively low granite ridge running from the East Fork with a northerly trend down the right bank of the Yellowstone River. The highest portion of this mass seems to be that northeast from the basin, about the headwaters of Clark’s Fork and the Rosebud. Northward from there it soon runs out and makes way for the valley of the Lower Yellowstone River. Its structure seems to be buried beneath the most extensive outpouring of lava and volcanic matter yet observed on the globe. Along its eastern base we gained only an inkling of its structure from the dip of the upper-lying rocks. Probably the key lies in the country on the Muscle-Shell River, to the northward. It is probable that the southern portion of this volcanic overflow at one time overlaid the northeastern slopes of the Wind River range, and that the erosion of the drift period has cut a channel through on this flank, forming the Wind River Valley and leaving the extensive deposits of volcanic debris in the valley as well as tremendous precipices of castellated basalt, trachytes, conglomerates, and sandstone that fringe and seemingly seal its head and northern border. I had the topography of the country in sight from this station sketched with great care and reasonable precision. It is the best geodetic station in the region traversed. My topographical party has now inspected the Yellowstone Lake Basin from mountain-peaks favorably situated on its eastern, northern, and southern borders.

We commenced the descent at 12:30 p.m., and as soon as possible took up the march for the main party. Their trail was struck at 5 p.m., and followed until sundown, when we camped on the spot they had left in the morning.

The smoke was still rising from the smouldering fires and the ground still fresh on their departing trail. As I rode up to the scene so lately rife with the jest; the coarse shouts of laughter; the murmuring of many voices; the bugle’s blast; the loud words of command; the round-toned, cadenced shouts of the Indians; the shrill, clarionet-like cry of the squaws; the crying of papooses; the barking of dogs; neighing of horses; braying of mules; the roaring and crackling of great camp-fires; and the occasional rifle or pistol shot at some misguided squirrel — it seemed utterly cheerless and desolate. What can appear more desolate than a freshly deserted camp?

Sunday, August 31 — We have now only twelve days’ rations, and between us and Camp Brown is the “impassable barrier never scaled by white man or Indians.” If it were not for the question of provisions I would laugh at it, because we have an outfit that can go almost anywhere; but the question of time now assumes an unhappy importance, and I begin to feel much worried.

We arose at daylight, cooked a hasty breakfast, and started off at sunrise, overtaking the main party at 9 a.m. on Yellowstone Lake, just as they were preparing to start on the march. They had made one march of ten miles over a good trail, and the one of the day before of nine miles, which had been beset with difficulties, owing to the attempt to follow the lake-shore too closely. There was no trail, but a great deal of marsh and fallen timber.

Owing to some misunderstanding, the Indians had become angry with Lieutenant Hall, and considerable jealousy had sprung up among themselves, whereat the greater portion of them had left our camp and gone off.

After a short rest I started off with the guides to make a trail. It was pretty rough for a few miles, but after that we struck a good trail, with many freshly blazed trees marking it. A queer freak of the disaffected Indians was here displayed. They had deserted the main party and gone on ahead, when, finding this excellent trail, they had freely blazed it with their hunting-knives for quite a distance until the work and slow progress involved became monotonous. I regarded this as an olive-branch, and
treated them very kindly, as though nothing had happened, when we passed them. They staid away two or three days and then came back in driblets, but I never, by word or sign, let them know that their absence had been thought of. Their own jealousy continued a few days longer, and then everything went on as happily as before.

We marched ten miles and camped at the extremity of the arm of the lake that we left this morning. There is a well-marked beach along this shore of the lake, but it is frequently deceptive and dangerous from quicksands where the water comes in from marshes above; the timber gradually becomes more open and meadows replace the swamps; the country to the south rises rapidly into hills of considerable magnitude, and the water drains off too rapidly to permit the formation of much marsh.

**Monday, September 1** — Broke camp and marched ten miles into the valley of the Upper Yellowstone River. The trail strikes the southeast arm of the lake, thence following up the valley of a small tributary of the lake whose course is parallel to the river to a point high up on the hills bordering the west side of the valley. The latter part is pretty bad from marsh and underbrush. Our camp was about ten miles from the mouth of the river.

The valley about the mouth is very marshy, with numerous small ponds and sloughs. There is also a great deal of timber on the low grounds on the west side, but from its proximity to water there must be in it a great deal of fallen timber to impede progress.

While the advance was quietly following a first-rate trail, it was suddenly observed to lead up a high hill to our right. I sent an Indian to see what became of it up there, who came back with the information that it "kaywut" (played out). It now appeared that the top of the hill was used as a stamping ground for elk, and they had made such a broad trail leading up to it as to completely deceive us. Sending back word to the train to go into camp, we started in search of our lost trail, which was soon found considerably lower down in the valley.

We have now reached a country from which one of our Indians says he knows the way back to Camp Brown by the head of Wind River. He belongs to a band of Shoshones called "Sheep-eaters," who have been forced to live for a number of years in the mountains away from the tribe. A heavy rainstorm set in about nightfall.

**Tuesday, September 2** — Broke camp a.m. and marched up the Yellowstone River thirteen miles. The trail leaves the timber and goes into the open valley. This latter is probably quite marshy earlier in the season. It is also probable that the river is not fordable in the spring.

The storm of last night burst out about noon with great violence and continued during the day and night. A good deal of snow fell in the mountains about 1,000 feet above us.

We camped in the edge of a grove of pines with a dense fringe of fallen timber on its border. It was a cold, wet camp in the border of the timber, and considerably mixed withal. As it was raining hard when we reached it, everybody dropped into the first place that presented itself; the fallen timber monopolized nearly all of the ground, so that there was little choice; the result was that Indians, soldiers, citizens, and officers were all camped together in the direst confusion, on a small spot that it seemed possible almost to cover with a blanket.

All through this basin game-tracks have been very abundant, but our party from its size makes a good deal of noise, which will account for the fact that we did not see a great deal. A magnificent elk crossed the valley in advance of us, and in plain sight today. He was a royal fellow, indeed, and seemed to resent our intrusion upon his chosen rutting ground. The party was too much drenched and too cold from the driving rain to make any attempt to get him; the first instance of the escape of anything (except bear) that came in sight of it. The trail was very good except the last mile, which was quite marshy.

**Wednesday, September 3** — The storm continued. Broke camp 8 a.m. and marched thirteen miles. The trail soon leaves the main stream and follows up a small tributary that comes in from a little west of south, crossing a low divide to a tributary of the Snake.

At this divide occurs a curious phenomenon, probably the one referred to by the early trappers as the "Two Ocean Pass."

Marching at the head of the column where the trail approached the summit, I noticed that the riband of meadow in which lay the stream we had been following suddenly dropped away in front of us with a contrary slope. I could still see the stream threading it, and for a moment could scarcely believe my eyes. It seemed as if the stream was running up over this divide and down into the Yellowstone behind us. A hasty examination in the face of the driving storm revealed a phenomenon less startling perhaps, but still of remarkable interest. A small stream coming down from the mountains to our left I found separating its waters in the meadow where we stood, sending one portion into the stream ahead of us, and the other into the one behind us — the one following its destiny through the Snake and Columbia Rivers back to its home in the Pacific; the other, through the
Yellowstone and Missouri, seeking the foreign water. On the Snake River side of the divide the stream becomes comparatively large at once, being fed by many springs, and a great deal of marsh.

While the small advance party was approaching camp two of our Indians discovering three elk close by gave us an illustration of skillful hunting by crawling up and killing the three with four rifle shots. They were extremely large and fat. As examples of Indian generosity to white men are becoming rare, I wish to put on record this one where one of them made me a present of the whole carcass of one of these elk. Being hungry enough to eat it all myself, after the long march in the cold rain, I had a vivid appreciation of the gift.

The trail was good, passing around a beautiful lake in the Yellowstone Valley, which is probably the Bridger Lake of the old maps.

The valley of the Upper Yellowstone is quite flat, and lies between grand and rugged walls of bare, broad mountains of volcanic ejectamenta. It is from one to three miles wide, and interspersed with broad meadows, and groves of pine and spruce. The amount of water that it receives from the slopes on either side is astonishing, and accounts sufficiently for its marshy character.

There is a remarkable discrepancy between the volume of water in the river above and below the lake. The storm prevented us from making observations for a comparison, and I can only say that above the lake the stream seems ridiculously small compared to what it is below. The volume of water which it receives from small streams and the numberless marshes along its border must be very great.

In conclusion, I may perhaps be pardoned for referring to the opinions that previous explorers have held with regard to the character of the undertaking accomplished by this expedition.

From the report for the year 1872 of N. P. Langford, superintendent of the Yellowstone National Park, I extract the following:

The park is only accessible from Montana. It is impossible to enter it from Wyoming. Attempts to scale the vast ridge of mountains on the eastern and southern borders have been made by several expeditions across the continent, commencing with that of Wilson G. Hunt, the chief of Astor's overland expedition in the year 1811. As late as 1833 the indomitable Captain Bonneville was thwarted in a similar effort, and, after devising various modes of escape from the mountain-labyrinth in which he was lost, determined to make one more effort to ascend the range. Selecting one of the highest peaks, in company with one of his men, Washington Irving says:

"After much toil he reached the summit of a lofty cliff, but it was only to behold gigantic peaks rising all around, and towering far into the snowy regions of the atmosphere. He soon found that he had undertaken a tremendous task; but the pride of man is never more obstinate than when climbing mountains. The ascent was so steep and rugged that he and his companion were frequently obliged to clamber on hands and knees, with their guns slung upon their backs. Frequently, exhausted with fatigue and dripping with perspiration, they threw themselves upon the snow, and took handfuls of it to allay their thirst. * * * As they ascended still higher, there were cool breezes that refreshed and braced them; and springing with new ardor to their task, they at length attained the summit."

As late as 1860, Captain Raynolds was foiled in repeated efforts to cross the barrier. While camped on Wind River, at the southeastern base of this formidable mountain, he wrote (Senate Ex. Doc. No. 77, 40th Congress, 1st session):

To our front and upon the right the mountains towered above us to the height of from 3,000 to 5,000 feet in the shape of bold, craggy peaks of basaltic formation, their summits crowned with glistening snow. * * * Directly across our route lies a basaltic ridge, rising not less than 5,000 feet above us, its walls apparently vertical, and no visible pass, or even canyon. On the opposite side of this are the headwaters of the Yellowstone. Bridger remarked triumphantly and forcibly to me upon this spot, "I told you you could not go through. A bird cannot fly over that without taking a supply of grub along." I had no reply to offer, and mentally conceded the accuracy of the information of the "old man of the mountains."

Dr. F.V. Hayden, in his Report for 1871 of the Geological Survey of the Territories, p. 134, says:

The range of mountains on the east and south of the Yellowstone Basin * * * seems to be entirely of volcanic origin; they are also among the ruggedest and most inaccessible ranges on the continent. From the valley of Wind River they present a nearly vertical wall from 1,500 to 2,000 feet high, which has never been scaled by white man or Indian, but are covered with perpetual snows to a greater or less extent. From any high point a chaotic mass of peaks may be seen.

PHYSICAL GEOGRAPHY

The Yellowstone – Teton Basin

As the region here to be described is quite small, it is thought advisable to treat it as a whole, although it is traversed by the main divide of the Rocky
Mountains — here very low — and part of the divide between the Upper Yellowstone and Missouri Rivers. It includes the Yellowstone National Park. It has the Sierra Shoshonee range on the north and east, the Wyoming Mountains on the south, and the Tetons on the southwest. All but the latter have been described. This range is quite short, and extends in a northerly direction between the parallels of 43° 30' and 44° 15', in longitude 110° 35'. A few peaks are quite acicular in character, and attain in the Grand Teton and Mount Moran the altitude of 13,835 and 12,800 feet respectively, as given by Professor Hayden. The figures are largely in excess of what the previous estimates of these altitudes had been. This region is an elevated plateau, lying about the sources of some of the principal rivers of the continent. It has a surface of high, rolling hills, covered with dense forests, with many lakes, some quite large, about the sources of the streams which lower down have cut very deep valleys.

The northwestern portion about the sources of the Gallatin and Madison is mountainous, culminating in Mount Washburn, overlooking the Grand Canyon of the Yellowstone at an elevation of 10,105 feet. About ten miles south of Yellowstone Lake is Mount Sheridan, a small knob, with an elevation of 10,156 feet. The soil is quite rich, and vegetation flourishes, although there are indications of a severe climate. At the foot of the Tetons, on the east, is a large, fertile valley called Jackson's Hole. In the midst of it is Jackson's Lake, a considerable body of water. The whole region is thoroughly well watered and is notable for the quantity of timber which it carries on low-lying land. Its greatest dimension is one hundred and four miles from north to south, and there is an area of over five thousand square miles. Southwest from Yellowstone Lake is a cluster of small lakes — of which the largest is Shoshonee Lake — all at the sources of Snake River.

Yellowstone River rises in the Sierra Shoshonee range about fifty miles above the lake, to which it flows in a northwesterly direction. Shortly after leaving the latter it makes a fall of about 500 feet into its Grand Canyon, through which it flows in a curved line, emerging with a northwesterly direction, and afterward makes a grand detour around the northern extremity of the Sierra Shoshonee, from whence it joins the Missouri by an easterly and northeasterly course.

Within the limits of the region described, the only tributaries of consequence are Pelican Creek and East Fork, on the right, flowing from the Sierra Shoshonee.

Snake River rises along the Continental divide, between latitude 43° 50' and 44° 30', in a large number of streams that spread out like a fan from a base at the foot of the Teton Mountains. The principal ones are: 1st, Lewis Fork, rising in a series of lakes lying southwest from Yellowstone Lake; 2nd, Barlow's Fork, a tributary of the latter from the east; 3d, Pacific Creek, rising near Two-Ocean Pass; 4th, Buffalo Fork, rising far to the eastward, in the vicinity of the Washakee Needles; and 5th, Gros Ventres Creek, rising near the head of Wind River.

There are no roads traversing this basin. One from Fort Ellis leads to the Great Hot Springs, just inside of its northern limit.

THE YELLOWSTONE ROUTE TO MONTANA

A Short Route to the Yellowstone National Park

The discovery of Togwotee Pass, at the head of Wind River, is pregnant with results to the future commerce of the West and Northwest, as it discloses in all probability one of the principal highways that will in the future bind their interests with those of the Mississippi Valley and the Atlantic States.

One important object of the expedition was to discover, if possible, a practicable approach to Yellowstone Lake from the south or southeast, an approach which would not only furnish the shortest route to the Yellowstone National Park, now practically inaccessible, but would open a new route to Montana by a wagon-road but little, if any, longer than the present one from Corinne, Utah, that would save a considerable distance by rail. In this it has met with a gratifying success.

In the first place, it was ascertained that there are three passes through the Sierra Shoshonee affording approaches to the Yellowstone Basin from the east. These are: 1st, from the head of Clark's Fork to the East Fork of the Yellowstone; 2d, from the head of the North Fork of the "Stinking Water," entering the basin opposite the foot of Yellowstone Lake (the route of the expedition); 3d, from the head of the Ishawooya River, entering the basin opposite the head of Yellowstone Lake. These passes are all difficult.

Also there is one at the head of Wind River, a little southeast from Yellowstone Lake, which affords a perfectly practicable passage to the Yellowstone Valley, via Wind River Valley and the head of Wind River. I have named it Togwotee Pass, preferring to attach easy Indian names, wherever possible, to the prominent features of the country. It lies in latitude 43° 46' 29", longitude 110° 1', and has an altitude of 9,621 feet above the sea. Notwithstanding this altitude the slopes approaching the summit are so long and regular that a railroad could be built over it at a reasonable cost.

At present there are two routes to Montana, over which the interchange of products between that
character, is the equivalent of money gained. It is this
As the business of the country is now conducted,
competitors with water-lines of traffic — success
underlies the astounding success of railroads as
time and its money equivalent
that
Every day saved on goods, of
transitu.
whatever
months, or weeks, or even days, locked up in goods
in
men can ill afford to have their money lying idle for
long and wholly uncertain length of time
all times; so that shipments over it are detained a very
its navigability is far from being certain and reliable at
land-route is not brought into competition with it.
no such thing as slow freight; that men want some
our rivers; success that is proving to us that there is
through which the steamboat is disappearing from
rates
no means improbable that the great saving in distance
probability, be followed by virtual disappearance of
steamboat traffic from the Missouri River; and it is by
the Union Pacific Railroad, it would, in all
effects, the proposed route is fraught with benefit to
the people of Montana, through the bringing of the
rival lines into a closer competition.

