

Star Crossings and Stone Monuments— Field Astronomy by the Wheeler Survey in 1870s Colorado



Circular 1362

U.S. Department of the Interior
U.S. Geological Survey

Front Cover The Georgetown monument. *Denver Public Library, Western History Collection, Call No. F-38166*. Hand tinting by Pearson Design, Evergreen, Colorado. Marie Ecklund Johnson and Charles Eric Johnson of Georgetown pose in their Sunday best on the Georgetown monument, *circa* 1937. The site at that time was still relatively clear of vegetation.

Star Crossings and Stone Monuments— Field Astronomy by the Wheeler Survey in 1870s Colorado

By William E. Wilson (Retired)

U.S. Geological Survey

Circular 1362

**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2010

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment, visit <http://www.usgs.gov> or call 1–888–ASK–USGS

For an overview of USGS information products, including maps, imagery, and publications, visit <http://www.usgs.gov/pubprod>

To order this and other USGS information products, visit <http://store.usgs.gov>

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

Suggested citation:

Wilson, W.E., 2010, Star crossings and stone monuments—Field astronomy by the Wheeler Survey in 1870s Colorado: U.S. Geological Survey Circular 1362, 38 p. (Also available online.)

Acknowledgments

This story of the Wheeler monuments in Colorado actually began in my head back in 1993, when my wife and I retired to Georgetown. I had spotted the notation “Astronomic Monument” on the Georgetown topographic map, and my curiosity led me to track it down. Intrigued by the inscriptions on the sandstone block, I tucked the possibility of a research project in the back of my mind until I became more settled in our new town and had absorbed some of its history. Other projects took precedence, but in 2003 I began in earnest to seek the stories behind that monument and others in Colorado.

Along the way, many have helped, for which I am deeply appreciative. The Internet has transformed the process of historical research, and my task was made much easier – and quicker – through my many email correspondents and the discovery of many helpful Web sites. Trudy Bell, free-lance writer and editor, was particularly helpful in providing me with an understanding of various aspects of 19th-century astronomical methods for determining latitude and longitude, and she made constructive reviews of early manuscripts on that topic. A breakthrough in my search for Dr. F. Kampf came when Robert Karrow, Newberry Library, Chicago, and Thomas Hockey, University of Northern Iowa, independently and almost simultaneously identified through the WorldCat database a C.L.F. Kampf, who had earned a Ph.D. degree in astronomy in 1868 at the University of Göttingen, Germany. I am grateful to Dr. Ulrich Hunger, archivist at the University of Göttingen, for sending me Kampf’s vita, and to Dr. Victor Castellani, University of Denver, for translating that Latin document as well as other Latin expressions in Kampf’s “Recording Book.”

Archivists are indeed among the researcher’s best friends. David Hays, archivist at the Norlin Library, University of Colorado, Boulder, introduced me to three boxes full of original field notes from the Wheeler Survey. The discovery of Kampf’s “Recording Book” in that collection truly formed the basis for much of this story. Kevin B. Leonard, University Archivist at Northwestern University, and Linda Hall, Archives Assistant at Williams College, uncovered various useful references to the astronomer Truman Safford. Staff members of the Western History and Genealogy Department of the Denver Public Library generously spent time feeding me a host of government reports and other obscure documents that were tucked away in the basement of the library.

Many helped me in my field searches for the Colorado monuments. In Florence, members of the Fox family – John, Carol, and Barb – enthusiastically took up my cause by helping me explore the area and by providing me with references and documents on the history of Florence and Labran. In Trinidad, Alice Romero, researcher at the Carnegie Public Library of Trinidad, guided me directly to the monument in that town. Thanks go to Mary F. McKinstry, Office Supervisor and Archivist at the Fort Sedgwick Historical Society, for providing historic photographs of the monument in Julesburg. Larry Green, a local railroad historian, helped me understand the history of Pueblo and South Pueblo through the emails, maps, and photographs that he sent me. He also joined me in the field search for the South Pueblo monument.

I especially thank my friend Bob Gibbs, one of the founders of Historic Georgetown, Inc., and owner of the property on which the Georgetown monument sits, for his gracious cooperation and support in allowing a shelter and plaque to be installed at that site. The Professional Land Surveyors of Colorado, with John B. Guyton as their president at the time, enthusiastically supported that project with their donations and encouragement, as did Timothy Hixon of Hixon Manufacturing and Supply Company, Denver, Colorado.