The present land-route leaves the Central Pacific
Railroad at Corinne, Utah, and runs in a northerly
direction through Idaho to Montana, crossing the
Bannack Mountains on the divide between the Snake
and Missouri Rivers. The distance from Corinne to
Fort Ellis, Montana, is four hundred and three miles.
The proposed road should leave the Union Pacific
Railroad in the vicinity of Point of Rocks, Wyoming,
and run about north into the Wind River Valley;

Territory and the East is carried on, and government
supplies shipped to the military posts and the Indians
in that country. These are: 1st, the Missouri River
route, by which supplies are carried by steamboat as
far as Fort Benton, Montana, and from thence
distributed through the Territory by wagons; and, 2d,
the Union Pacific Railroad route, over which supplies
are carried by rail as far as Corinne, Utah, and from
thence northward, by wagons to Idaho and Montana.
In the Government's freighting contracts of 1873, the
rates from Fort Benton to points in the Territory,
and from Corinne to the same points, are exactly the
same. Of course, so far as rates are concerned, the
land-route cannot compete with the water-route; but
the river-route is only open during a few months of
the year, and during the remainder of the time the
land-route is not brought into competition with it.
Furthermore, during the season that the river is open,
its navigability is far from being certain and reliable at
all times; so that shipments over it are detained a very
long and wholly uncertain length of time in transitu.
As the business of the country is now conducted,
men can ill afford to have their money lying idle for
months, or weeks, or even days, locked up in goods in
transitu. Every day saved on goods, of whatever
character, is the equivalent of money gained. It is this
element of time and its money equivalent that
underlies the astounding success of railroads as
competitors with water-lines of traffic — success
through which the steamboat is disappearing from
our rivers; success that is proving to us that there is
no such thing as slow freight; that men want some
kinds of freight shipped faster than others, but that
there is none they want shipped in a slow and
unreliable manner.

These considerations are so potent that, were a
railroad constructed to Montana from some point on
the Union Pacific Railroad, it would, in all
probability, be followed by virtual disappearance of
steamboat traffic from the Missouri River; and it is by
no means improbable that the great saving in distance
effected by the new Yellowstone route will, even
without any more railroad, enable the land-route to
compete successfully with that via the Missouri. In all
events, the proposed route is fraught with benefit to
the people of Montana, through the bringing of the
rival lines into a closer competition.

The present land-route leaves the Central Pacific
Railroad at Corinne, Utah, and runs in a northerly
direction through Idaho to Montana, crossing the
Bannack Mountains on the divide between the Snake
and Missouri Rivers. The distance from Corinne to
Fort Ellis, Montana, is four hundred and three miles.
The proposed road should leave the Union Pacific
Railroad in the vicinity of Point of Rocks, Wyoming,
and run about north into the Wind River Valley;

thence following up that valley to its head, and,
through Togwotee Pass, northerly, to Yellowstone
Lake, and through the Yellowstone National Park to
Fort Ellis. This route would pass directly by all of the
principal phenomena of the park — except the
geyser, which could easily be reached by a short
side-road. By it, the distance from Point of Rocks to
Yellowstone Lake is two hundred and eighty-nine
miles, and to Fort Ellis four hundred and thirty-seven
miles.

The proposed route will not be blocked by snow
so much as the present one, as the snow-belt lies in a
heavily timbered country, in which the snow will not
drift much. This will include a distance of fully one
hundred and fifty miles north from Wind River
Valley. It will open up a body of 2,000,000 acres of
timber-land, well watered, and with a rich soil.
Observations thus far indicate that this is a region of
equable precipitation of rain, and that irrigation will
not be necessary in cultivating the soil. There is
considerable frost even during the summer, but in
spite of it the vegetation is always quite luxuriant.

There is good reason for believing that the
Yellowstone National Park will, in time, become the
most popular summer-resort in the country, perhaps
the world. This, of itself, is a sufficient reason for
opening the way to it at once.

To sum up, the proposed route will save two
hundred and fifty miles of distance by railroad; four
hundred and eighty-two miles in reaching
Yellowstone Lake, and two hundred and sixteen
miles in reaching principal cities of Montana; is a
direct route to the Yellowstone National Park, which
at present is practically inaccessible, and will
eventually be the shortest railroad line to Montana; it
opens up a very large tract of low-lying timber-land, a
feature of rare occurrence in the great Rocky
Mountain plateau; it will open up to settlement the
Wind River Valley, the Teton Basin, and the valley of
the Upper Yellowstone; and, finally, will throw open
the Yellowstone National Park to the wonder-seekers
of the world.

METEROLOGY

Upper Yellowstone — Teton Basin

These two basins, although on opposite sides of
the main divide of the Rocky Mountains, are yet
subject to the same climatic influences; for this divide
is so low between them as to lose its mountainous
character almost entirely. This is supplied by the
Sierra Shoshone range which borders them on the
east, the Wyoming range to the south, and the
Tetons which lie to the west.

This region is also characterized by wide extremes
of diurnal temperature, although the day temperature is generally rather low, making an agreeable summer climate. The freezing-point seems to obtain quite commonly just before sunrise; and, late in August, different parties, in three consecutive years, have noted at this time of the day such very notable temperatures as 14° F., 13° F., and 12° F. The nights are extremely cold as a rule. An approximation to the mean annual temperature obtained from the temperatures of some springs east of Yellowstone Lake, and one between the lake and the falls, is 37.5° F.

The relative humidity is remarkably high for the Rocky Mountain region, which is so generally characterized by the small proportion of aqueous vapor in its atmosphere; as a natural attendant upon this exceptional feature, the whole region is densely timbered.

There is ample evidence of a moderately copious rain-fall in and around this basin, especially about the headwaters of Snake River, the vegetation is always fresh and tolerably luxuriant; the country is amply supplied with water in marsh, spring, stream, pond, and lake, and the meteorological records of parties who have visited it for three years in succession point clearly to it. We had several rainy days while traversing it, days in which the rain fell almost continuously during the night and day. This is a notable fact.

It is probably a region of severe storms; for an inspection of a general map . . . shows that the principal southwest air-current, moving over a low portion of the mountain mass of the Pacific coast, reaches the Teton's and Sierra Shoshonee range without being deprived of much of its vapor. It is not only checked in its course by this high, cool wall, but the tremendous acicular ridge of the Tetons stands in such a position as to produce a strong eddy about the headwaters of the Snake and over the lake basin.

The equable precipitation favors the growth of forest and rank vegetation, while the latter stores up the water, to be constantly vaporized and held ready for reprecipitation, the cause and effect each favorably acting upon the other. The indications are that this region along the western base of the Sierra Shoshone Mountains,* and lying between the parallels of 43°30' and 45°30' north latitude, is one of equable precipitation. The severity of the summer frosts, however, will prevent any extensive tillage of the soil, which, by the way, is a rich black loam. The prevailing winds are westerly, and mild in their character.

*I use the word “mountains” in connection with sierra in deference to the custom of considering them words of different shades of meaning. To the majority of English-speaking people mountain is the only word that completely covers the idea involved.

William Ludlow, 1843 - 1901.
Writing to the Chief of Engineers in March 1876, Capt. William Ludlow summed up his impressions of Yellowstone National Park:

The region...is, for its area, the most interesting in the world. It is situated at the very heart of the continent, where the hidden pulses can, as it were, be seen and felt to beat, and the closely written geological pages constitute a book which, being interpreted, will expose many of the mysterious operations of nature. My own interest in this land of wonder is so keen as to lead me...to hope that it will be protected from the vandalism from which it has already suffered.  

As chief engineer of the Department of Dakota, Ludlow had journeyed through the park the previous summer while on a road reconnaissance. Resourceful and perceptive, he was an exceptional man. Graduated from West Point in 1864, he attained the brevet rank of lieutenant colonel before Lee surrendered. His later successes in molding the first topographic company in the Army, in organizing a new Engineer depot, and in designing a hydraulic hopper dredge, and his humane proposal to reserve the Black Hills for the Sioux marked him as a creative individual. His Yellowstone report was a pioneer conservationist work.

Ludlow's party was small but versatile. The well-known frontiersman Charlie Reynolds was hunter and guide. Lt. Robert E. Thompson of the Sixth Infantry and a detachment of Engineer soldiers acted as topographers and surveyors. Also accompanying the expedition at their own expense were three cultivated Easterners: the captain's brother, Edwin Ludlow, and two Yale professors, George Bird Grinnell and Edward S. Dana. Grinnell, who afterward as editor of Forest and Stream did much to promote the park, described the zoological and paleontological features of the region, while Dana submitted a worthwhile report on geology. Following trodden routes, Ludlow made no major discoveries, though he was the first to measure accurately the height of Yellowstone Falls.

The value of Ludlow's expedition lay not in the field of exploration but in the realm of conservation. A sensitive and cultured observer, Ludlow observed with the eye of a naturalist the splendors of the park, the general purity of atmosphere which gave objects a "wonderful transparency and distinctness," the "wealth and luxuriance of color almost supernatural" in the Grand Canyon, and the unique geyser basins where nature, "abandoning for the time all thoughts of utility, seems to have been amusing herself in this far-off and long-hidden corner of the world by devoting some of her grandest and most mysterious powers to the production of forms of majesty and beauty such as man may not hope to rival." Yet nearly everywhere he turned he witnessed men and women chopping and hacking and prying loose nature's irreplaceable handiwork. Around the crater of Old Faithful he saw delicate formations shattered, specimens removed, and everything immovable defaced by the "names of great numbers of the most unimportant persons." Lamenting the havoc worked "by the rude hand of man," he noted: "Miracles of art...can be ruined in five minutes by a vandal armed with an axe, and nearly all the craters show signs of [this] hopeless and unrestrained barbarity." Equally disturbing to Ludlow was the wanton slaughter of wildlife. Of the elk, he wrote: "A continuance of this wholesale and wasteful butchery can have but one effect, the extermination of the animal...from the very region where he has a right to expect protection, and where his frequent and inoffensive presence would give the greatest pleasure to the greatest number."

In his report Ludlow outlined a plan to save the
park: call in the Army, let troops patrol the area, and have the Engineers build roads. Fortunately for the public, these proposals were eventually carried out. In the mid-1880's the Corps began road construction and the Cavalry moved in to protect the park.

REPORT

St. Paul, 1876

The region included within the limits of the Yellowstone Park is, for its area, the most interesting in the world. It is situated at the very heart of the continent, where the hidden pulses can, as it were, be seen and felt to beat, and the closely written geological pages constitute a book which, being interpreted, will expose many of the mysterious operations of nature. My own interest in this land of wonder is so keen as to lead me again to hope that it will be protected from the vandalism from which it has already suffered, and that the suggestion of an accurate topographical and geological survey, to complete the work so well inaugurated by Professor Hayden, may be made the subject of favorable consideration and recommendation by the Chief of Engineers.

The trail led us on up the valley, past two ranches, from which supplies were obtained, to within a few miles of Gardiner's River. At this point it leaves the valley of the Yellowstone, and, over a hilly route, passes across the angle between the two streams, until, at the farther side of a level, well-grassed piece of prairie, it reaches the valley in which the Mammoth Hot Springs are situated. The rain had descended heavily all the afternoon and continued into the night.

August 14 [1875] – The day opened wet but cleared in a few hours. A thorough examination was made of the springs, which well repaid it.

They have been already described with great particularity and minuteness in the reports of Dr. Hayden and Captain Jones, and a few words of description from me will suffice.

This remark is not to be confined to the locality of the springs, but must be understood as applying, and in a still greater degree, to the whole park, of which I shall not even attempt a full description, but content myself with recording only a few of the more prominent and enduring impressions received in our hurried visit.

Pressed for time, with other work to do, our constant idea was one of eager haste, and we passed rapidly from place to place, thoroughly enjoying every hour, but always with some new wonder in advance, to divert our attention and to draw us on.

The park scenery, as a whole, is too grand, its scope too immense, its details too varied and minute, to admit of adequate description, save by some great writer, who, with mind and pen equally trained, could seize upon the salient points, and, with just discrimination, throw into proper relief the varied features of mingled grandeur, wonder, and beauty.

The Mammoth Hot Springs are the first point of interest in the park, the northern boundary of which was crossed yesterday some miles back. They occupy a small valley, discharging eastward into that of Gardiner's River, and which the spring deposits have partly filled. Our camp was pleasantly situated in the valley below the springs, among trees growing out of these deposits, in which occasional pits and holes 15 to 20 feet in depth existed. Above the camp rose the extinct spring, called, from the shape of the mausoleum which it had itself constructed, the "Liberty Cap, or "Giant's Thumb," and beyond this again a succession of terraces, rising to a height of some 200 feet, dazzling white in the sun, indicated the presence of the active springs, which indeed had all along been evident enough from the vast clouds of vapor constantly arising. The terraces exhibited great variety and beauty of form, much enhanced by the quivering and sheeny effect of the thin descending sheets of water.

The material is a carbonate of lime, deposited by the cooling of the waters, of a nearly pure white, and while wet of a moderate hardness. Upon drying, the deposit becomes soft and friable, and a hunting knife could be easily plunged into it to the hilt. The main springs occupy the upper portion of the terrace, and spread out into large limpid pools of a superb blue tint, boiling violently in places and emitting clouds of steam. Overflowing the pools, the waters escape down the face of the terraces, and in cooling gradually part with the carbonate held in solution, making constant additions to the ornamentations of the surfaces, and constructing scalloped pools and "bath-tubs" of every form and temperature.

The whole vicinity of the springs returns a hollow echo to the tread, highly suggestive of the pit-falls beneath. The party, however, overran the neighborhood, at first with tentative step, and
UPPER GEYSER BASIN

Drawn under the direction of
Capt. W. Luellon, Corps of Eng.
To accompany his report

Compiled and drawn by Ch. Becker, Serg. U.S.E.
afterward with all confidence, no accident occurring. Remains of extinct springs abound above and below the active ones, while still others in full flow exist near the river’s edge.

The grass in the valley of the springs is poor, but on the small prairie above is excellent. Wood and cold water are sufficiently abundant and convenient.

There are two “ranches” near the springs, which do duty as “hotels,” and are available for the use of travelers.

August 15 — Wagons can be taken as far as the springs without much difficulty; the road having been made entirely practicable, though of an occasionally undesirable steepness. At the springs, however, wheels must be abandoned, and everything carried upon pack-animals.

The odometer-cart was left behind, both on account of the difficulty of getting it along and the danger of rendering it unfit for use on the return trip to Carroll. The mean solar chronometer was left with it, in charge of the “hotel”-keeper, and the sidereal was rolled in a bundle of bedding, and intrusted to the somewhat uncertain fortunes of the packs. All other reductions had been made at Ellis, and camp was broken at 8:15 a.m.; the “buffet” consisting, besides the party and the engineer soldiers, of three packers, a farrier, and a cook, in all twenty-two persons and thirty-three animals, of which eleven were pack-mules carrying about two hundred pounds.

The trail (a bridle-path only) leads up the valley of Gardiner’s River (which is of considerable depth, and slopes steeply down to the water’s edge) across the West Fork, and then the East, gradually climbing the eastern side of the valley to a plateau, whence on the right of the trail descend the waters of the river, and form a very pretty fall. The slopes of the river-valley are composed of loose basaltic debris, making a toilsome path, deeply gashed in places by washings from the foot of the great basaltic wall which towers above it on the east. Although not insecure, the ascent to the plateau is unnecessarily difficult, and a little labor expended upon it would serve to improve it greatly.

The falls are some 20 feet in width, and make three plunges, estimated at about 45, 55, and 30 feet each; in all a descent of 130 feet.

Leaving the river, the trail follows up in an easterly direction the shallow valley of a small brook called Black Tail Deer Creek, which traverses an open hilly prairie, and affords an excellent and easily traveled road. Reaching the head of the creek, the trail bore to the right, through a dry canyon place to the edge of the valley of Meadow Brook, where, turning sharply to the left, it descends along a steep high slope, out of which the narrow trail is cut, to a fine open meadow, well grassed and watered, where camp was made, 13 miles from the springs. Several of the party rode on, a mile and a half farther, to the Yellowstone River. It was found to be a foaming torrent, some 60 feet in width, with steep, rocky banks. The water, a rich green in hue, was broken into pools and eddies by obstructing bowlders, and a strong odor of sulphur pervaded the air. Spanning the stream is a rough bridge some 80 feet in length, resting upon cribs at either extremity, and affording a passage to the east bank, where, at a short distance from the “bridge,” is the “ranch” of Jack Baronet.

Two or three miles below the “bridge,” the two forks of the Yellowstone unite, and, to the traveler approaching it, the locality is marked by a large, flat-topped butte, with steep escarpments, which stands in the angle, and from its shape is a noticeable object, contrasting with the pointed hills and peaks which surround it. The West Fork drains the lake, and the East, a mountainous district not yet thoroughly examined.

Rain fell again during the afternoon and night, and our experience of the weather in the park seemed to be similar to that of Captain Jones, as recorded in his report. On one day only of the two weeks passed in the park did we fail to have rain or shower, and night observations were in consequence greatly interfered with.

August 16 — Camp was broken at 8:30. The herd had wandered during the night, and a couple of hours were lost in getting them in and ready for the road. The pack-mules had been employed on similar duty just before, and heavily laden. The construction or adjustment of the army pack-saddle is doubtless capable of great improvement; at any rate, the backs and shoulders of the animals were in very bad condition, and one of them was found to be so unfit for a load that it was necessary to leave him at the bridge.

While in the park, as there was no grain for the animals, they were allowed free range at night, and the grazing is so plentiful and nutritious that the majority of them held their own, although the work was occasionally severe. There need be little or no apprehension from Indians, and guards were not posted after leaving the Mammoth Springs.
the falls, which leap down 150 feet into a narrow, dark canyon some 480 feet in depth. Basaltic tufa cones and columns in the vicinity of the fall have suggested the name, and all the surroundings are picturesque in the highest degree. The finest view of the falls can be gained from a projecting spur on the south bank just below them, whence both the canyon and the creek-valley above can be seen. The stream discharges into the Yellowstone River near by, and at its mouth very fine fishing rewards the visitor.

There seem to be two varieties of trout here, the bulky ones of the Yellowstone, with bright-yellow bellies and stripings of red, and a smaller kind more silvery in appearance, and exhibiting much greater activity and game qualities. These latter seemed to come generally from the creek. The mouth of the creek may be called the lower end of the Grand Canyon, which extends up the river some 16 miles to the foot of the Great Falls.

Leaving the creek, the trail, alternately rising and falling, and curving to the right and left, gains the foot of a long, somewhat rolling ascent, which finally attains the western shoulder of Mount Washburn. The flanks of this incline fall steeply on both sides displaying to the west an ocean of deep-green pine, surrounded by ragged, bare pinnacles, and to the east breaking into the foot-hills of Washburn. This incline is approximately located on Raynolds's map, and called the Elephant's Back, which name has on some later maps been transferred to a minor elevation near the Yellowstone Lake. The name is appropriate and descriptive, and, having been given by the first topographer of the region, should be allowed to have its original application.

Over this the trail by a gradual ascent reaches a high point on Mount Washburn, passing between banks of snow, which had remained unmelted by the summer's sun. Here, leaving the trail, the party ascended to the summit of the mountain. The climb was made in less than an hour, and can almost be accomplished on horseback, so rounded is the mountain-top, although consideration for the saddle-horses would suggest making it on foot. In passing some stunted pines near the trail, it was observed that there were no branches or twigs on the northwest side of the tree, and that those which sprung from the northeast and southwest sides were twisted back and trailed away to the southeast. The explanation of this was not long in doubt. Reaching the summit, the whole panorama of the park sprung into view: the lake, with deeply sinuous shores and silver surface, interspersed with islands, with the Yellowstone River crooking away from it toward us, was set, as it were, in a vast expanse of green, rising and falling in huge billows, above which here and there jets of steam arose like spray; the encircling peaks, ragged and snow-clad, almost too numerous to count; Mount Humphreys, 30 or 40 miles southeast, Sheridan and Hancock the same distance to the south, and beyond and above them, 90 miles away, looking almost mysterious from their distance and vast height, the Teton, of a pale purple hue, with their piercing summits glittering like icebergs. Only to the southeast, looking toward the great Idaho Desert, did a space appear which showed no prominent peaks. We had scarcely time to more than glance at this superb landscape, while resting and eating lunch with the aid of a hatful of snow from a neighboring bank, when a ferocious squall of hail, rain, and snow burst upon us from the northwest, and swept us like dust from the bald summit of the mountain. We were instantly compelled to seek shelter on the lee side, where, cowering and half-frozen, we awaited the passing of the storm. Motion, however, was absolutely essential to warmth; so, without again trusting the untender mercies of the mountain, over which the wind still blew keen and cold, we plunged into a deep ravine leading steeply down its western flank, and regained the trail at the foot. The storm had wet the rich black mold, and made the path slippery and difficult through the densest timber of spruce and pine, where hardly sufficient cutting had been done to afford the narrowest of passage-ways. The projecting branches flapped back their freight of raindrops into our faces and clothing, and many of the broken twigs bore trophies snatched from the packs.

There were several sharp pitches into and out of the valleys of small brooks, which could easily be avoided. At present, the trail is unnecessarily hilly and fatiguing, although delightful on account of the fine forest and the great number and variety of the flowers. The grass is everywhere luxuriant and sweet, the brooks are frequent, and flow in all directions, and camp could be made at almost any point. The trail, however, might be greatly improved by means of a little well-directed labor and the exercise of better judgment in selecting it. The work of a pack or saddle animal is vastly increased by unnecessary ascents and descents, which both their conformation and the position of the load render arduous, and the easiest road is one of even grade, though it be thrice the length of the more direct one.

Ascending to a low divide between two mountains, the valley of Cascade Creek was reached and followed to camp. The last three or four miles were over a meadow which in many places was wet and very boggy. The hail here had fallen in considerable quantity, and whitened all the ground; the sky was dark, and the air raw and wintry. Camp was made on the east bank of the creek, where it leaves the meadow and stone. A roaring camp-fire soon restored
The Lower Falls of the Yellowstone River.
the warmth and cheerfulness of the party, which had been somewhat impaired by the shivering weather. We were only about a mile from the falls, and after everything had quieted down to silence their deep roar became vaguely audible. The evening was again cloudy and rainy. Distance traveled during the day estimated at eighteen miles.

August 17 – Lay over in camp to visit the falls. The night had been cold, and by 8 a.m. the hall of yesterday had not disappeared. Waiting an hour longer for the sun to dry the heavy grass, we took on foot the trail which led us to the brink of the river-valley, half-way between the upper and the lower fall, which are half a mile apart. Reserving the lower fall, whose deep thunder we could now plainly hear, we descended toward the upper, and, after a short scramble over loose trachytic blocks, climbed out upon a point which, projecting into the canyon below the fall, furnished a fine view of it almost en face. The river makes a sharp bend to the eastward just above the fall, which in consequence fronts nearly at right angles to the general direction. From the sharp and narrow pinnacle on which we stood, or rather to which we clung, the cataract, some 150 feet distant, was exposed in its full height and beauty. It is a slanting one, having a base of perhaps one-half its altitude, which, as measured by a cord brought for the purpose and marked in 10-foot lengths, is 110 feet. The water leaps down its rocky slope between black, shining walls of trachyte, and its pure green is broken into foam and spray from the very summit. From the foot the currents of air drove the clouds of vapor up the steep sides of the canyon, which were clothed in vegetation of the freshest and most brilliant hue, while a double rainbow illumined the surface of the stream below. The picture was certainly a beautiful one, and we hung over it in delight for an hour, which, with the thunder of the lower fall still fresh in recollection, was all the time we could afford. Half an hour of rough climbing over bowlders and loose trachytic blocks, across Cascade Creek, and down the side of the main valley, brought us to a small plateau at the very crest of the main fall, and almost at the water’s edge, where the eye could plunge into the vast chasm below the fall, known as the Grand Canyon. I had not time to think of it then, but was afterward not a little amused to remember that we passed on the way one of the men, who, seated on the bank, was pensively watching for a trout to seize his grasshopper. He had evidently wearied of too much bacon and scenery, and proposed a change at least of diet.

The view of the Grand Canyon from the point where we stood is perhaps the finest piece of scenery in the world. I can conceive of no combination of pictorial splendors which could unite more potently the two requisites of majesty and beauty.

Close at hand, the river, narrowed in its bed to a width of some 70 feet and with a depth of 4 or 5 feet, through the pure deep green of which the hardly wavering outlines of the brown bowlders beneath are distinctly visible, springs to the crest with an intensity of motion that makes its clear depths fairly seem to quiver. Just before making the plunge, the stream is again contracted, and the waters are thrown in from both sides toward the center, so that two bold rounded prominences or buttresses, as it were, are formed where green and white commingle. Lying prostrate, and looking down into the depth, with the cold breath of the canyon fanning the face, one can see that these ribs continue downward, the whole mass of the fall gradually breaking into spray against the air, until lost in the vast cloud of vapor that hides its lowest third, and out of which comes up a mighty roar that shakes the hills and communicates a strange vibration to the nerves. From far below this cloud emerges a narrow, green ribbon, winding and twisting, in which the river is hardly recognizable, so dwarfed is it, and creeping with so oily and sluggish a current, as though its fall had stunned it. On either hand, the walls of the canyon curve back from the plunging torrent, and rise weltering with moisture to the level of the fall, again ascending 500 or 600 feet to the pine-fringed margin of the canyon; pinnacles and towers projecting far into the space between, and seeming to overhang their bases.

These details are comparatively easy to give, but how to find words which shall suggest the marvelous picture as a whole! The sun had come out after a brief shower, and, shining nearly from the meridian straight into the canyon, flooded it with light, and illuminated it with a wealth and luxuriance of color almost supernatural.

The walls appeared to glow with a cold, inward radiance of their own, and gave back tints of orange, pink, yellow, red, white, and brown, of vividness and massiveness hopeless to describe, and which would overtax the powers of the greatest artist to portray. The lower slopes, wet with spray, were decorated with the rich hue of vegetation, while through the midst the river, of still more brilliant green, far below pursued its tortuous course, and the eye followed it down through this ocean of color until 2 or 3 miles away a curve in the canyon hid it from view and formed its own appropriate background.

The height of the fall, as ascertained by attaching a heavy weight to the measured cord, and lowering it down, is 310 feet. The first attempt to get the height was made from the little plateau by the side of the crest, but the spray soon hid the weight from view, and the water so tore at it that it was impossible to
Elk snowbound in Hayden Valley.
tell when the bottom had been reached. A point was found, however, to the left and in advance of the crest and some 80 feet above it, from which the weight fell nearly vertically, and, by aid of the colored tags which marked the intervals of the cord, could be followed with the eye until it reached the brink of the stream below. From this same point, a sort of perch upon the very border of the precipice, can be had a most comprehensive view at once of fall and canyon.

After making the measurement, we ascended the side of the canyon, and climbed out to one of the projecting pinnacles, half a mile farther down stream, whence a full view of the fall was obtained. It was remarkable to note how small a portion of the view was actually filled by the fall itself. Tremendous as it is, it seems but a minor incident in the picture constructed on the huge scale of the canyon.

From the projecting point, the width of the chasm across the top was estimated from the range of a carefully sighted rifle at 700 yards. This, however, is greater than the average width, the canyon just below narrowing considerably and gaining at the same time in depth, which is about 300 yards.

The descent to the bottom of the canyon from the east side is comparatively easy. From the west side it has also been accomplished, but it is toilsome and not unattended with danger, and the time necessary to descend and return would be considerable. Among other improvements that suggest themselves to the visitor as proper to be made in the future is the construction of facilities for making this descent, such as rude but strong ladders, which could readily be placed in position where their aid would obviate all danger and decrease fatigue. One of the party made an attempt to get down, but lost time in looking for the most favorable place, and, the afternoon waning, he was compelled to abandon the undertaking.

August 18 – The morning opened cold and foggy. Camp was broken at 8. Took the trail which crosses Cascade Creek near the river by a steep pitch, and after a short ride over hilly ground and through timber reached comparatively open ground on the bank of the river, which was there 100 to 200 yards wide, and peaceful enough, flowing with smooth, gentle current, between low, grassy banks. The pack-train meanwhile had taken a trail somewhat farther to the westward, which avoided the steep descent into Cascade Creek and made an easier crossing of it. The two trails united at a small creek discharging into the river, crossed it, and through dense timber climbed around the shoulder of a mountain to again descend into the broad open valley of Alum Creek. This is a shallow, sluggish stream of tepid, undrinkable water, some 30 feet in width and an inch or two deep, with a general northeast course to the Yellowstone. Off to the right, across an open prairie, appeared the Sulphur Springs, or Soda Mountain, as it has been called, which we visited. Some 40 or 50 acres are covered with extinct and active springs and their deposits. Pure sulphur in considerable quantity is distributed over the surface. Several springs were boiling violently, one of them to a height of 3 or 4 feet, and emitted large volumes of steam. Pursuing the course again toward the river, over a hilly prairie, and crossing one or two creeks and arms of the river, and a broad meadow, the borders of which were springy and boggy, the trail led to the edge of some timber, soon after entering which the Mud Geysers were found. We passed on to a small pine grove, favorably situated for camp near the river and 12 miles distant from Cascade Creek. Leaving the horses, we returned on foot to examine the geysers. The main one is a bubbling pool of muddy, hot water some 50 or 60 feet across, with a sloping shore 4 or 5 feet high, and numerous small vents and springs within the perimeter. The water is thick with gray, unwholesome-looking mud, and exhales a foetid odor.

Another geyser, much more impressive in appearance, which however has not been seen to spout, at least of late years, has a crater some 50 feet in diameter and 25 feet deep, narrowing at the bottom to a mud pool of the consistency of boiling mush, about 15 feet across. From the northwest side of this a perpetual boiling takes place, with a threatening roar and huge clouds of steam. If the mud apparently splashed upon the trees in the vicinity would serve as an indication, when an explosion does take place the display must be a very fine one. The “Devil’s Workshop” is a small steam spring issuing from a little cavern apparently 15 or 20 feet in depth horizontally, but constantly obscured by a great volume of vapor. Hollow, bubbling noises continually issue from it, which simulate, by aid of the cavern, the metrical clang and clash of great pieces of machinery, turning and splashing, accompanied by a recurring hiss of escaping steam. About 4 p.m. pistol-shots from the Mud Geyser summoned us to witness an explosion. The water had risen gradually until the small springs were submerged and the basin enlarged to its full dimensions. Near the center the geyser was boiling and bubbling actively, and soon spurted to a height of 5 or 6 feet, falling and rising again, and after about three minutes of excitement subsided, the water lowered, being gradually swallowed down the several orifices, and the discharge was over. The geyser has a period of about 4½ hours, and several of the subsequent eruptions were witnessed. None exceeded 10 or 15 feet in height. The force is evidently weakening, as indeed the large number of dead and dying thermal springs
seen in other localities additionally testify. This geyser has been known in previous years to spout 50 and 75 feet. There is still, however, a wonderful amount of force at work, and in a marvelous variety of forms.

The fish taken from the river near camp were in appearance large and fine, weighing two pounds and upward; but out of the large number caught, all, with one exception, were affected by the worm mentioned by previous visitors and described by Professor [Joseph] Leidy [of the Philadelphia Academy of Natural Sciences]. The appearance and health of the trout do not seem to be noticeably injured by them, but the presence of the worm in the flesh can almost invariably be detected from a slight protuberance or rounding-out on the sides. Laying this open, the worm is found, white, the size of a knitting-needle, and twisted in the flesh. We made no experiments to determine the flavor of these fish, although many of the men ate them heartily and pronounced them perfectly good. It is certainly most unfortunate that these fine fish should be so spoiled for the table. They abound in the lake and river, and, affording the finest sport, would be an immense attraction could they be used for food.

August 19 — Without moving camp, we rode 7 or 8 miles to a "ranch" in a grove on the west shore of the lake. From the Mud Geyser, the trail led through alternate forest and river side, with an occasional marsh, the landscape generally quiet and pastoral. Ascending upon a high prairie point, the lake lay before us, a beautiful sheet of water, with deeply indented shores, and the wooded mountains closing it in on all sides. We chartered a small center-board cat-rigged sail-boat, cleverly constructed by the owner of pine cut out of the forest with a whip-saw, and crossed to the east shore. The water appeared filled with a round greenish seed, probably of some aquatic plant, and little windrows of the same seed lay upon the beach, thrown up by the waves. Some trout were taken with a spoon on the way over, all wormy, and a squall or two gave variety to the sail and tested the weatherly qualities of the boat.

We passed the mouth of Pelican Creek, in the valley of which large numbers of thermal springs have been found, and landed near Steamboat Point, 7 miles from the starting-point. Two or three steam-vents were seen, and one of them on the farther side of the point has suggested the name. From a small aperture, colorless superheated steam escapes with a hiss and roar that indicates an excessive tension, and imitating precisely the blowing-off from a full boiler. Multitudes of grasshoppers, unwittingly encountering the steam, had met instant death.

From the projecting point, some 12 feet above the water, the finest fly-fishing was found. An arc of nearly 180° could be covered with the fly in from 6 to 10 feet of water, out into the lake as far as the skill of the fisherman would admit. The fish, though sometimes gorged with grasshoppers, would rise eagerly to the fly, and weighed from 1/2 to 4 pounds and upward. The largest measured 20 inches in length. None of them could be eaten.

August 20 — The trail to the Great Geyser Basin breaks away from the vicinity of the Mud Geyser to the west and north over an open sagebrush prairie, gradually becoming more hilly, crosses Alum Creek near its head, and, following up a small coulé with flowing water at 6 miles from camp, climbs a hill and enters a heavy forest richly grassed. The ascent through this forest to the summit of the divide between the Yellowstone and Madison Basins is very gentle from the east. Two or three groups of sulphur springs were passed on the way. The descent from the divide into Madison Valley is precipitous, winding down a drop of a thousand feet through fallen and burned timber, and over a rocky, bare, and stony soil destitute of grass. Reaching the border of the valley of the East Fork of Madison River, the trail winds along the meadow and two or three alkaline brooks, in which the animals mired badly, and follows down the bank of the East Fork, which was forded two or three times. The stream is 10 to 20 feet wide and 2 or 3 feet deep; a clear, swift current and gravelly bottom, the water tepid and alkaline from the numerous hot springs which discharge into it. Camp was made in a grove of pine, after having traversed a pass between two hills which project into the Lower Geyser Basin. A small rill furnished a sufficient supply of good water, but the grazing was inferior. Several hot springs had been passed before reaching camp, and to the south the geysers appeared covering a large area. The distance traveled during the day was about twenty-six miles.

The upper valley of the Madison, including those of the forks, is quite barren and unattractive, owing probably to the action of the chemical hot springs which abound everywhere. The bordering hills are stony and bare, and at the time of our visit were covered with dead and burned timber. The landscape in consequence is uninviting, the grass poor, and good camping-places, such as can be made at almost any point in the Yellowstone Basin, are not to be found.