Contents

Acknowledgments	iii
Introduction.....	1
The Wheeler Survey.....	2
Dr. F. Kampf, Wheeler’s Astronomer In Colorado	4
1873 Field Season.....	5
Georgetown	8
Hughes.....	16
Colorado Springs.....	17
Labran	18
Trinidad	19
1874 Field Season.....	22
South Pueblo.....	22
Julesburg.....	26
Conclusions.....	28
Notes	29
References Cited.....	32

Sidebars

Were Dr. F. Kampf and C.L.F. Kampf the Same Person?	6
Granite or Sandstone? From Maine or Colorado?.....	11
Astronomical Observations.....	12
A Friendly Visit?.....	15
A Mixed Blessing—The Mormon Observatory, Salt Lake City	21
Truman H. Safford, Noted Astronomer	24

Figures

1. Locations of monument sites in Colorado	2
2. Portrait of George M. Wheeler.....	3
3. Segment of Wheeler’s hachure topographic map of Central Colorado	4
4. Historic map of Georgetown and monument site, surveyed 1873	8
5. 1870s photo of Georgetown and monument site, looking northeast.....	9
6. Modern photo of Georgetown and monument site, looking northeast	9
7. Modern close-up photo of Georgetown monument, showing inscription	10
8. Modern photo of Georgetown monument and site.....	10
9. Transit instrument held in place by plaster of Paris	14
10. Hole in top surface of Georgetown monument.....	14
11. Georgetown, July 3, 1873, looking north.....	15
12. Historic map of Hughes and monument site, surveyed 1873.....	16
13. Historic map of Colorado Springs and monument site, surveyed 1873–76.....	17
14. Historic map of Labran and monument site, surveyed 1873.....	18
15. Historic map of Trinidad and monument site, surveyed 1873.....	19
16. Historic landscape sketch of Trinidad area, looking east.....	19
17. Modern photo of Trinidad monument with view of Trinidad area, looking east.....	20
18. Modern close-up photo of Trinidad monument.....	20
19. Historic photo of South Pueblo showing brick telegraph building (right) and wooden Union Depot (left)	23
20. Historic map of Julesburg area and monument site.....	27
21. Modern photo of Julesburg monument and site.....	27
22. Modern photo of fracture and steel posts in Julesburg monument	28
23. Historic photo of Julesburg monument, showing capstone fragment	28
24. Georgetown monument with steel shelter and bronze plaque.....	29
25. Close-up view of bronze plaque at Georgetown monument site	29

Star Crossings and Stone Monuments— Field Astronomy by the Wheeler Survey in 1870s Colorado

By William E. Wilson

Introduction

The decade of the 1870s was a time of extensive exploration and surveying in the American West. The nation needed knowledge of the cultural features, topography, natural resources, and geology of this land to promote and aid the “rapid development of an empire.”¹ The need was particularly acute in the region that still was known in the early 1870s as Colorado Territory. There, cities and towns were springing up along the base of the Front Range, railroads were expanding, and in the mountains prospectors and miners were exploring the countryside seeking and extracting the region’s abundant mineral resources. Also, recurring conflicts between the newcomers and Native Americans made it desirable to have accurate maps for military purposes.

Four major government-sponsored scientific surveys formed the principal organized effort to provide critical knowledge of the land. Civilian scientists led three of these: John Wesley Powell (“Geographical and Topographical Survey of the Colorado River of the West”); Ferdinand V. Hayden (“Geological and Geographical Survey of the Territories”); and Clarence King (“Geological Exploration of the Fortieth Parallel”). Lt. George Montague Wheeler, a young graduate of West Point (Class of 1866) and a member of the U.S. Army Corps of Engineers, led the fourth and most ambitious project (“United States Geographical Surveys West of the One Hundredth Meridian”). Each of the survey leaders included all or parts of Colorado Territory in his plans: Powell focused his Colorado efforts on the upper basin of the Colorado (Grand) River; Hayden emphasized the Colorado Rocky Mountains, though his 1877 published atlas included four maps of the entire state;² King included a strip of northern Colorado in his exploration of a band 100 miles wide along the 40th parallel, from California to eastern Wyoming; and Wheeler’s plans to map the entire country that lay west of the 100th meridian included, of course, all of Colorado Territory.³

Inevitably, conflicts and rivalries developed among the leaders, especially between the civilians and the military. In the spring of 1874, the U.S. House of Representatives Committee on Public Lands, chaired by Rep. Washington

Townsend from Pennsylvania, held a hearing to ascertain whether or not overlaps and inefficiencies existed among the various federal surveys in the West. The hearing further considered the possibility of consolidating the surveys that were underway west of the Mississippi River. Powell introduced the additional question of who should oversee a consolidated survey, military personnel or civilian scientists. Wheeler, Powell, and Hayden were among those who testified; King’s field work was completed, so he was not involved.