August 21 — The morning was devoted to the examination of the springs and geysers of the Lower Basin, which are very numerous, and cover a large extent of ground, the principal ones being about half a mile to the southward and eastward of camp. Minute descriptions of them have been published, and a detailed account is here unnecessary. Some are boiling, others spouting springs, the latter generally appearing large and fine, weighing two pounds and upward; but out of the large number caught, all, with one exception, were affected by the worm mentioned by previous visitors and described by Professor [Joseph] Leidy [of the Philadelphia Academy of Natural Sciences]. The appearance and health of the trout do not seem to be noticeably injured by them, but the presence of the worm in the flesh can almost invariably be detected from a slight protuberance or rounding-out on the sides. Laying this open, the worm is found, white, the size of a knitting-needle, and twisted in the flesh. We made no experiments to determine the flavor of these fish, although many of the men ate them heartily and pronounced them perfectly good. It is certainly most unfortunate that these fine fish should be so spoiled for the table. They abound in the lake and river, and, affording the finest sport, would be an immense attraction could they be used for food.
intermittent. On a high mound built by the geyser, we found a large pool about 25 by 15 feet, which was known to play, and the discharge of which we awaited. The water, of a deep azure hue and a surpassing clearness, was rising gradually but constantly to the level of its scalloped and ornamented rim, constantly becoming hotter, with bubbles of steam escaping more and more rapidly. Ebullition began near the middle, and the geyser finally commenced to spout, throwing the water about in all directions and to heights varying from 10 to 50 feet. The display continued for over an hour, and we left it playing, but with gradually diminishing force. Meanwhile other small geysers in the vicinity played from time to time, all apparently independent of each other. The pools of all these, exhibiting every variety of form and ornamentation, possessed in common the beautiful azure tint and clearness of the water, contrasting finely with the light-gray hue of the silica deposited by them. The margins of all were incrusted with this in various forms of bead, coral, and sponge work, and wherever the geyser-water flowed silicious shale was deposited.

Passing over a low ridge, a few hundred yards to the southeast, we came upon the "Paint Pots." This singular phenomenon consists of a "pool" some 60 by 40 feet, with a raised margin of dry and cracked mud, within which numerous mud-puffs slowly rose and fell, some through the partially liquid mass, which again closed over them, others possessing a small crater of their own, to which additions were constantly making from the bursting of the sluggish bubbles. The pool displayed various colors, white, yellow, and red predominating, but shading into each other very beautifully through all the intermediate and combined tints. The clay was soft and smooth to the touch, with scarcely a trace of grit, and near where the bubbles emerged from below exceedingly hot.

Leaving these, and passing by many other springs and small geysers, we went down to the Fire Hole River, crossed it, and pushed up the west bank toward the Upper Basin, wherein are situated the Grand Geysers. After some 2 or 3 miles of travel over fallen timber and through marsh and bog, we came upon some immense springs and pools, boiling violently and discharging a great amount of water into the river. These exhibited many hues of red, yellow, and green, from the presence of iron and vegetable growths; the pure geyser blue appearing where the spring was deepest and clearest. From the pools, we continued, passing many curious springs and small geysers, and then, crossing to the east bank, pushed rapidly on through a sort of canyon on the river, until at about 7 miles from camp, in the Lower Basin, we reached the lower end of the Upper, and were at once hurried across to the west bank again to examine the "Grotto," which began to play as we arrived. This geyser does not spout to any great height, 20 or 25 feet being the limit, but is beautiful and interesting from the shape of its crater, which some 12 or 14 feet in height, is curved and convoluted into massive arches and exceedingly graceful forms. It played whenever we were by to see it, and evidently continues in operation for considerable periods, from the dimensions of the crater it has built. These craters are all constructed, by the geysers themselves, of the grayish-white silica, or geyserite, deposited by the cooling of the water; the process being very gradual and slow. The water in all is of the same pure clear blue, without a trace of any impurity. The taste, when cool, is the flat, insipid one of distilled water.

Close by the "Grotto" stands the picturesque crater of the "Giant," or "Broken Horn," a geyser of the first class. From the aperture of this, large volumes of steam were escaping, and the water was boiling violently 8 or 10 feet below the surface, occasionally rising in huge spurts and splashing over, symptoms which led us to watch it unavailingly for an hour in hope of a discharge.

Meanwhile the pack-train had been making its way along the regular trail up the east bank, and, reaching the upper Basin, camp was established in the center of the basin on the west bank of Fire Hole River, in a small group of trees, with a fairly good marsh in front for the cattle. We found the waters of the river cool and palatable, and sufficient wood for camping purposes at hand. At short range from camp, and in full view of it, were the first-class geysers named "Old Faithful," the "Bee Hive," the "Giantess," the "Grand," and the "Castle;" while the "Giant" and the "Grotto" were but a short distance farther down stream. Beside these, the "Pyramid" and "Punch Bowl," near the "Giant," could be easily seen. Almost as we reached the camp, "Old Faithful," which stands at the head of the valley overlooking it, and which has earned its name from the regularity of its discharges, gave us his first display. The time was noted and the second discharge awaited. An hour after, we walked over to the elevation which marked his crater, 400 yards from camp. In a few minutes, after some preliminary spurts and splashes, the geyser, emitting a deep roar which shook the ground, shot up a clear, straight shaft of water, which, with two or three rapid impulses, gained an altitude of over 100 feet; clouds of steam towering far above and drifting with the wind. For full five minutes, the superb column maintained its height, and then, with some unavailing efforts to check its fall, sank down, and was swallowed up in the crater. An examination of this followed. An immense quantity of water had
been ejected, which, after bathing the crater and refilling the adjacent pools, flowed down the slopes and discharged by various channels into the river. The crater of "Faithful" is one of the most beautiful of all. The lips are molded and rounded into many artistic forms, headed and pearled with opal, while closely adjoining are little terraced pools of the clearest azure-hued water, with scalloped and highly ornamented borders. The wetted margins and floors of these pools were tinted with the most delicate shades of white, cream, brown, and gray, so soft and velvety it seemed as though a touch would soil them. The material, however, is the constant silica, of which also are composed the pretty pebbles which furnish an additional charm to the pools.

The only blemish on this artistic handiwork had been occasioned by the rude hand of man. The ornamental work about the crater and pools had been broken and defaced in the most prominent places by visitors, and the pebbles were inscribed in pencil with the names of great numbers of the most unimportant persons. Such practices should be stopped at once. The geysers are more than worthy of preservation. It is not only that they constitute a superb spectacle in themselves; they are likewise unique, both in performance and design. Nature, abandoning for the time all thoughts of utility, seems to have been amusing herself in this far-off and long-hidden corner of the world by devoting some of her grandest and most mysterious powers to the production of forms of majesty and beauty such as man may not hope to rival.

The geysers, in the slow process of centuries probably, have built up miracles of art, of an enduring though brittle material, that can be ruined in five minutes by a vandal armed with an ax, and nearly all the craters show signs of the hopelessness and unrestrained barbarity of many of their visitors. It cannot fail to fill the mind with indignation to see the utter ruthlessness of these sacrilegious invaders of nature's sanctuary. To procure a specimen of perhaps a pound weight, a hundred pounds have been shattered and destroyed, and always in those places where the most cunning art has been displayed, and the ruin produced is correspondingly great. Upon our arrival in the basin, we found several persons already encamped, and a whisky-trader snugly ensconced beneath his 'paulin, spread in the shelter of a thick pine. The visitors prowled about with shovel and ax, chopping and hacking and prying up great pieces of the most ornamental work they could find; women and men alike joining in the barbarous pastime.

With regard to the play of the geysers, our visit was well-timed. Just at twilight, the "Bee Hive," 400 feet distant, on the opposite bank of the river, gave an exhibition of its power. The crater is a small, conical, gray mound of silica, severely simple and unpretentious in appearance, with an aperture of some 18 inches, from which steam gently escapes. Near by is a small vent, which is the herald and precursor of its greater neighbor.

Before the "Bee Hive" plays, this vent commences to emit steam loudly, with occasional splashes of water. Soon the geyser begins to boil and steam, the water occasionally surging over. Suddenly comes a burst of 15 or 20 feet, and then almost instantly the slender shaft rises to a height of nearly 200 feet. So great is the impetus, and so slender the column, that the water, in its swiftest ascent, is nearly all dissolved into fine spray, which drifts off with the clouds of steam before the wind, to fall like rain. The play lasted about three minutes, and ceased as suddenly as it had commenced.

An hour and five minutes after his previous display, "Faithful" again reared his magnificent column, and during the night, whenever the roar was heard, we looked out from our tents at the grand sight, rendered more beautiful by moonlight. The intervals were exactly 65 minutes in every case.

August 22—We were aroused at an early hour by the report that the "Bee Hive" was again about to play. This proved a false alarm, but sufficed to draw us across the river, which was some 25 feet wide and 1½ to 2 feet in depth, and while on the opposite bank we examined the huge pool of the "Giantess," which was known not to have played for some weeks, for symptoms of agitation. We found it full to the brim with beautifully clear water, of a deep blue, boiling gently, and giving out clouds of steam. It stands upon a hill of silica, 420 feet from the "Bee Hive" and 300 yards from camp.

While waiting for breakfast, attention was called to the Grand Geyser, half a mile below camp, on the east bank, which had begun to send out great volumes of steam. Hastily mounting the nearest horses, we hurried down to it. The Grand Geyser is double, the two orifices 15 or 20 feet apart. The down-stream one has a handsome crater, while the other has only an ornamental pool, several feet lower. It is from the pool, however, that the discharge takes place. Rising with rapidly succeeding impulses, the column rushed to a height of some 80 feet, sustained itself for a few seconds, fell, rose again, and receded to its basin. In a minute or two it again shot to the same height, again faltered, rose, and subsided. Still a third effort was made and exhausted, and the waters receded until the empty basin was exposed to view, and could be examined with impunity. Meanwhile the neighboring geyser was splashing its waters in all directions, and discharging clouds of steam, while a steam-vent close at hand kept up a most outrageous roar. Though not so lofty a play as some observed by previous visitors,
the exhibition was very fine; the swiftly successive pulses of water and steam breaking into beads and spray at intervals up the full height of the column, accompanied by vast clouds of vapor, and the mighty roar, combined to make an imposing and beautiful spectacle.

The surroundings of the “Grand” are the most ornate of all, and exhibit greater variety and beauty than any other.

The “Turban,” which stands at the northern edge of the “pool,” serves to distinguish the geyser. It is of singular form, highly ornamented, and I experienced almost a pang in becoming conscious of an apprehension that I should meet it again somewhere on exhibition. Some visitor, a little more enterprising than his predecessors, will be sure to detach it and carry it off. Shovel and ax had been busy with the geyser, and large quantities had been removed.

While returning to camp, the “Castle,” on the west bank, was observed to be in agitation and giving out vast quantities of steam. A discharge soon took place, to a height of 10 or 15 feet only; but from the commanding position of the geyser and its handsome appearance, possessing, as it does, a high mound, richly decorated, and several apertures through which it plays at once, the sight is very fine. Several times during the morning it repeated its performance, rarely exceeding, however, 20 or 25 feet. After breakfast we returned to the “Giantess,” which was evidently during the morning it repeated its performance, rarely exceeding, however, 20 or 25 feet. After breakfast we returned to the “Giantess,” which was evidently becoming more excited, and, while awaiting its discharge, examined the surroundings more closely.

The basin is some 25 by 16 feet and 25 or 30 feet in depth, with scalloped margin; 70 feet north of this stands a handsome boiling spring, which has built itself a sarcophagus 2½ feet in height, like a huge bath-tub, with richly ornamental borders. This operates in sympathy with the “Giantess;” it is evidently becoming more excited, and, while awaiting its discharge, examined the surroundings more closely.

About 11 o’clock, this, the greatest geyser, gave its first spout, and we continued watching its subsequent action until nearly 3 p.m. The water was expelled by a succession of violent splashes to a height of 15 to 50 feet, but without at first reaching a great altitude. With occasional lulls, the performance went on, the water sometimes being thrown 100 feet in the air. Large stones and stumps were cast into the basin and hurled instantly to a height of 200 feet, the high wind which prevailed at the time preventing the water and steam from attaining a similar elevation. The water fell occasionally, leaving the basin empty; and by standing on the windward side we could look down into it and see the large triangular-shaped vent at the bottom, whence issued the transparent steam. Again and again the geyser renewed its strength, sending out vast volumes of steam with a deafening roar that shook the whole valley, and occasionally snatching hold of a new reservoir of water and instantly ejecting it; each fresh access of wrath or travail being heralded by deep, mighty thuds, as though some vast machinery were at work beneath. The exhibition of enormous power wasted in these prolonged spasms of blind rage was both fascinating and terrible, and the imagination, powerfully stimulated in the presence of such strength and fury, could not avoid imputing to the scene the attributes of gigantic passion and suffering. It seemed as though the geyser, maddened by some inexpressible and mysterious torment, were imprisoned beneath and gradually exhausting herself in unavailing struggles to escape it by bursting the bonds that held her, the paroxysms of efforts being alternated with intervals of stupor, again and again overcome by her still unabated rage.

During the afternoon, the “Bee Hive” again played, the high wind depressing its column below that of the previous discharge.

A party, about dark, came in from Virginia City. Following up the valley of the Madison River, they had brought two wagons without much difficulty through the Lower Basin, but were compelled to leave them a short distance above on account of the fallen timber and bog along the trail. The distance to the Upper Basin from Virginia City is 110 miles.

August 23 — All the first-class geysers had now been favorably seen, with the sole exception of the “Giant,” toward whose picturesque crater we went, with the intention of devoting the day to it. The “Broken Horn” is a well-chosen and descriptive name, and worthy of being retained. The crater is a steeply conical mound of geyserite, 12 or 15 feet in height, tapering toward the summit, and having the west side broken down, or rather partly unconstructed. The geyser still boiled strongly, and we felt great hopes of seeing it play. Near by are the “Grotto,” seen yesterday, and which played almost constantly during the day; the “Pyramid,” a cone of silica 25 or 30 feet high, with steam slowly escaping from it, but its life now nearly extinct; the “Punch Bowl,” and smaller ones. The last-named geyser played frequently during the day, some of its exhibitions being very fine. We waited the greater part of the day for the “Giant” to give us a display, but though evidently powerfully excited and from time to time arousing fresh hopes, to our great regret failed to do so. Returning toward camp, the “Grand” again gave indications of strong disturbance, and we remained there for an hour, but without result.

While waiting, we had additional evidence of the brutality of the average visitors, several of whom, of both sexes, were busily chopping and prying out the
were now some thirty visitors in the basin. Afternoon from the lake. Including my party, there postpone the attack. Our shouts fortunately reached her just in time, and easily knocked to pieces. We got back to camp just in while the material, though hard, is very brittle and can only be made by a discharge from the geyser; would be destroyed. It should be remembered that 40 feet; still its very frequent flow and almost constant escape of large quantities of steam, with its striking-looking and highly ornamented crater, constitute it properly a geyser of the first class. This, too, showed, and even in a greater degree than others, how greatly protection against vandalism is needed. From every part of the “Castle” pieces had been chopped, loosening quantities of the rock and threatening to ruin the construction. Two women, with tucked-up skirts and rubber shoes, armed, one with an ax, the other with a spade, were climbing about. Should this continue for another year or two, the beauty of form and outline of the geyser-craters would be destroyed. It should be remembered that these craters were constructed with the greatest slowness by almost imperceptible additions, which can only be made by a discharge from the geyser; while the material, though hard, is very brittle and easily knocked to pieces. We got back to camp just in time to prevent the fall of an uplifted ax, which a woman was evidently about to bring straight down on the summit of the “Bee Hive,” whose modest crater forms so strong a contrast to the grandeur of its play. Our shouts fortunately reached her just in time, and subsequent remonstrance induced her at any rate to postpone the attack.

Another party of four men came over in the afternoon from the lake. Including my party, there were now some thirty visitors in the basin.

August 24 — Broke camp for the return to Ellis. I should have liked to return by way of the Madison Valley, for the purpose of examining that route, which at present is the only practicable one for wagons into the park; but I had reason to believe that the Missouri River navigation would probably close about September 20, and the long journey of 375 miles back to Carroll had yet to be made, and a few days’ delay at Ellis, in order to refit and procure fresh transportation, to be allowed for. We took the back trail to the Lower Basin, examining en route the Fan, Riverside, and Sentinel Geysers. The day was cold, dark, and wet, the air chill and raw. Below the Upper Basin we met three men going to the geysers, each of whom, I supposed, would carry off 20 pounds of specimens and destroy 500. The trail between the two basins is about the worst in the park, and stands in urgent need of improvement, which could readily be effected, and without the use of skilled labor. Timber, fallen and standing, could easily be chopped and thrown aside, and the marshy places in great part avoided by making the trail on higher ground along the foot-hills. Crossing the Lower Basin, which the rain had made miry and passing our former camp, we continued up the valley of the East Fork, the principal features of which are alkaline marsh, dead timber, and little or no grass, the surrounding hills being equally uninteresting to the rapid traveler.

I was desirous, on the score of time, to take the trail direct from the East Fork to Gardiner’s River Springs, but a brief examination convinced me that nothing would be gained, as it was obstructed with fallen timber. The ascent out of the Madison Valley to the divide was laboriously made, the rise being fully 1,000 feet, and the back trail down the Yellowstone slope pursued. The Sulphur Springs, three in number, were briefly examined en route. They exhibit considerable activity, though evidently waning in force. The jets of vapor deposit small cones of nearly pure sulphur.

Emerging from the timber, and soon after reaching the head of Alum Creek, we left the trail going on to the Mud Geyser, and inclining to the left crossed a range of prairie hills, and followed down the left bank of Alum Creek until the main trail down the Yellowstone was reached. This was pursued for 2 or 3 miles farther, and camp made in a drenching rain on a small creek, which we named “Jay Creek,” and near the point where the two trails from Cascade Creek had united coming up. We had traveled for eleven hours and made about 36 miles.

August 25 — Took the back trail over which the pack-train had traveled on the journey out, past our former camp of the 16th and 17th on Cascade Creek, and up the creek-valley. The day was very wet and cold, and desirous as I was of again looking at the Grand Canyon, I was unwilling to impair my vivid recollection of it by seeing it for the last time deprived of its marvelous wealth and brilliancy of color.

As we neared the belt of hills stretching nearly east and west across the trail, and commenced to ascend the shoulder of one of them, we were greeted with a sharp burst of hail, followed by successive gusty showers. The rain made the mountain-trail a hard
one, turning the rich, black mold in the narrow bridle-path to a slippery mud, and making the up and down grades equally severe on the animals. The trail gradually ascends from the head of Cascade Creek to the divide between two mountains, thence following partly the valley of another creek, which rises nearly at the summit of the divide, descends a long winding slope, with many fatiguing and unnecessary rises and falls, until the west part of Mount Washburn is reached. Ascending this rapidly but laboriously to the shoulder, we were in a few minutes enveloped in a blinding snowstorm from the west and north, which forbade another ascent to the summit of the mountain, and continued until we were about to descend from the Elephant’s Back. The thermometer fell below freezing, the wind blowing in furious gusts, and the snow occasionally turning to hail, with frequent splashes of rain. As we were about leaving the Elephant’s Back, half-frozen and entirely discontented with the weather, a change took place. A rift suddenly opened in the clouds to the northward, and rapidly widening disclosed the mountain-tops brilliantly white with fresh-fallen snow, which reflected the clear rays of the sun; the dense strata of clouds drifting black and heavy beneath; the sun soon after reached us with grateful warmth.

The trail winds rapidly down to Tower Creek, just before reaching which two deer were seen, the only game animals we encountered in the park. A number of trout were taken at the mouth of the creek, and we were much disappointed to find that out of twenty-five cooked for supper two certainly were affected by the worm previously mentioned. It has been hitherto stated, and generally believed, that the wormy trout were confined to the lake and river above the falls. It afterward appeared that one captured in Cottonwood Creek, between Ellis and Baker, and several from Deep Creek east of Baker, were affected in the same way. Camp was made at the former place on Meadow Brook, and rain came on again in the evening.

August 26 – A visit was paid to Baronet’s Ranch, across the bridge, in the forks. We found there a large collection of specimens from Amethyst Mountain, on the east side of the river, a locality which we had not time to visit. The specimens were mainly impure amethysts and forms of quartz, chalcedony, etc.

The weather continued unpropitious as ever, and in a drenching rain the back trail up Meadow Brook was resumed. In such weather, the trail is difficult and in places not a little dangerous. It leads along and ascends slopes of clay which the rain makes exceedingly treacherous and slippery, where a misstep would precipitate a mule with its pack or a horse with its rider down several hundred feet. A great improvement could be made with comparatively little labor by widening the trail and placing rocks on its outer edge. Rain fell all day, with occasional intervals of sunshine; the trail over the broad rolling divide between the Yellowstone and Gardiner’s River affording a good road, however, even in such weather. The Gardiner’s River Falls were passed, and the long, sloping descent made into the valley, out of which we again climbed to the springs, just before reaching which camp was made.

Thus terminated this most interesting trip, which had covered, by rail, water, and on horseback, thirty-three hundred miles of travel in ninety-three days, through every variety of landscape, from the most forbidding to the grandest and most picturesque.

I beg leave to add the following suggestions relative to the National Park. The main points are such as would present themselves to any visitor capable of appreciating the wonders of the park, and have been in some cases anticipated in the remarks and recommendations of previous visitors. Nevertheless, a repetition of them can do no harm, and will at least show what the concurrent testimony on the subject is.

Congress, by an act approved March 1, 1872, . . . set aside the area therein defined (and which intended to include all the more remarkable objects and scenery) as a national domain, and consecrated it to the enjoyment and improvement of all mankind. For this purpose, the park was placed under the control of the Secretary of the Interior; but, unfortunately, the act provides no further practical measures for its improvement than authorizing the making of small temporary leases (the revenues from which should be devoted to the proper management and improvement of the park) and the promulgation of regulations mainly looking to the preservation of the game. I am not informed as to whether any such leases have been made; but it is certain that no expenditures have been made for the improvement of the park, nor even for its proper protection. Of the preservation of the game I will mention some facts further on. The park remains in the same wild, secluded condition in which it was discovered, a few squatters and hunters inhabiting it. The number of visitors is not great, but is yearly increasing, and is mainly made up from the inhabitants of the Montana towns. Until some railroad facilities shall make the journey less expensive and fatiguing, the people at large can hardly avail themselves of the “pleasuring ground” so provided. Meanwhile, however, those who from propinquity are able to do so are entering upon the possession of their privileges, and abusing them by
Giantess Geyser, photographed by Jackson in 1871.
the wanton destruction of what was intended to be for the edification of all.

The treasures of art and beauty, cunningly contrived by the hand of nature, are in process of removal to territorial homesteads, and the proportion of material destroyed to that carried off is as ten to one. Hunters have for years devoted themselves to the slaughter of the game, until within the limits of the park it is hardly to be found. I was credibly informed by people on the spot, and personally cognizant of the facts, that during the winter of 1874 and 1875, at which season the heavy snows render the elk an easy prey, no less than from 1,500 to 2,000 of these, the largest and finest game animals in the country, were thus destroyed within a radius of 15 miles of the Mammoth Springs. From this large number, representing an immense supply of the best food, the skins only were taken, netting to the hunter some $2.50 or $3 apiece, the frozen carcasses being left in the snow to feed the wolves or to decay in the spring. A continuance of this wholesale and wasteful butchery can have but one effect, viz, the extermination of the animal, and that, too, from the very region where he has a right to expect protection, and where his frequent inoffensive presence would give the greatest pleasure to the greatest number.

The cure for these unlawful practices and undoubted evils can only be found in a thorough mounted police of the park. In the absence of any legislative provision for this, recourse can most readily be had to the already existing facilities afforded by the presence of troops in the vicinity and by the transfer of the park to the control of the War Department. Troops should be stationed to act as guards at the lake, the Mammoth Springs, and especially in the Geyser Basin. A couple of signal-sergeants might profitably be employed in keeping meteorological and geyser records, which would be of great interest and value.

In time, with faithful supervision, the park could easily be made self-supporting. Franchises and leases will be valuable, and, properly administered, would furnish a revenue sufficient to proceed gradually with all the improvements required. But meanwhile, and before any improvements can be judiciously undertaken, an indispensable preliminary would be a thorough and accurate topographical survey, which, having been completed, would serve to indicate where roads and bridle-paths could best be opened or most improved. The boundaries of the park could at the same time be run and laid down upon the ground.

For this a small annual appropriation of from $8,000 to $10,000 should be made, and the survey might properly be under the charge of an engineer officer, who, while making his survey and map, might at the same time be turning his attention and devoting, perhaps, a certain sum to the selection and construction of better routes of travel. While it would not be possible at once to make the park practicable for vehicles, the pack-trails could be vastly improved at slight expense, the survey indicating the best routes. An observatory on Mount Washburn, with a wire to Bozeman, could be constructed cheaply, and furnish a starting-point whence all the higher peaks, and from them the intervening country, could be mapped. Rough bridges could be constructed where needed, and the worst portion of the trail corduroyed. This preliminary work accomplished (and about two seasons' work would be required for it, the yearly appropriation being continued), the roads could by degrees be made practicable for wagons and carriages. Lodging-places could be constructed at the Mammoth Springs, the bridge, the falls, the lake, and the geyser-basins, for the accommodation of visitors; and these, after the construction by the engineer officer, should be under the charge of an officer detailed to make constant inspections of them and of the detachments doing guard and police duty in the park. Visitors should be forbidden to kill any game. The hunters should have their arms and spoils confiscated, besides being liable to prosecution.

For the accomplishment of these purposes, it would certainly be most convenient and expedient to take advantage of the presence and organization of the military, and to intrust the care of the park, at least temporarily, to the War Department; at least until such time as a civilian superintendent, living in the park, with a body of mounted police under his orders, should suffice for its protection.

The day will come, and it cannot be far distant, when this most interesting region, crowded with marvels and adorned with the most superb scenery, will be rendered accessible to all; and then, thronged with visitors from all over the world; it will be what nature and Congress, for once working together in unison, have declared it should be, a national park.

Dan C. Kingman, 1852 - 1916.
The Grand Loop:
A Legacy of Dan C. Kingman

During its first decade Yellowstone National Park existed as a “public park or pleasuring ground” only in the wording of the statute. Anyone who ventured into Yellowstone in those years had to be more explorer than tourist. Visitors encountered hostile Indians in or near the park as late as 1877, and well into the 1880’s they faced crude, frequently impassable trails which could only be called roads euphemistically. Poaching and vandalism raged unchecked. And park administration was ineffectual and at times corrupt. Most of these problems stemmed from Congressional reluctance “to go into show business.” The park received no funds during its first five years and only token sums thereafter.

A turning point came in 1883, when Congress entrusted park improvement to the Corps of Engineers and authorized the Secretary of the Interior to call upon the Army to patrol the area. The Secretary took no action until 1886, when at his request a cavalry troop was detailed to Yellowstone; but the Corps lost no time in assuming its new duties. The park assignment went initially to Lt. Dan C. Kingman, Engineer Officer of the Department of the Platte. Second man in the West Point class of 1875, Kingman had served with the Engineer Battalion at Willet’s Point, New York, and had taught engineering at his alma mater. His performance at Yellowstone reflected superior abilities that would, in time, win him the coveted post of Chief of Engineers.

When Kingman arrived at the park in the summer of 1883, he found 160 miles of primitive unlinked roads — narrow, crooked, hilly, and poorly drained, “all very bad.” During his three-year tour, he successfully launched a program of permanent construction completing thirty miles of solid, durable roads, no mean feat in such formidable terrain. But his big achievement was not in building but in master planning. His major contribution was the concept for the Grand Loop, the present system of beltline scenic roads, which he designed to enable “tourists to visit the principal points of interest in the Park without retracing their steps; and to take a long or short trip, according to the time and means at their disposal.” A true conservationist, he based his plan “upon the supposition, and in the earnest hope, that [the land] will be preserved as nearly . . . as nature left it — a source of pleasure to all who visit it, and a source of wealth to no one.”

Kingman made no formal report of his Yellowstone endeavors but he did leave behind a sheaf of notes, extracts of which his successor, Capt. Clinton B. Sears, included in his own report for 1887. Kingman’s notes clearly showed his sincere attachment to the park, his horror at the thought that it might become “a sort of Coney Island,” and his opposition to building unnecessary roads and bridges and to routing a railroad through the park. In all of his efforts, Kingman viewed preservation of the park as “of more than national importance.” Yellowstone, he believed, was “an object of direct and personal interest, now and in times to come, to travelers and scientists the world over.”
REPORT

Mammoth Hot Springs, 1886

An act of Congress, approved March 3, 1883, appropriated $40,000 for every purpose and object necessary for the protection, preservation, and improvement of the Yellowstone National Park, including compensation of the superintendent and his assistants. The salaries of these persons were fixed by the act, and amounted in the aggregate to $11,000. The act provided that the balance of the appropriation should be expended in the construction and improvement of suitable roads and bridges within said park, under the supervision and direction of an engineer officer detailed by the Secretary of War.

This was the beginning of systematic road construction in the Park. Prior to that Congress had made a number of small appropriations for the protection and improvement of the Park, and a portion of this money has been expended by the different superintendents in opening roads and trails. These roads and trails made it possible to reach the various points of interest in the Park, but the work done was temporary and the locations were faulty, and thus were of little or no value in the general plan of permanent improvement.

In July, 1883, I was designated by the Secretary of War to carry out the provisions of the act before referred to, and I went to the National Park. I found the following roads in existence then:

A road from the western boundary to the Forks of the Fire Hole River, about 20 miles in length.

A road from the last-named point to Mammoth Hot Springs, about 40 miles.

A road from Mammoth Hot Springs to the mouth of the Gardiner River, about 4 miles.

A road from Mammoth Hot Springs eastward via Baronett's Bridge towards Clark's Fork Mines, about 50 miles.

A road from the Forks of the Fire Hole River to the Upper Geyser Basin, about 10 miles.

A road from the same point to the Falls of the Yellowstone River, about 28 miles.

A branch from this road to the outlet of the Yellowstone Lake, about 8 miles.

In all about 160 miles of road, over which one could pass with a wagon under favorable circumstances with more or less difficulty.

In addition to this there were many miles of blazed trails, passable on horseback.

The roads . . . were all very bad -- barely passable even in good weather. The lack of means and the desire to reach in some way the various points of interest had forced those in charge to be guided in their location by the question of first cost. Very crooked as well as very hilly roads were the result. In general, only trees enough have been cut down to permit the passage of a single wagon, and the stumps were left standing well above ground.

For miles the roads were so narrow that teams meeting had great difficulty in passing, and an outrider was a necessary adjunct of a train. Such bridges as had been constructed were covered with small poles, and there were long stretches of badly built corduroy that were almost impassable when wet.

The side-hill cuttings were generally supported on the outside by small logs and brush, and were necessarily very temporary in character. No attention had been paid to drainage, and the water ran in the middle of the roads, or stood in pools in the low places.

The principal points of interest, and those which the public were most anxious to visit, were: The Mammoth Hot Springs, the Norris Geysers, the Lower Geyser (at the Forks of the Fire Hole River), the Upper Geyser, the Yellowstone Lake, and the Falls and Grand Canyon of the Yellowstone River, and it will be seen that the existing roads enabled the tourist to visit them all.

The approaches are, first: Via the Northern Pacific Railroad to Livingston, Mont.; thence by the Park Branch Railroad to Cinnabar, Mont., from which it was about 8 miles to Mammoth Hot Springs. And second: Via the Utah and Northern Railroad to Beaver Canyon, Idaho; thence by stage up the valley of the Madison River to the Fire Hole Basin, about 100 miles. By far the greater number of travelers chose the former route.

Such was the condition of affairs at the time of my arrival in the Park.

The project that I have prepared for the improvement of the Park called for the construction of . . . [a 223-mile] system of roads, [which], if
MAP OF THE
YELLOWSTONE NATIONAL PARK
SHOWING ROADS
completed, under construction, and
approximately projected.

NOTE:
Completed Roads
Uncompleted
Projected
Old Trails

Compiled from Map of U.S. Geological Survey
and other sources.
To accompany Major Charles J. Allen's
project dated November 1868.
constructed, would enable tourists to visit the principal points of interest in the Park without retracing their steps; and to take a long or short trip, according to the time and the means at their disposal.

The route from Mammoth Hot Springs through the Norris Geysers to the Lower and Upper Geyser Basins, thence to Shoshone Lake, thence to the Yellowstone Lake, and along the lake to the outlet, thence down the river past the Mud Geysers to the Falls, thence along the brink of the Canyon, and over the shoulder of Washburn to Tower Creek and Falls and to Yancy’s, and thence back to the springs, would enable persons, without retracing their steps, to visit all the principal points of interest, and would be a journey of about 150 miles.

By not visiting the lakes and going from the geysers to the falls the journey would be reduced to 125 miles, and by going from the Norris Geysers to the falls the trip would be but 80 miles.

The region embraced by the Yellowstone Park, from its high, rugged, and mountainous character, presents in varied forms and combinations almost every obstacle that nature offers to the construction of roads. There are steep mountains, dense forest, rocks, streams, canyons, and marshes, heavy rains, deep snows, besides the peculiar hot springs formations, which are very extensive, and afford the worst road material I have ever met with.

I recommended that no more bad roads be built in the Park, but that thereafter they have something of the solid, durable, and substantial quality that usually characterizes the works constructed by the Government.

I therefore proposed that all roads in the National Park should be made at least 18 feet wide and well-rounded up in the center, and provided with suitable side ditches and cross-culverts; that all trees be removed for a width of 30 feet; and on side-hill cuttings the fill to be retained by a dry stone wall, and that an ample ditch be placed on the uphill side to catch the snow-water and carry it to the natural water-courses; that all culverts be of stone or 3-inch plank; and that all bridges be well constructed of sawed lumber.

After carefully examining the country through which the roads would have to pass, I was satisfied that suitable ones could not be built for a less average cost than $1,000 per mile, nor properly maintained for a less annual outlay than 10 per cent of the first cost. In the execution of the project it was proposed to make such repairs to the existing roads as would enable them to be used till the new ones could be built; then, as the amount appropriated was very small, in comparison with the estimated cost, it was proposed to expend it on such parts of the new system of roads as would be of most direct and immediate benefit to travelers in the Park. The work was all done by hired labor, and the supplies were purchased in open market. The repairs above mentioned consisted in widening and straightening the roads, removing stones, stumps, and trees, improving the drainage, constructing turn-outs at frequent intervals, reducing slopes, repairing bridges and fords, covering corduroy with sods and earth, etc., and the cost was from $25 to $175 per mile. The roads were much improved; but they were very far from being good, even then.