For the most part, Wheeler was on the defensive, as Powell, and especially Hayden and the supporters of both, severely criticized the Wheeler Survey for its topographical inaccuracies and the purported general uselessness of the Wheeler maps for purposes of geological mapping. However, this criticism applied principally to Wheeler’s very early work. By the time of the hearing, he had modified and significantly improved his methodology. Powell did initially offer high praise for one aspect of Wheeler’s efforts: “His astronomic work ranks with the best that has ever been done in this country, and, perhaps, with the best that has ever been done in the world.”⁴

Much of the credit for this high-quality astronomic work must go to Dr. F. Kampf, the young civilian astronomer whom Wheeler had hired as one of his principal astronomical observers and computers. Following Wheeler’s instructions, Kampf established six “main astronomical stations” in Colorado during the field seasons of 1873 and 1874. In the order of their establishment, these were at Georgetown, Hughes (now Brighton), Colorado Springs, Labran (now Florence), Trinidad (all in 1873); and Julesburg (1874) (fig. 1). At each of these field sites, Kampf’s party installed an inscribed stone “astronomical monument,” or pier, upon which Kampf placed his instruments for making observations of the stars to determine accurate values of latitude and longitude of the site.⁵ Nearby each site, the party laid out a baseline, whose length they measured with extreme accuracy. These monuments and the baseline end points then became the principal reference points for surveying by triangulation for Wheeler’s mapping parties.

In 1874, Kampf also determined coordinates at a seventh Colorado site, known then as the independent community

2 Star Crossings and Stone Monuments—Field Astronomy by the Wheeler Survey in 1870s Colorado

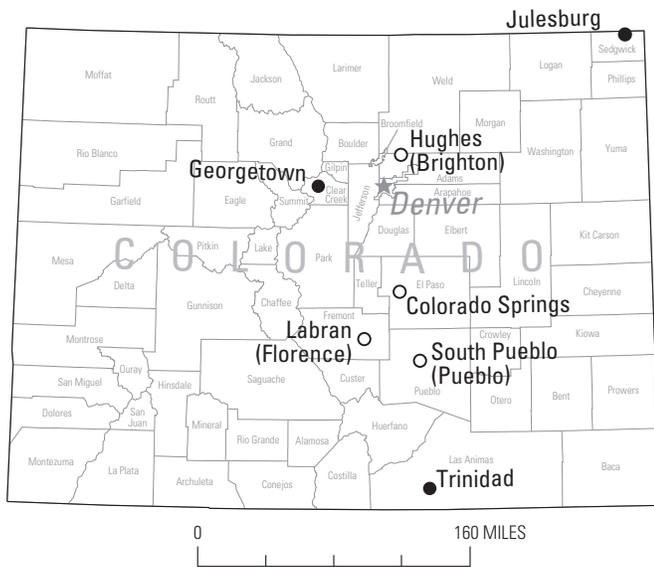


Figure 1. Locations of monument sites in Colorado. During 1873–74, Dr. F. Kampf installed monuments at six “main astronomical stations” in Colorado, plus an additional station at South Pueblo, mostly in and along the base of the Front Range. Solid dots show sites where monuments still exist; open circles show sites where monuments could not be located; star indicates the site of Denver.

of South Pueblo (now a part of Pueblo). Wheeler included this site in his lists of main astronomical stations in some reports⁶ but omitted it in others.⁷ This site differed from the other six in that Kampf determined coordinates there by less precise methods, and he used a brick pier rather than a stone monument as his instrument platform. Furthermore, unlike the other six sites, no detailed tabulations or analyses of astronomical observations that Kampf made at the South Pueblo site are included in any of Wheeler’s reports. Nonetheless, the South Pueblo station formed an important point in the network of Colorado astronomical stations.

Few immediate changes of any real significance came out of the Townsend hearing. The Committee’s final report recommended that all three surveys remain in the field. As a result of the Committee’s concerns, however, General A.A. Humphreys, Chief of Engineers, directed Wheeler to restrict his Colorado field mapping in 1874 to the southern part of the Territory, so as not to overlap with Hayden. The Committee did note that consolidation under the Department of Interior would be desirable in the future.