In the meantime I commenced a new road from Mammoth Hot Springs to and through the canyon of the west fork of the Gardiner River, to connect with the road of the Fire Hole, at a point near Swan Lake.

At the end of the working season of 1883, I estimated that it would require $205,000 to complete the project; of this amount, $6,000 was for office and quarters; $20,000 for the road from Yancy’s to Clark’s Fork: . . . thus leaving $179,000 as the amount necessary for completion of the system of roads that now form the project.

The superintendent of the Park was authorized by the Secretary of the Interior to expend such portion of the appropriation as might be necessary for the protection and preservation of the Park. This reduced the amount available for roads and bridges from $29,000 to $23,570.03.

The total amount that has been expended upon this work, up to [June 30, 1886, is $69,779.42].

The first [new road, from Mammoth Hot Springs to Gardiner, Montana] was begun in the summer of 1884, and was completed August 18, 1885. This is the route followed in going from the Park to the terminus of the Northern Pacific Railroad, and is used as a freight road, as well as for the transportation of passengers. It is used by the superintendent of the Park and his assistants, and other residents of Mammoth Hot Springs, during the entire year. They receive their mail and supplies over it, and therefore, unlike most of the roads in the Park, it must be practicable at all times; in other words, it must be a winter as well as a summer road.

The total cost of the work was $7,750.52.

The second piece of new work (Mammoth Hot Springs to Swan Lake) was commenced in September,
The first road through Gibbon Canyon, shown here near Gibbon Falls, was built by the Engineers in 1885.
A team of horses toils along old Mount Washburn Road.
Road from Mammoth Hot Springs to Swan Lake, shown here bridging Golden Gate near Kingman Pass, built by Engineers, 1885.
1883, and finished June 12, 1885. This road was intended to avoid the worst obstacle to the entrance to the Park from the north, which was the steep hill which must be ascended in order to reach the plateau lying south of Mammoth Hot Springs, and commanding the site of the hotel some 1,200 feet. This ascent was overcome by the old road in about 2 miles, and not by a uniform grade either, but by a series of inclines so steep as to be almost impassable for a loaded wagon when the ground was wet, and dangerous to descend at all times. The new road follows up the west fork of the Gardner River, and unites with the old one about 5 miles from the starting-point. This route, though heavily timbered, and covered in many places with rocks and bowlders, offered no serious obstacle to the construction of a road until the head of the Canyon was reached. Here, for about 1,000 feet, the rock walls approached each other, and were nearly vertical, and the little stream in the canyon had a fall of 60 feet. The walls were too high to admit of the road being carried over the top. This quarter of a mile was by far the most difficult and expensive piece of work undertaken in the Park.

At the mouth of the canyon the wall was nearly vertical, and sufficient roadway could be secured only by cutting and breaking down the solid rock over 100 feet. The cost of this would have been excessive. The road in this portion was supported by timber trestles.

The total length of the structure is 224 feet, and its cost was $3 per running foot. When the rock walls were sufficiently inclined the road was built entirely in excavation. At some points it was necessary to begin work 70 feet above the proposed road-bed.

The excavation of this work required the removal of over 14,000 cubic yards of solid rock, besides a very large amount of rock in a crushed and broken condition. Twelve hundred and seventy-five pounds of explosive (one-half of which was dynamite) was used in the work, and nearly 1,300 shots in drilled holes were fired. The work was accomplished without accident or injury to any one. The benefits conferred by this improvement are very marked. The distance from Mammoth Hot Springs to the Geysers and other points of interest is reduced 1½ miles, and the height to be overcome in reaching the Swan Lake Plateau is reduced 250 feet. The ascent is made so gradually that loaded teams pass over the road in both directions with ease and safety, and the time required to go from Mammoth Hot Springs to points within the Park has been shortened by the improvement alone from two hours to a half a day, depending upon the team and its load. The total cost was $14,395.39.

The third new work is the road from the south end of Beaver Lake to the hotel at Norris Geysers Basin. It was begun and finished in the summer of 1885. The object of this road was to avoid a series of obstacles due to bad location.

The new location follows a lower level, giving drainage, exposure to the sun, and a soil more suitable for road covering. The total length of the section is 7 miles, and its cost of construction was $6,269.80, or about $993.62 per mile, including wear of tools, office expenses, etc.

The fourth improvement (Fire Hole to Upper Basin). This road was completed in one season (1885). Its length is 8.9 miles, and its cost was $6,042.53. It reduces considerably the distance to be traveled in reaching the Upper Geyser Basin. It is well built throughout, and its bridges and culverts are of the most substantial character. It follows the river, and is sensibly level, and as the road-bed is mostly composed of gravel that packs well, it is a very pleasant road to drive over.

The fifth new road (through Gibbon Canyon) was commenced in the summer of 1884 and completed August 1, 1885. This section, about 3 miles in length, was generally one of the worst in the Park, and was dreaded alike by drivers and tourists. It is now a good road at all times, is never muddy, and forms a stretch that drivers soon select to make up lost time on. Its total cost was $4,604.64, including a very good bridge that cost $877.

The sixth section was along the Yellowstone River, near the Falls. The improvement was made in the summer of 1884 and cost $1,919.57.

This was the condition of affairs at the beginning of the present fiscal year [1887] . Up to this time the funds for the work had been disbursed by the superintendent of the Park on my vouchers duly certified. The appropriation for the fiscal year ending June 30, 1887, amounted to $20,000, and it was provided in the act that this money should be expended under the direction of the Secretary of War.

The project for its expenditure was as follows: First, to build a wagon-road from Norris Geysers to Grand Canyon, 12 miles, cost $12,000; Second, general repairs to existing roads, $8,000.

Work was pushed vigorously on the new road, but owing to early snow-storms and bad weather it was not completed. Its total length is 11½ miles. All of the trees, stumps, and rocks have been removed from
the right of way, and about 9 miles have been graded. The amount expended on this work is $9,368.48, and I estimate it will require about $3,000 to complete the work. About $1,000 of this will be needed for the repair of the portion graded last fall, for, being soft, it will probably be washed a good deal. I also made thorough repairs (amounting to rebuilding) to the section of road from Green Creek along Beaver Lake and Obsidian Cliff. The work was expensive on account of the number of rock cuts, and it is very well done. The right of way is cleared for about 2½ miles and it is graded and finished for about 1½ miles. A very good bridge was built across the outlet of Beaver Lake. The cost of the improvement was $4,431.49.

By direction of the Chief of Engineers I submitted an estimate October 9, 1886, [of $150,000 for the fiscal year ending June 30, 1888]. This will build 100 miles of new road and repair 100 miles.

In the foregoing I made no estimate for the road from Yancy’s to the boundary of the Park towards the Clark’s Fork mines. This item has been omitted from the estimate since the first year of the work. About this time an effort was made to secure from Congress a right of way for a railroad through the Park to reach these mines. If this railroad was built there would certainly be no need of a wagon-road. Fortunately this bill failed each year to become a law, and now another route, that does not pass through the Park, has been found, and the matter may be regarded as settled.

I think, however, that a road should some time be built as far as Soda Butte. This is a very beautiful and interesting portion of the Park, and Soda Butte ought always to be kept up as a game-keeper’s station. In regard to railroads, I need only say that I should regard their introduction into the Park, upon any pretext whatever, as a very serious detriment and injury, and I think that all true friends of the Park should oppose them by every means in their power.

It is very difficult to make plans for the improvement of the Park, on account of the uncertainty as to what its future is to be.

The law says that it is dedicated and set apart as a public park or pleasure ground, for the benefit and enjoyment of the people. As long as its timber is preserved it is valuable as a reservoir for our two great rivers. If it were extended, so as to include winter as well as summer ranges, it might also afford a last resort and permanent abiding place for the large game of the country.

The plan for improvement which I have submitted is given upon the supposition, and in the earnest hope that it will be preserved as nearly as may be as the hand of nature left it — a source of pleasure to all who visit it, and a source of wealth to no one. If the Park ever becomes truly popular and national, it will be when the people come to know and appreciate its delightful summer climate, the wonderful efficacy of its baths and its mineral waters, as well as the natural wonders, beauties, and curiosities to be seen there; then, if there are numerous small, quiet hotels scattered here and there throughout the Park, where visitors can have plain and simple accommodations, at moderate prices, the overworked and the sick, as well as the curious, will come here, not to be awed by the great fall and astounded by the geysers, and then to go away, but will come here and remain for weeks or months, and will find what they seek — rest, recreation, and health. But if it ever becomes the resort of fashion, if its forests are stripped to rear mammoth hotels; if the race-course, the drinking saloon, and the gambling-table invade it; if its valleys are scarred by railroads and its hills pierced by tunnels, if its purity and quiet are destroyed and broken by the noise and smoke of the locomotive; if, in short, a sort of Coney Island is established there, then it will cease to belong to the whole people and will be unworthy of the care and protection of the National Government.

During the past season ... the game, the growing timber, and the objects of curiosity and interest in the Park have been better protected than ever before; the number of visitors increases from year to year, and while there are many complaints of bad roads, poor and inadequate hotel accommodations, and high prices, I talked with none among the thousands who visited it who did not appreciate the wisdom that dedicated the National Park to its present uses, or who doubted that the Park was destined to a great and valuable future. It is not too much to say that if the Park can be preserved as it now is, subject only to such slight changes as are necessary to secure good roads and trails through it and proper hotels to insure the comfort of visitors, it will become, in time, a health and pleasure resort unequalled in the whole world. Its maintenance is of more than national importance; it is an object of direct personal interest, now and in time to come, to travelers and scientists the world over.

From Dan C. Kingman, Notes on “Construction of Roads and Bridges in Yellowstone National Park.” Quoted in ARCE, 1887.
Hiram M. Chittenden, 1858 - 1917.
VII
Labors of Love:
The Projects of Hiram M. Chittenden

A remarkable and lifelong commitment to Yellowstone National Park began inauspiciously in 1891 when Hiram M. Chittenden was transferred from his duties on the Missouri River near Sioux City to Yellowstone as assistant to Maj. William A. Jones. Chittenden, then a young lieutenant with seven years service in the Corps of Engineers, reached the park in the midst of a dismal spring rain. Still recovering from a bout with typhoid fever contracted the previous autumn, he nevertheless immediately joined a party that was to locate a road from the Geyser Basins to the Lake. As a portent of the skill and energy which would characterize his later work, he proceeded to lay out a road from Firehole River to the West Thumb of Yellowstone Lake with only two assistants, a hand level, and a five-foot stick.

Chittenden, a graduate of West Point and the Engineer School of Application, had served with the Engineer Battalion, the Department of the Platte, and the Missouri River Commission previous to his Yellowstone assignment. It is ironical that in 1891 he viewed the park assignment as routine and incidental. Many years later, at the close of a distinguished career as soldier, engineer, and author, he looked back on his Yellowstone work as one of his more important accomplishments. Certainly no other project was so revelatory of the man.

During his first season in the park, roads were still rudimentary and budgets still pitifully lean. The small appropriation for the next fiscal year was so late that the work period was drastically shortened. Chittenden took advantage of this opportunity to conduct an opinion poll of “the traveling public.” The responses indicated that tourists were of one mind in viewing “the present imperfect conditions of the roads, the steepness of the hills, the presence of mud or dust, [and] roughness of the roadway” as “the principal drawbacks to the enjoyment of the Park.” The poll confirmed Chittenden’s contention that “the problem of road construction in the Park [had] yet to be solved.” Realization of Kingman’s plan awaited adequate funds.

In 1893 Chittenden left Yellowstone, not to return until late in the decade. The following year responsibility for park improvements reverted to the superintendent, who held it until 1899. Despite his other assignments, river and harbor duty, and service in the Spanish-American War, and despite the Corps’ noninvolvement in park affairs, Chittenden’s interest in Yellowstone continued, and in 1895 he published The Yellowstone National Park, the first book-length study of the subject. Chittenden himself revised the volume three times, and, after three-quarters of a century, fresh editions still appear regularly.

When the Engineers resumed work in Yellowstone in 1899, Chittenden took charge of operations and remained there for six years. His annual reports for 1899 to 1905, together with his earlier reports as assistant to Major Jones, reveal a dramatic transformation in the road system under his care. By 1905 he could assert that “all the roads which it has ever been proposed to build are now open to travel” and that “there are but few portions of the roads that can not now be traveled with speed, safety, and comfort.”

Chittenden’s engineering feats in Yellowstone included at least five masterpieces: the imposing masonry Entrance Gate at Gardiner, the Melan arch bridge over the Yellowstone River above the Upper Falls, the splendid road through Sylvan Pass, the road over the almost impossible summit of Mount Washburn, and the exquisite Golden Gate viaduct, the most difficult piece of work he executed in the park. The Melan arch bridge and the Mount Washburn Road were both renamed in his honor.
With the help of the Chief of Engineers, Chittenden persuaded Congress to vote the funds that made these projects possible. Before the Corps entered the picture in 1883, appropriations for the park totaled less than $70,000. Between 1883 and 1900, sums available for the dual purpose of protection and construction averaged but $40,000 a year. By pointing out the growing importance of the park, the increased traffic, and especially the false economy of sacrificing quality to total mileage, Chittenden was able to obtain a three-year appropriation of $750,000 in 1902, a sum greater than he had dared to hope for.

His construction was remarkable, esthetically as well as practically. Whenever possible he provided the tourist with "a sense of expectancy" by avoiding monotonous straight stretches in favor of roadways that were adapted to the natural terrain and passed by points of interest. The phrase "for the improvement" of the park used in appropriation bills, he once confessed, grated harshly on his ears. Chittenden was always to feel that, almost without exception, "the greatest service which official authority [could] render to posterity [was] to maintain and transmit this possession as it came from the hand of Nature."

**REPORT**

*Mammoth Hot Springs, 1893*

The work . . . was mainly done along the Yellowstone River, consisting of road completion, general repairs, and graveling, particularly at Trout and Antelope Creeks, Alum Creek, and the stretch of road along the cut bank about a mile north of Alum Creek. After the completion of this work the opening of about a mile of new road was begun along the rapids of the Yellowstone to replace the bad stretch of old road which passes through the fields at some distance back from the river. This work was carefully laid out . . . and will form probably the finest piece of work from a professional point of view, as it certainly will be the most interesting scenic route hitherto constructed. Commencing at that point of the river where it breaks into the extremely picturesque rapids which extend for half a mile above the falls, the road leaves the river just opposite the brink of the falls, forming a fitting introduction to the general scenery of the Grand Canyon. On this piece of road will be the largest bridge yet constructed in the Park. Its length is 180 feet and greatest height about 52 feet. It crosses the inlet of a small, and generally dry, tributary of the Yellowstone. It is built on a gradient of 3 feet to 100. It is composed of three decks on the plan of ordinary railroad bridges. The proper sizes of timbers have been carefully computed and the cost of the whole estimated. It will require approximately 70 M feet of lumber, a part of which we have from last year's supply, and will cost, complete, about $1,500. The only work so far done upon it is the building of the foundation to a point above high-water mark, and the hauling of about 20 M feet of lumber to the ground. It will take but little work in addition to the completion of the bridge to make this piece of road available.

The season's work was executed under considerable difficulties, which arose principally from the necessity of organizing a force in too short a time to permit of careful selection. There are always many floating laborers or tramps (for that is what they really are) who want to go through the Park and who seize the opportunity offered by the Government work to get into the Park and out again at no expense. They are utterly useless as laborers, and it is not easy, without taking greater precautions than our limited time permits, to exclude them. All the laborers are generally poorly supplied with clothing and bedding and find the frosty nights in the mountains too severe to get along with and consequently they generally remain but a little while. The problem of getting efficient help for the work in the National Park is the most serious one we have to deal with.

After the close of the tourist season I made a statistical investigation on a small scale designed to ascertain the views of the traveling public as to what will most contribute to the enjoyment of a tour of the National Park. I was led to examine this question from the fact that the hotel company, which has been seeking an electric railway franchise in the Park, had endeavored to obtain, during the summer, the signatures of all tourists who favored an electric line as a means of transportation. Of course such an expression, being entirely one-sided, could form no fair criterion as to the actual state of opinion upon the subject. For the purpose of obtaining a fair expression upon this point, and incidentally to show how little foundation there is for the opinion entertained in certain quarters that the Park road-work is practically completed, as well as to get the general impression of visitors upon the importance of the Park as a national pleasuring
ground, I selected the name of one tourist for each day of the tourist season, covering all conditions of climate and travel, and sent to each the following questions: (1) What was the principal drawback to the enjoyment of your tour of the Park? (2) From the experience of your own tour would you advise your friends to visit the Park? (3) Assuming that there were a complete system of thoroughly macadamized or graveled roads in the Park, so constructed as largely to eliminate the mud and dust nuisance, and in which there should be no hills so steep that teams could not ascend them at a trot; and assuming also that there were a well-equipped electric railway covering substantially the same route, by which method would you prefer to make a tour of the Park: by [stage] coach or by [railroad] car?

The names selected were in all cases those of strangers to myself, and were chosen from all sections of the country in order that the answers might form as fair a basis of general opinion as possible.

Of the one hundred and twenty letters sent out about twenty failed to reach their destination, owing to the defective post-office address taken from the hotel register. The answers to the rest were full and complete, quite beyond my expectation, and were the best possible proof of the deep interest which all who have seen the National Park take in that reservation. The answers nearly always contained the additional views of other members of the particular party to which the person addressed belonged, so that the aggregate of answers considerably exceeded the number of letters sent out. The tabulated result is as follows:

Answer to first question: Condition of roads, 97; hotel accommodations, 26; transportation accommodations, 17; miscellaneous, 24; no drawback whatever, 24; no answer to question, 4.

Answers to second question: Yes, 141; no, 2; no answer, 4.

Answers to third question: By coach, 147; by car, 29.

The above answers show (1) that to the great majority of tourists the present imperfect condition of the roads, the steepness of hills, presence of mud or dust, roughness of the way, are the principal drawbacks to the enjoyment of the Park. (2) That the wonders of the Yellowstone National Park more than offset the often serious discomforts of travel. The expression of opinion upon this point was practically unanimous. (3) That tourists, by a majority of five to one, object to the introduction of electric railways into the Park. It must be stated, however, that the answers to this question were in many cases conditional upon the existence of roads such as are described in the question. It is quite certain that if the choice had been between an electric line and our present roads the vote would have been in favor of the former.

It was the third question that elicited the most interesting comments upon the Park. Many of the writers insisted at length upon the importance of keeping the Park free from corporate encroachment of any kind, especially in the introduction of any form of railroad. The use of stage coaches was considered a desirable feature of the tour. In fact, those who favored the car were in most cases those who lacked either time or physical strength for the slower and rougher method of carriage.

The whole inquiry emphasizes the importance of securing a thorough system of macadamized roads for the Park and of keeping it free from anything like railroad encroachment.

The extraordinary lateness of the season — the latest known in the history of the Park — has deferred even these minor operations beyond any previous experience and has carried them into the next fiscal year. . . .

The annual repairs, including opening the roads through the snows which lay very heavy on the higher sections of the road system, were actively prosecuted during the month of June. A veritable winter climate prevailed throughout the upper Park during the first half of the month, snowstorms being of almost daily occurrence. The melting of the snows and the frequent storms left the ground in many places thoroughly soaked, at the very time when the heavy supplies for the hotels were being hauled into the Park. It has been with much difficulty, therefore, that the roads, which as yet are composed for the most part only of the soil through which they pass, have been placed in fairly passable condition in time for the opening of the tourist season. . . . The ordinary method of doing this preliminary work, based upon many years' experience, is to send out parties at as early a day as practicable to shovel a passage through the deepest snows and then to follow up this work, as soon as the snow is mainly gone, with one or two considerable parties equipped for regular road work. These parties open and repair damaged culverts; repair the bridges, clear away landslides and fallen timber, smooth up the road surface with grading machines, repair retaining walls, and do whatever else is rendered necessary by the action of the elements during the long and severe winters which prevail in this region. As a general thing, fair weather follows closely upon this preliminary work and is the most important factor in putting the roads in good order. Under such circumstances, two or three weeks' work suffices to place the system in as good condition as it is susceptible of.
In other years, when the seasons are late and the snow melting and resultant storms continue after the spring traffic has opened, the problem is far more serious. The experiment has been tried this year on a small scale of posting section gangs at intervals throughout the Park, similar to those on railroads. Only moderate results are looked for, however, in this direction. The road system is not yet in a state of efficiency to make it a complete success. With macadamized pikes the system of small repairs by section crews would undoubtedly be the best, but now the repairs so often amount to actual reconstruction that small parties are incompetent to handle them. The section plan is being tried upon the urgent recommendation of several parties who understand the needs of the Park thoroughly from long residence here, and doubtless considerable benefit will result from the trial.

In addition to the current repair work, plans have been matured for the new work of the season which will be begun promptly upon the opening of the new fiscal year. This work will consist mainly in the building of a new road of about 3 miles length between Mammoth Hot Springs, Wyo., and Golden Gate. This line has been selected after several personal examinations by the officer in charge, and is now being laid out by instrumental surveys preparatory to commencement of the work.

In making up the estimates for the ensuing year in accordance with the customs and regulations of the Engineer Department, to which this work is now returned after the experiment of withdrawal during a period of four and one-half years, it will contribute to a better understanding of the magnitude and importance of the work if a brief sketch of its origin and development is given.

The discoverers of this region in 1870 found numerous trails of infrequent use, made by the Indians, passing over several of the routes now followed by the regular highways. As travelers became attracted here in the early seventies, saddle trails developed leading to the principal localities of interest. The main trail led from the Mammoth Hot Springs, via Mount Washburn, to the falls of the Yellowstone, crossing hence by the now abandoned Mary Mountain route to the Firehole Geyser Basins, where it was joined by another trail coming in from the valley of the Madison on the west. During the superintendency of Colonel Norris, 1878-1882, several wagon trails (mere passage ways for wagons, with no grading except where absolutely necessary) were built, and the present general line was opened from the Mammoth Hot Springs to the Upper Geyser Basin, with a line across Mary Mountain to the lake and canyon. In 1883 the roadwork was formally assigned to Lieut. D. C. Kingman, Corps of Engineers, by whom the project for the Park road system, as it has since been worked out, was prepared. Lieutenant Kingman himself made an important commencement to this work.

The project for a system of tourist routes to the various points of interest in the Yellowstone National Park, as proposed by Lieutent Kingman, and slightly modified since, embraces a belt line which makes a general circuit of the Park, approaches by which the belt line is reached from various points on the Park boundary, and side roads to scattering points of interest. To these might also be added the numerous trails used mainly by scouts and troops in protecting the Park, but involving little if any outlay for construction or maintenance.

The Belt Line, as proposed, includes Mammoth Hot Springs, Norris Geyser Basin, the Firehole Geyser Basins, the Yellowstone Lake, the Grand Canyon, and the section near Tower Falls below the Grand Canyon at the northern base of Mount Washburn. Between Norris and the Grand Canyon there is a crossroad which will always be of use for freight, even when the Belt Line is complete and tourist travel no longer passes over it.

The main approaches will probably not exceed one on each side of the Park. Of these the principal one now is on the north via the Gardner River to Mammoth Hot Springs; this is the Northern Pacific connection.

The next most important approach is from the west via the Madison Valley. The Utah Northern connection is here, although the railroad is a day's journey from the boundary of the Park.

The southern approach leads up the valley of the Snake River from the celebrated locality known as Jackson Hole, and joins the Belt Line at the Yellowstone Lake. With a southern railroad connection, this will be an important approach.

On the east there is no regular approach. There is a road to the northeast corner of the Park from near Tower Falls, but it is used almost exclusively by miners located just outside the boundary. It is probable that before many years it may be necessary to make an approach from Big Horn Basin via Jones's Pass to the outlet of the Yellowstone Lake. The necessity for such a road, however, will be contingent upon the advent of a railroad in the Basin, and it is, therefore, not included in the present estimate.

The Park itself is fulfilling the purpose of its creation beyond the expectation of its most sanguine advocates. As a refuge of the native fauna of the
Corkscrew Bridge on the Sylvan Pass road.
continent it is an unqualified success. As a resort for pleasure seekers and those interested in natural curiosities it has continually grown in public favor. Its administration, protection, and methods of caring for tourists have developed into a comprehensive and admirable system. Congress may therefore rest assured that an appropriation for the completion of the approved project of improvement of the Yellowstone National Park will be in every sense a judicious expenditure.

At the close of the last fiscal year the programme of work in the Park for the ensuing season had been laid out and operations were begun as soon as the appropriation was available. The amount of the appropriation being insufficient for the work that needed to be done, it was thought best to concentrate it as far as possible on a single portion of the work and do that thoroughly, rather than scatter it in several places. After consulting with those who are best acquainted with the needs of the Park road system, it was concluded that the work which was most urgently required was the construction of a new road from Mammoth Hot Springs to the top of what is called the Golden Gate Hill.

This hill rises about 1,000 feet above the level at the Mammoth Hot Springs hotel in a distance of 4 miles. It has always been one of the most serious obstacles to travel in the Park. The first road built up the hill was what is called in that country a wagon trail; that is, a primitive road without any grading to speak of, but simply a track capable of giving passage to wagons. It reached the upper plateau through Snow Pass, about 2 miles west of Kingman Pass, in which the present road lies, and 2 miles distant from Mammoth Hot Springs. The road was almost impassable on account of its excessive grades and was abandoned as soon as the Park work was systematically taken up.

The next road was located by Captain Kingman through the pass, where the waters of Glen Creek flow from the plateau above to the valley of the Gardiner. This pass was lower than Snow Pass and more in the direct line of the road. The Golden Gate Canyon, which constitutes the pass, was exceedingly difficult to build through and took so large a part of the funds available that only a small amount could be used on the 3 miles between Golden Gate and Mammoth Hot Springs.

The direct line between these two points, and the one where the best grades and most interesting scenery were to be found, lay through an excessively difficult tract of limestone rock. This singular formation, to which local usage has given the name "hoodoos," is quite unlike any other to be seen in the Park, if, indeed, its like is to be found anywhere else in the world. It has the appearance of unslacked common lime, and the action of fire on it is to reduce it to a white powder very much like the product obtained from slacking lime. The rock abounds in every conceivable variety of form and size, from the smallest chip to immense masses a hundred or more feet through. These masses have been thrown by some natural convulsion into a most confused and irregular arrangement in which all trace of the original positions is lost. The scenic effect, while extremely interesting, is of a weird and unusual character quite unlike anything else in the Park.

This formation varies in width from a quarter to a half a mile and is wholly impassable by wagons or on horseback. Even on foot it is a difficult and laborious matter to get through. To carry a road through it was too expensive a matter to be attempted with the funds which Lieutenant Kingman had at his disposal, and it was necessary to follow a line further east, near the immediate valley of Glen Creek, where the rough formation largely disappears. But in so doing it was impossible to avoid several very heavy grades, ranging from 10 to 21 feet in the hundred. These steep pitches have always been a great drawback to the road and the source of much danger to heavily loaded coaches going in either direction. It has been found impracticable to maintain the road in good condition. The action of brakes and rough locks in descending and of the horses' shoes in ascending was to dig up whatever surfacing material might be placed on the bed of natural rock, while the rain would wash this material to the bottom of the hill or the wind would blow it away. The result was that for a good portion of the time the rough rock under the roadbed would be exposed, making the road both uncomfortable and dangerous.

It has been intended for several years to change this location, but the demands for new work elsewhere and the difficulty of finding a better route have hitherto prevented it. In looking over the entire situation at the beginning of the present season it was considered that this work was quite as urgent as any other remaining to be done in the Park. It was accordingly decided to take it up at once and not undertake any other work until the balance remaining from the completion of this could be known.

In the selection of a route the natural conformation of the ground over the greater part of the distance led to an easy decision. The former road passed over a considerable elevation in the vicinity of the old military post and then dropped down into a valley, losing about 50 feet of grade which had to be overcome later on. It was decided to commence the new location at the top of this rise by keeping to the side of the hill and then commence the general ascent.
Chittenden Bridge across the Yellowstone.
at once. This took the road across the foot of the Hot Springs formation and by a circuitous line carried it to the top of the hill immediately in rear of the great spring. For this distance the road also serves the purpose of giving a convenient local driveway to the top of the Mammoth Hot Springs formation.

For about a mile above the top of Formation Hill the location of the road was a simple matter, as there was natural and easy grade all the way. From there on to the “Hoodoos” the choice of route was more difficult. The location was mainly on very steep slopes, requiring a great deal of heavy side cutting, and the work was costly. The position, however, is such as to give a wide and unobstructed view over the entire Gardiner Valley and to the mountains beyond.

The choice of routes through the “Hoodoos” was the result of a careful search over the entire belt that lay within the possible range of the road. The line finally selected gives a nearly level grade through the entire distance of 1,800 feet. The cuts and fills very nearly offset each other, and the cost of the work, though heavy, was reduced to a minimum.

Leaving this rocky tract, the road descends at a slight grade to the head of a ravine about 1,000 feet distant, and then ascends by a grade of from 3 to 7 per cent, until it joins the old road a little below Golden Gate Bridge. The introduction of a descending grade on the way up the hill was for the purpose of utilizing some work which had been done the previous year. A new location had then been selected, following pretty closely the old line, and considerable work had been done at the upper end. This location did not seem to be a sufficient improvement upon the old to justify the great cost of construction, and it was accordingly abandoned, except at the upper end, and the location of the present road was changed, from what it would have been, sufficiently to save this work.

On July 5 the work of construction was commenced, and was prosecuted vigorously from that time on with three large parties. The road was opened to travel on September 10. The whole length of this new road is 16,500 feet.

The bridges in the Park have always heretofore been constructed of wood, and although they have stood exceedingly well, it was believed to be better, in replacing them as they wear out, to put in steel bridges with concrete abutments. In particular it was thought best to do this with those bridges which are nearest the railroad. The cost of transportation to the interior of the Park will probably cause timber to be used there for some time to come.

[The road from Norris to the Grand Canyon] has three of the worst and most dangerous hills on the entire system. The Virginia Cascade hill is a positive menace to the lives of travelers. Several accidents have occurred here, and one life has been lost. Stage drivers are often compelled to make passengers alight and walk down the hill. The “Devil’s Elbow,” a very short turn of nearly 180°, is another dangerous place. Blandon Hill is a long, difficult, and dangerous ascent, which it is impossible to maintain in good condition. The long hill descending into the valley of the Yellowstone is composed of wretched material which so cuts up in wet weather as to be impossible of ascent by loaded wagons. The dense forests on top of the plateau retain the snow so late that it has to be shoveled out every spring at great expense. It is proposed to cut out some of the hills, reduce the grades on others, surface the bad stretches, and clear the timber away on the north side of the road so as to let the sun in. This work is of pressing importance, as the road will always be extensively used even after the Washburn road... is completed.

[The Mount Washburn Road] is the only extensive portion of the Park road system that is still untraveled. Although it will be one of the most interesting and attractive parts of all, it has never been possible in a period of over twenty-five years to get money enough to undertake it. It is a great source of disappointment to all tourists that this section of the Park is shut out to them except on horseback. That portion of the road extending from near Baronett Bridge to Mammoth Hot Springs is a part of the road leading from Gardiner to Cooke City through the Park. As is well known, Cooke City has made a long and strenuous fight to get a railroad along this line, but the Government has wisely refused this privilege. In thus refusing, however, there is something of an obligation resting on the Government to provide at least a respectable highway for travel which has to follow this route, particularly as it does not permit private parties to build roads in the Park. The road, moreover, has long been a postal route from Mammoth Hot Springs to Cooke City. This road, therefore, is required for the double reason of forming a part of the regular tourist route and providing a necessary commercial highway across the Park. The present road is one of the most difficult and dangerous to be found in all the Rocky Mountains, and it is a discredit to the Government that travel over any part of the Park has to be made at this late day over such a thoroughly wretched highway. The entire work is of immediate and pressing importance.
[A bridge over the Yellowstone near the Upper Falls] has long been of urgent importance. The public is still (twenty-seven years after creation of Park) entirely shut out from views on right bank of the Yellowstone. The superintendent has to send his patrols, for protecting the eastern part of the Park, via Baronett Bridge in extreme north of Park. The patrols at Grand Canyon and Yellowstone Lake can render no service in protecting the country on the east bank of the river. The bridge is thus a necessity both to the traveling public and for the proper police of the Park. Being in one of the grandest situations in the entire Park, its design and construction should conform to the surroundings. No cheap iron or wooden structure should be considered. It is proposed to adopt the construction known as the Melan arch, a combined steel and concrete structure in which great strength, artistic design, and reasonable cost can be combined.

The condition of the old wooden bridge at [Golden Gate Canyon] had become such as to excite general uneasiness and concern among the traveling public, and although still safe it was felt that its reconstruction could not long be deferred anyway and might as well be taken up at once. After a thorough study of the site it was decided that a concrete structure would be better adapted to the situation than any other. It could be undertaken without previous accurate measurements, which would be very difficult to make while the old bridge was in place. If steel were used these measurements would have to be determined before the material could be ordered and would so delay the work that it could not be done during the season. With concrete this made no difference, for whether the foundation went a little lower or not so low as estimated the material was of a character that would adapt itself to any irregularities or variations. The site was therefore surveyed without stripping the foundation and the necessary cement for the work ordered. The rock and sand were found near the site.

It was decided to build the new viaduct in a series of arches.

The execution of the work was of extraordinary difficulty. There was an almost constant gale of wind through the canyon, which was frequently of such force as to compel a suspension of work. During the period of concrete mixing this was a most troublesome matter, and it was found necessary to commence work each day about daylight and suspend about 11 a.m. The site of the work was very contracted, and operations were seriously hampered for lack of room to work. It was, moreover, a dangerous situation, being on the face of the cliff, where any misstep would cause a fall of from 20 to 75 feet.

The necessity of interrupting tourist traffic as little as possible made great haste necessary in the execution of the work. During the time of actual construction a temporary road was provided via Snow Pass. This road was about 1½ miles longer than the regular route and had some steep grades, but nothing unsafe. The greatest drawback was the excessive dust. There was scarcely a drop of rain from the time it was opened until traffic returned to the regular road and the newly moved earth cut up into a fine powder from 6 to 12 inches deep. . . .