Not until 1879 did Congress take significant action. Upon the recommendation of a committee of the National Academy of Sciences, Congress discontinued the three surveys that were still underway—those of Wheeler, Powell, and Hayden—effective as of July 1. In their place, Congress established the U.S. Geological Survey, an independent agency within the Department of Interior. In April 1879, the Senate confirmed President Hayes’ nomination of Clarence King as the first

director of the new agency.⁸ Two years later, another of the eminent survey scientists, John Wesley Powell, succeeded King as director.⁹

In subsequent decades, opinions have differed as to the value of Wheeler’s work and whether Congress should have allowed him to complete his project. As Richard Bartlett points out, Wheeler’s civilian competitors happily acclaimed the abolishment of the Wheeler Survey; for them it signaled a major defeat of the military in western exploration.¹⁰ Others describe Wheeler’s work as reminiscent of the great reconnaissance surveys of the pre-Civil War era and saw Wheeler himself as “out-of-date and anachronistic”¹¹. Wallace E. Stegner states that Wheeler’s methods were inadequate and the results not always sound.¹²

Yet others suggest that discontinuing the Wheeler Survey in fact “spelled defeat for the best interests of the United States.”¹³ Various historians are convinced that with little additional cost and time Wheeler could have completed a useful map of the West.¹⁴ In contrast to Phillips and Axelrod, Robert Karrow believes that Wheeler’s most important contributions were his published topographic sheets, a manifestation of what Wheeler called “a connected survey.”¹⁵

William Goetzmann noted in 1966 that the Wheeler Survey is “comparatively little known and largely uncelebrated.”¹⁶ The same is probably true today, despite the fact that numerous historians and others have documented the story of Wheeler and his survey in various published accounts.¹⁷ Furthermore, none of these accounts documents the story of Colorado’s astronomical monuments or describes the work of Dr. Kampf.

Wheeler intended that these monuments would be permanent markers that surveyors and astronomers could use for future observations. During this study, however, only three of the original six monuments at Colorado’s main stations could be located, those at Georgetown, Trinidad, and Julesburg; the others apparently have been destroyed or moved to unknown locations. This publication documents the astronomical work performed in Colorado by the Wheeler Survey, and it describes the three monuments that remain as the only field legacies of that survey in the state.

The Wheeler Survey

For many decades prior to the Civil War, the U.S. Army, most notably its unit known as the Corps of Topographical Engineers, had been a leading organization in surveying and topographic mapping in the United States, including exploration of the West;¹⁸ however, the Corps of Topographical Engineers was abolished in 1863. In the years following the Civil War, the American West was undergoing a rapid expansion, and information was needed about the land and its resources. Already in the late 1860s, the Powell, King, and Hayden geological and geographical surveys of the West were underway or planned. The leaders of these

surveys were all civilian scientists, primarily geologists, but their projects did include topographic mapping; consequently, the Army viewed them as “imposters, preempting duties that traditionally belonged to army engineers.”¹⁹ Thus when a recent graduate of West Point and a member of the U.S. Army Corps of Engineers, Lt. George M. Wheeler, proposed an ambitious and comprehensive mapping project of the West, his superiors jumped at the opportunity. This project would, they believed, “recover for the Corps its preeminence in western exploration.”²⁰

In June 1872, Congress authorized the Corps’ proposal “for the detailed topographic survey of the entire territory of the United States west of the one hundredth meridian.”²¹ The project became known generally as the Wheeler Survey, for the Corps assigned 30-year-old Wheeler to be its leader (fig. 2).

The one-hundredth meridian, or line of longitude, passes through the central parts of North Dakota, South Dakota, and Nebraska; through western Kansas, about 110 miles east of the Colorado border; along the border between Oklahoma and the Texas panhandle; and through Texas, near Abilene. Wheeler proposed to map the 1,400,000 square miles west of this line in the span of 15 years at a cost of \$2.5 million.²² His approach was to follow the concept used by many previous Army mapping investigations, that is, he would conduct systematic areal investigations, in contrast to the linear investigations that had been common among many other explorers. But Wheeler was thinking on a grander scale than his predecessors: he divided the entire West into 94 geodetic quadrangles, which he planned to map in systematic fashion. This quadrangle concept was a precursor of the topographic and geologic mapping of quadrangles that the U.S. Geological Survey later adopted and still utilizes.

Wheeler sought to produce maps that would be sufficiently accurate for military use, but his secondary aim was to collect information necessary for the settlement of the country. He recognized that the Army needed maps that stressed human developments—mines, farms, villages, roads, railroads, and dams. Topographic maps, he claimed, were more essential to the nation’s security than the geological maps of the civilian surveys.²³

To help him get his share of funds that Congress allocated to the surveys, Wheeler also grandly proposed to include information concerning the “branches of mineralogy and mining, geology, paleontology, zoology, botany, archaeology, ethnology, philology, and ruins.”²⁴ Like his competitors, he hired civilian scientists to make these studies. At various times, the Wheeler Survey employed about 40 civilian scientists in a dozen disciplines.²⁵ For example, in 1873 professional civilians in the Wheeler Survey consisted of 5 astronomers (including Kampf), 6 topographers, 2 meteorologists, 4 geologists, 3 naturalists, and 1 photographer.²⁶

In 1873, three “Main Field Parties” of the Wheeler Survey operated in the West. Wheeler’s own party operated out of Santa Fe, primarily working in New Mexico and



Figure 2. Portrait of George M. Wheeler (1842–1905). *National Archives, Local Identifier 57–GP–280*. During the 1870s, Lt. George Montague Wheeler, U.S. Army Corps of Engineers, directed an ambitious project to map the entire country west of the 100th meridian. His efforts were cut short in 1879, when Congress created the U.S. Geological Survey to replace the various surveys underway in the West.

Arizona; Lt. Richard L. Hoxie headed the Utah Division; and Lt. William L. Marshall headed the Colorado Division.²⁷ Wheeler had designated himself and his senior officers not only as party chiefs, but also as “field astronomers.”²⁸ As part of their field-mapping activities, they determined latitude and longitude of “secondary astronomical stations.” However, the accuracy of the coordinates at these sites intentionally was less precise than at the main astronomical stations, and there is no indication in published reports that any of these military field astronomers installed permanent stone monuments at the secondary stations in Colorado or elsewhere.

Within Colorado Territory, the survey initially placed emphasis on the mountains of the central, southern, and southwestern parts. In 1873, for example, Lt. Marshall’s Colorado field work focused on the drainage basins of the Arkansas, Gunnison, and Rio Grande Rivers, where he spent the summer surveying by triangulation.²⁹ By the end of the season, his team had occupied 36 peaks more than 13,000 feet high, and had covered nearly 21,000 square miles.³⁰ Marshall later served as Chief of Engineers (1908–10) with the rank of brigadier general, but in Colorado he probably is best known

4 Star Crossings and Stone Monuments—Field Astronomy by the Wheeler Survey in 1870s Colorado

as the one who discovered the mountain pass that was later named for him, in the south-central part of the state.³¹

Kampf and his support staff operated independently of Marshall's main mapping party. Wheeler had instructed all his astronomers to establish main astronomical stations along or at the termini of telegraph lines, at intervals of 250–300 miles. Each of Kampf's six main stations in Colorado met the telegraphic requirements, but the spacing of these sites is much closer than that proposed by Wheeler. With the exception of the Julesburg station, each main station in Colorado is within 100 miles of another one. Perhaps he chose the closer spacing along the Front Range to provide a more reliable basis for the initial triangulation surveys westward into the mountains.

Wheeler believed that maps that illustrated the topography by means of hachures, or artistically-drawn short tick marks, served his purposes better than topographic maps that used contours, or lines of equal elevation (fig. 3). Wheeler's mapping method was a major complaint of the civilian surveys, for they needed contour maps to accurately trace the contacts of geologic formations. Perhaps as a

concession to these requests, Wheeler produced a contour map of the San Juan Mountains, in southwestern Colorado.

By the time Congress prematurely terminated the Wheeler, Powell, and Hayden surveys in 1879, Wheeler's field parties had mapped about 33,000 square miles in Colorado, or about a third of what had become the State of Colorado during the course of his project.

Dr. F. Kampf, Wheeler's Astronomer In Colorado

Despite the important role he played in the Wheeler Survey, Kampf basically has remained unknown. American documents refer to this person universally as "Dr. F. Kampf." This is true wherever his name appears, whether as an author, in lists of personnel, in citations by others, and even in letters and field notes where Kampf signed his own name. No United States document mentions any personal information about him—his first name, where he was from, where he went to