The old bridge was closed to traffic on the 6th of August, and was reopened just four weeks later. After the resumption of traffic, work continued on the viaduct and through the canyon, and was not completed until nearly the end of October. One interesting feature of this later work was the removal of the large rock which stood at the entrance to the old bridge and partially blocked the roadway which passed between it and the cliff. The changes involved in the new structure necessitated the removal of this rock. As it was the unanimous desire of those familiar with the park that this unique and picturesque feature be retained, the rock was broken off, lifted about 6 feet to the new grade, moved out about 6 feet and down the road about the same distance, where it was set up on a new foundation, consisting of a square column of concrete 3 by 3 feet and 24 feet high. The whole foundation was then covered up, so as to remove all evidence of its artificial character. This rock weighed about 23 tons, and as its removal took place on the steep face of an unstable cliff it had to be managed with great care. . . .

In connection with the reconstruction of the viaduct it was planned to rebuild the entire road through the canyon a distance of 2,000 feet. The grades were reduced from 15 and 18 per cent to 8 per cent, and the roadway widened from a single carriage width so that teams can everywhere pass each other with ease and safety. About two-thirds of this work was done in the season of 1900.

Work on this road [the East Road] was begun immediately after the 1st of July and was continued until near the end of October. . . .

A great deal of care was taken in determining the best route across the Absaroka range, which extends along the east boundary of the Park. There are only two practicable crossings, Jones Pass and Sylvan Pass, and both of these are excessively difficult. Sylvan Pass in nearly 1,000 feet lower than the other, and
The Golden Gate Viaduct, built in 1900 by the Army Engineers.
Cub Creek. It crosses the latter stream above the hot Creek are crossed by pile bridges. From Pelican Creek valley of the Pelican Creek. This valley is a swamp. Both the Yellowstone River and Pelican Creek are crossed by pile bridges. From Pelican Creek the road is led along sidehill slopes that afford fine views of the Yellowstone Lake.

The road ascends the valley of Clear Creek on the north side to its source in Sylvan Pass. This place is one of scenic attractions unsurpassed in any part of the mountains. Sylvan Lake is a small but exceedingly beautiful sheet of water near the summit of the pass, which is about 2 miles farther east. Between this lake and the pass there is a small but deep pond fed by the melting snows that drift into the valley. The bed of this lake is so porous from its composition of broken rock that the water falls upward of 15 feet in a dry season below the overflow level of spring.

From this pond east to a large spring presently to be referred to, a distance of about 1 mile, is the pass proper. It lies between high dominating peaks, which rise directly on both sides of the pass to elevations above it varying from 1,000 to 2,000 feet, the pass itself being about 8,600 feet above the sea and 900 feet above the level of the Yellowstone Lake. The two most prominent peaks on the north are Avalanche and Hoyt peaks, and on the south Grizzly and Top Notch peaks. Although the summits of these peaks are about 2 miles apart, the gorge between them which constitutes the pass is very narrow. It is unique among mountain passes in that it is almost entirely occupied with broken rock, which has apparently been loosened from the cliffs on either side by the action of frost. This broken rock varies in size from pebbles to pieces a cubic yard in volume.

The descent from the pass on the east to the valley of the North Fork of Middle Creek is excessively steep, and it will be a matter of great difficulty to carry the road down with a grade even as small as 10 per cent. Just at the foot of this descent and within a short distance of the North Fork of Middle Creek is a very large cold-water spring from which a strong, clear stream flows. From this spring the road follows the valley of the North Fork to its junction with the main stream, a distance of nearly 4 miles. This is the most difficult portion of the entire route, for the slopes are excessively steep, the ground in many places unstable, the mountain sides subject to avalanches and landslides, and the ground everywhere filled with huge boulders which have been washed down in past ages. The exact location over this distance has not yet been determined. From the junction of the North Fork with the main stream of Middle Creek the road will probably follow the north bank to its junction with Shoshone River, a distance of about 7 miles. The work along this part of the route, though much easier than along the North Fork, will still be very difficult.

From the junction of Middle Creek with the Shoshone the road will follow the latter stream, most of the way on the north bank. With the exception of the river crossings, the work over this distance will be much lighter than on any other portion of the route. The scenery along the entire valley of this stream is on the highest scale of grandeur and sublimity. The work on the east road has been costly, owing to heavy grading at the crossings of the Yellowstone and Pelican valleys and the delay caused by the necessity of transporting supplies by water over a portion of the distance. Two weeks' time was practically lost by having to use the force to fight forest fires.

In the vicinity of Yanceys a road has been constructed from the north end of Crescent Hill Canyon to a little beyond the proposed crossing of the Yellowstone River, half a mile above the old Baronet Bridge. This work was nearly all on what is known as the Yancey Hill, one of the most difficult hills by the old road in the entire West. The length of the road is about 6½ miles, and the difference of elevation between the river and the top of the hill, where the work began, is 1,571 feet. The old road had gradients as high as 30 per cent. On the new road the ruling gradient is 8 per cent, with one short stretch where a 10 per cent gradient could not be avoided except at very great cost.

The work on this line was of a heavy character
nearly all the way. There was a large amount of dense and heavy clearing, and rock was encountered in many places along the cut banks. It was impossible to give the roadway its full final width with the means available, but it is opened to travel and can be widened very rapidly when it finally comes into use as a part of the main tourist route.

The approach to the proposed bridge over the Yellowstone on the left bank is by means of a high embankment on the right bank through a deep cut. Both pieces of work were heavy and expensive, as were also the grades leading up from the approaches to the plateau on either side. The tubular piers for Yellowstone and Lamar bridges have been purchased and hauled to the site of the Yellowstone bridge. A false work was built over the Yellowstone for the erection of the bridge, and this is now used as a temporary bridge, so that the entire stretch of road built is in use for travel in that direction. The bridges themselves have not been built, owing to the failure of the mills to furnish the material.

Work at Mammoth Hot Springs — The necessity for this work arose after the season's operations began. For several years it has been contemplated to realign the roads at Mammoth Hot Springs; cut down the steep grade near the old post; resurface all the roads in that vicinity and confine travel to them, instead of permitting it on every part of the plateau; provide water for irrigating the grounds, so as to convert the formation dust into lawn; and otherwise to improve this point, which is the administrative and business headquarters of the park. The occurrence of two consecutive low-water years in the park had reduced the water supply at Mammoth Hot Springs, so that some action had to be taken to reinforce it. The plan recommended was to bring the water of Glen Creek to the Springs, store it in a reservoir just above the old post, and carry it in mains from the reservoir to points of consumption.

The situation at Mammoth Hot Springs has long been desired to have this ground irrigated, covered with soil, and turned into lawn, but the necessary work was so great that the means of accomplishing it have never before been available. Under the present appropriation and through the assistance of the Quartermaster's Department of the Army in its improvement of Fort Yellowstone, which is situated upon these grounds, the work was undertaken and is now practically completed. It is embraced under the following headings: Roads and walks, grading and clearing of grounds, water supply and irrigation system, buildings, electric light and power plant.

The roads around the plateau have been so laid out as to serve as well as possible the convenience of all parties concerned. They have been given a width of 20 feet, have been laid out to true grades, and surfaced to a depth of 6 to 10 inches with gravel from Capitol Hill. This gravel packs in time to a very substantial roadbed, but requires liberal sprinkling to keep down the dust. The length of roadway constructed is 9,600 feet.

From its geographic situation and the fact that Mammoth Hot Springs has become the business and administrative headquarters of the Park, and the further fact that this is the only point at which railroads can approach any of the prominent natural features or large hotels of the Park, the northern entrance is the most important of any, and this importance it will probably always retain. It has been thought fitting, therefore, to provide some suitable entrance gate at this point. This was more important because the natural features of the country at this portion of the boundary are about the least interesting of any part of the Park, and the first impression of visitors upon entering the Park was very unfavorable. During the past year the Northern Pacific Railroad has extended the Park branch of its system from Cinnabar to the boundary line at Gardiner, and the time seemed particularly favorable to combine a proper entrance gate with the new station which the railroad was about to put in at the boundary. With this purpose in view, the railroad and the Government have cooperated, and the present arrangement, now practically completed, is the result. The railroad terminates in a large loop which is tangent to the Park boundary. The wagon road also terminates in a loop which is tangent to the boundary at the same point. Between these two loops is located the railroad station, with a platform on each side — one for unloading from the cars and the other for the convenience of carriages. Within the driveway loop an excavation has been made for an artificial body of water, and provision has been made for the irrigation of the grounds around it. The water supply comes from the Gardiner River, a distance of about a mile.
station grounds, a masonry arch has been constructed of columnar basalt found in the vicinity. The width of the opening is 20 feet, the height is 30 feet, and the maximum height of the structure 50 feet. Two wing walls, 12 feet high, run out laterally from the arch to a distance of 50 feet from the center, where they terminate in small towers which rise about 3 feet above the wall. From these towers and parallel to the two branches of the loop, walls 8 feet high extend to the Park boundary. Three tablets in concrete are built into the outer face of the arch, with the following inscriptions: Above the keystone, "For the Benefit and Enjoyment of the People;" on the left of the opening, "Yellowstone National Park," and on the right, "Created by Act of Congress, March 1, 1872." The corner stone of the arch was laid under Masonic auspices by President Roosevelt, on the 24th day of April, 1903. Leading from the arch across the plain, in the vicinity of the town of Gardiner, the road extends in a straight line until it strikes the Gardiner River, where a bluff crowds the road and stream together. Lines of trees have been planted along this avenue, and they are supplied with irrigation water from the ditch already referred to. The whole effect will be to give a dignified and pleasing entrance to the Park at the point where the great majority of visitors enter it.

1904

Work on the lava arch [the Gardiner Entrance] was completed, and it was thrown open to travel September 1, 1903. The small park within the terminal loop of the Government road was fenced to protect it from cattle. The trees planted along the new road across the Gardiner flat were protected against the large game that frequent the flat in the winter. With the opening of spring the snow water from the hills came down in such volume as to wash a great deal of silt into the small pond in the entrance gate park, and it was necessary to dredge it out and to take measures to cut off the surface flow, either from rain or snow, from the lake.

Particular care was taken to put the park into as good shape as the very arid region in which it exists would permit. It was sown to grass and planted with shrubbery in several places and provided with water for irrigation. These measures have been successful.

An extensive amount of work was done . . . [in the vicinity of the Grand Canyon] during the past year in connection with the erection of the new Melan arch bridge over the Yellowstone and the new steel arch bridge over Cascade Creek — both large and costly bridges. The first was built to give access to the right bank of the Grand Canyon, and a road has been constructed from the bridge to Artist Point, a view

point which corresponds to Inspiration Point on the opposite side of the canyon. It is on this side of the river also that is found the only practicable way down to the bottom of the canyon.

The new bridge over Cascade Creek eliminated two bad hills and sections of road where sliding clay slopes made it extremely difficult to maintain a road. The junction of the Norris and Lake roads was changed to conform to the new road over Cascade Creek, and the entire situation at this important point placed in permanent shape.

Work was carried on on . . . [the Mount Washburn Road] with much difficulty. The snow was late leaving the mountain, and when the parties were sent to work, there was still much snow and the ground was so soaked with water as to delay work very seriously. Not as much was accomplished as had been hoped. On the canyon side a passable wagon road was opened to a mile beyond Dunraven Pass and 2½ miles from the summit, and on the north side to within about 4 miles of the summit. The work is very difficult, owing to great proportion of rock work, the high altitude, and the lack of good camping places.

On the portion of this road leading from Tower Falls to Mammoth Hot Springs a half mile of new road was built to eliminate a dangerous portion of the old road near Ox Bow Creek, and the road through Crest Hill Canyon was widened to full width.

The largest and most important bridges on the entire road system were erected during the past year. They were:

The steel-concrete bridge over the Yellowstone at the head of the rapids above the Upper Falls . . . The opening of the present season found it in almost perfect shape, having gone through a heavy winter just after its completion with no apparent damage. In consideration of the great difficulty and cost of the work, owing to its remote location and of its prominence in the eye of all visitors to this region, the owners of the Melan arch patents generously waived all royalty on this work.

The Cascade Creek bridge near the Grand Canyon is a steel arch of 120 feet span, with a 3-panel approach on each end, making a total length of bridge of 223 feet. The floor of the bridge is about 80 feet above the bed of the stream and, as already stated, eliminates two bad hills from the road system at this point.

The middle Gardiner bridge is the largest in the Park. It consists of 5 steel-arch spans, 76 feet each, and 2 approaches of 15 feet, making a total length of 410 feet. The floor is about 70 feet above the river surface. The bridge eliminates nearly 2,000 feet of
road and 60 feet rise and fall at this crossing of the river as compared with the old road.

The new Baronett bridge, a steel deck truss 130 feet span, was built over the Yellowstone about half a mile above the old bridge. Upon its completion the old Baronett bridge was destroyed.

[The mileage of the park system] was given in the Annual Report of 1902 as 417 miles, consisting of 190 miles of approaches, 153 miles belt line or general circuit, and 74 miles side roads. Of the approaches, 111 miles lie outside the park, in the forest reserve. Since the above date 12 miles of road around the lake shore (side road) have been abandoned. The extent to which the roads in the forest reserve should be considered a part of the park road system is a question that has never been passed upon, but it is believed to be better to limit such mileage to those roads actually built under park appropriations. With this view there should be omitted from the above estimate the Fort Washakie military road and the road through Jackson Hole. This would reduce the mileage outside the park to 57 miles and would make the mileage of the park road system as follows:

<table>
<thead>
<tr>
<th>Approaches:</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the park</td>
<td>79</td>
</tr>
<tr>
<td>Outside park</td>
<td>57</td>
</tr>
<tr>
<td>Total</td>
<td>136</td>
</tr>
<tr>
<td>Belt line</td>
<td>153</td>
</tr>
<tr>
<td>Side roads</td>
<td>62</td>
</tr>
<tr>
<td>Total</td>
<td>351</td>
</tr>
<tr>
<td>Portion wholly within park</td>
<td>294</td>
</tr>
</tbody>
</table>

[Work on the Mount Washburn Road] has been of a very heavy character, particularly on Mount Washburn and at Tower Falls. There is now a good road all the way, but over the mountain it is only single width, and the stage companies will probably not wish to use it until further enlarged. As it rests on the precipitous sides of the mountain it is important to expend considerably more money to increase its width and erect guard walls at all dangerous places. This will be by far the finest road for scenery in the park, and it is urgently recommended that it be not left in an incomplete condition.

1905

The road from Norris to the Grand Canyon, which is the most unsatisfactory location in the park, never having been laid out on any rational system, was largely improved by cutting down the hills and filling the hollows, widening and surfacing and otherwise compensating as far as possible for the defects of the original location. In particular, the road down the high hill at the Grand Canyon was relocated so as to give an easy gradient. This stretch of road lies entirely in heavy clay deposits and is exceedingly hard to maintain during the periods of wet weather. It was heavily paved with broken rock which was covered with gravel, and it is believed that it will stand in good shape....

The road from Thumb Station to Lake Outlet, by way of Natural Bridge, was completed by grading to full width and surfacing with the best material available. Along the lake shore at the Thumb the alignment was in many places corrected so as to shorten the distance and even up the gradients.

The road across the summit of Mount Washburn was completed, including both the low line through Dunraven Pass and the high line passing over the summit of the mountain. This road has been one of great difficulty of construction, not only because of the general presence of solid rock in all portions, but particularly because of the shortness of season and the very wet condition of the ground until late in the summer. The road over the summit has been made 18 to 20 feet wide, instead of 12 feet as contemplated in the original estimate. This road, it is fully believed, will meet all the expectations of those who have favored its construction and will form one of the finest attractions in the tour of the park.

From Tower Falls to Mammoth Hot Springs the road has been entirely opened and completed as a permanent part of the system, thus completing the belt line or general circuit.

Much work was done on the Cooke City road from Yellowstone River to the northeast boundary of the park. An entirely new alignment was made from the Yellowstone River to near Soda Butte, the road crossing the Lamar River near the mouth of Slough Creek, instead of near the mouth of Soda Butte Creek as formerly.

The road from the Grand Canyon to Inspiration Point, which serves to give a fine view of the Grand Canyon, has been largely widened and otherwise improved.

The road opened early last season from the steel-concrete bridge over the Yellowstone to Artist Point has been fully widened and completed.

On the East road a large amount of work has been done from Sylvan Pass, 12 miles east, where it was too narrow for safe travel.

The work which was undertaken under the continuing appropriation four years ago has been
practically completed, and there has also been done considerable work not contemplated in the original estimates. All the roads which it has ever been proposed to build are now open to travel. . . . Only a few minor changes of location in some of the older roads remain to be made, and the eastern and southern approaches will not require general enlargement until railway facilities in those directions are materially advanced beyond their present condition. The sprinkling system has been developed to the full extent contemplated, and has largely mitigated the dust annoyance on the main circuit. There are but few portions of the roads that can not now be traveled with speed, safety, and comfort equal to what it was hoped to obtain with the funds granted by Congress.

New roads — It has been the policy of the officer in charge of the improvement work, and also of the present superintendent of the park, to discourage any material extension of the park road system. There are now roads enough. There are four excellent approaches, one on each side of the park, along routes fixed by nature in the valleys of important streams, and these will serve any probable future public needs. It is impossible that any important railroad system should build to the border of the park in a way that it could not be served better by existing approaches than it could by any others that might be built.

From Hiram Chittenden, Reports on “Improvements of the Yellowstone National Park.” ARCE, 1893 and 1899 to 1905 (incl).
NOTES


14. From 1838 to 1863 the Corps of Topographical Engineers was a separate branch of the Army.


17. 17 Stat. 32.