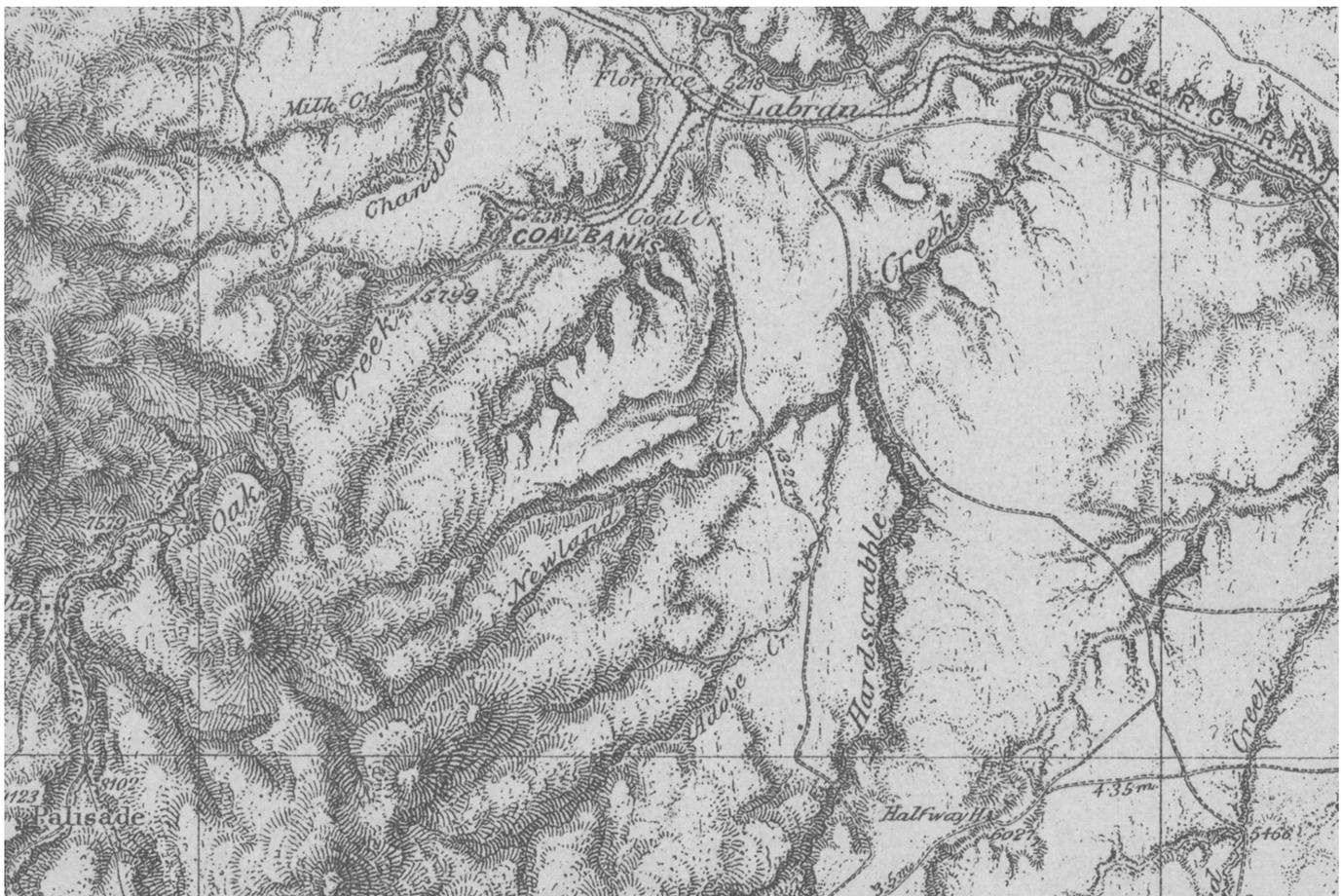


Figure 3. Segment of Wheeler's hachure topographic map of Central Colorado. *Wheeler (1878b)*. Despite the objections of geologists, Wheeler preferred using tick marks, or hachures, to illustrate topography, believing that hachures give a much clearer impression of the terrain when viewed as a whole. Labran is in the north-central part of this map segment.

school, or how he became associated with the Wheeler Survey. So who was this mysterious astronomer?

From various reports, articles, and books that were researched for this report, the conclusion is that Wheeler's Dr. F. Kampf and a Dr. C.L.F. Kampf were one and the same person. This person originally was from Altenburg, the capital of the duchy of Saxe-Altenburg in what is now central Germany. He obtained his doctoral degree in astronomy at the University of Göttingen, Germany, in 1868. As part of the degree requirements, he prepared a handwritten *vita* in Latin.³² According to this document, Carl Ludwig Ferdinand Kampf was born on March 23, 1842, the same year as Wheeler. After completing primary school in Altenburg, his family may have moved to Prussia, for in 1859 he entered the Gymnasium of the town of Gumbinnen. At the time, Gumbinnen was in East Prussia, but now it is in Russia and is known as Gusev, in Kaliningrad. In 1863 Kampf entered the University of Königsberg, also in East Prussia, where he studied mathematics and astronomy. Six months after graduation, he joined the staff as an observer at the Hamburg-Altona Observatory. Kampf completed his dissertation³³ and received his doctorate *in absentia* while working at the observatory.

Under the name "C.L.F. Kampf," he published two journal articles in 1870³⁴ that were based on observations that he made at the Leiden Observatory in the Netherlands. According to correspondence on file at the Leiden Observatory,³⁵ he worked there from January 1869 to January 1870. Apparently it was not a happy arrangement, for he did not get along with the observatory director, Frederik Kaiser. Shortly after an unpleasant conversation with the director on August 30, 1869, Kampf informed Kaiser of his intent to leave as soon as possible after he completed an article he was working on.³⁶ Kampf believed that his departure would end his career as an astronomer, for he did not expect to find work at an observatory again. This would mean "a complete collapse of my best hopes and wishes," he wrote Kaiser. By December, conditions had worsened, and Kaiser, in a draft letter written that month, complained that Kampf had been neglecting his duties; in another undated draft letter, Kaiser threatened to fire Kampf, who had "given him much cause for discontent."

Sometime in January 1870, Kampf resigned from the Leiden Observatory and returned to his home in Gumbinnen. He then unsuccessfully tried to obtain a position at various other observatories, including the Pulkowa Observatory near St. Petersburg. On February 15, 1870, Kampf wrote Kaiser that he had been unsuccessful in finding such a position and that he, therefore, would have to become a teacher. He sounded desperate, for he reported that he had no income and that the "father of his bride" was dying. He sought from Kaiser a letter of recommendation, but Kaiser refused, writing in a rather insulting letter, "During your stay in Leiden, you have used the mental powers Nature has given you so sparingly, and besides you have earned such a bad reputation because of the debts you made, that I can write no better testimonial than the one below." The testimonial that Kaiser provided simply states that Kampf was attached to Leiden Observatory

in 1869–1870, and that he participated in the observations and calculations there. Apparently, Kaiser was "no easy-going person himself,"³⁷ and so perhaps the conflicts between the two men arose because their personalities clashed.

Under unknown circumstances, Kampf later came to America and joined the Wheeler Survey, for he was working for Wheeler by the spring of 1873. In late May of that year, he made his first trip to Colorado to begin his field work. He worked for Wheeler for 5 years, making astronomical observations in the field during the summers and working up data and writing reports in the office at Washington, D.C., during the winters.

Kampf's career tragically was cut short in the spring of 1878, when he died from the after-effects of a field accident that he had suffered during the preceding summer. No description of the specific nature of the accident could be found in various reports or field notes dating from the field season of 1877. During that summer, one of Kampf's activities was to help measure a base line more than 4 miles long on one of the main streets of Ogden, Utah,³⁸ and perhaps the accident occurred during that time. His arrival in the early 1870s and death in 1878 explain why he did not show up in any U.S. census.

In contrast to the negative assessment of Kampf's work by the director of the Leiden Observatory, Kampf's American colleagues had nothing but praise for him after his death. In announcing his death, Wheeler wrote that "The Survey has sustained the loss of a valuable member in the person of Dr. F. Kampf."³⁹ Lt. S.E. Tillman, in charge of one of the field parties under Wheeler, wrote concerning Kampf's skills in data analysis and report writing, "Dr. Kampf's vast experience rendered him a most valuable assistant in this class of work. He displayed his usual interest and energy in the work up to the date of his final sickness..."⁴⁰ Of the eight or so civilian astronomers that Wheeler hired during 1873–1878, Kampf was the only one that he retained fulltime for that entire period.

1873 Field Season

During the field season of 1873, Kampf and his crew determined the coordinates of five "main astronomical stations" in the Colorado Front Range and along its base—Georgetown, Hughes, Colorado Springs, Labran, and Trinidad. In his annual report for fiscal year 1872–1873, Wheeler declared that, "Very substantial stone monuments that serve to mark the spot and for observing piers, have been fabricated and set in advance of the occupancy of the stations."⁴¹ To the contrary, one of the many difficulties that Kampf encountered during the season was that these stone monuments, which presumably had been ordered and delivered, were not awaiting him at most of the sites. Nonetheless, Kampf was able to locate and install a monument at each site, and by the end of the season he seemed satisfied that he had made accurate astronomical observations at each of them.

Were Dr. F. Kampf and C.L.F. Kampf the Same Person?

An effort was made to learn whether or not Dr. F. Kampf and C.L.F. Kampf were one and the same person, and if so, who he was, where he came from, his family history, and other personal aspects of this man who presumably had a doctoral degree in astronomy.⁴²

A search of many of the usual sources of historical personal information proved fruitless. Nineteenth-century newspaper articles, birth records, marriage records, obituaries, family trees, arrival lists of immigrants, and census data—none of them revealed an F. Kampf who fit the criteria of probable age and occupation. Nonetheless, the absence of an appropriate F. Kampf in the 1870 U.S. census and the presence of F. Kampf working for Wheeler in Colorado in 1873 indicate that this person probably immigrated to America in the early 1870s.

Not until a search of WorldCat, a database of the Online Computer Library Center, was made did a probable candidate emerge. A “C.L.F. Kampf” is the only one who satisfactorily meets the search

criteria for a person named “F. Kampf,” that is, one who had written a 19th-century dissertation in astronomy or had published papers in that field. Still, the question remained whether or not this C.L.F. Kampf was the Kampf of the Wheeler Survey.

The *vita* of C.L.F. Kampf provided not only biographical information for that Kampf, but also a handwriting specimen that could be compared to the handwriting of Dr. F. Kampf’s “Recording Book,” written in the field in Colorado in the summer of 1873.⁴³ Certain elements of the handwriting of the two documents are similar. Examples include the lower-case “t” at the end of a word and the capital letters “A,” “C,” and “R.” The similarities could be the result of two different people writing in the cursive style of the time, or the result of one person writing with distinctive flourishes.

Other letters are quite different in the two documents, for example, the capital letters “F” and “T.” Furthermore, the *vita* handwriting is slightly more slanted and much neater than the journal handwriting.

The two documents were prepared under different circumstances, which could account for these differences. The *vita* is a formal document that was probably prepared with utmost care, because C.L.F. Kampf was submitting it to his committee as part of the requirements for his doctoral degree. In contrast, Dr. F. Kampf probably scribbled in his Colorado field notebook hastily and under adverse conditions, which no doubt included working in cramped quarters, often late at night with poor lighting, and using a small notebook.

C.L.F. Kampf’s studies and work at Königsberg, Göttingen, and the Hamburg-Altona Observatory must have prepared him exceptionally well for a career in astronomy. These institutions were well known world leaders in positional astronomy, and they produced numerous noteworthy astronomers. For example, the brilliant American astronomer Benjamin Apthorp Gould studied at Göttingen and worked at the observatory in the 1840s before returning home, where he founded the first American research journal

A

honorem me conluli, studiis mathematicis et
 astronomicis operam navabam. Consummatus au-
 tem hic per dua semestria in universitatem
 litterarum Rhenanum demigravi. Tribus se-
 mestribus peractis ad academiam Regiomon-
 tanam reversus sum. Post sex menses specu-
 las Altonasensi adjunctus sum, ubi longita-
 dinem inter urbes Kiel et Altona, professorum
 Dr. C. A. F. Peters duce, determinavi. Nunc
 in specula Hamburgensi munus observatoris
 administro.

Comparison of handwriting in
 (A) *Vita* of C.L.F. Kampf, and
 (B) “Recording Book” of Dr.
 F. Kampf. (A) Kampf, C.L.F.
 (1868b); (B) Kampf, F. (1873a).
 Overall, the same person
 appears to have written the
 two documents, thus indicating
 that Dr. F. Kampf and C.L.F.
 Kampf were one and the same.

Were Dr. F. Kampf and C.L.F. Kampf the Same Person?—Continued

in astronomy, the *Astronomical Journal*, still published and still a world leader.⁴⁴ Thus, based on his training, one would also expect Kampf to have become a renowned astronomer, producing many technical publications, and perhaps eventually holding a professorship at a prominent university. Indeed, in Europe, Kampf published two papers within 2 years of completing his degree. Yet that is the last time he appears on the international scene—no additional European publications are known. He seems to have disappeared from the scientific world, and a reasonable conclusion is that he was the one who came to America to work on the Wheeler Survey, where his tasks and publications were limited to the project at hand. His premature death in 1878, before the closing of the Wheeler Survey, precluded his creating a notable career in astronomy after finishing his work for Wheeler.

The circumstances of Kampf's coming to America and starting to work for Wheeler are unknown. A tenuous, but not implausible

connection is that starting in 1864 the U.S. Army Corps of Engineers spent more than a decade assisting in a geologic and topographic mapping project in Prussia.⁴⁵ Perhaps Kampf, after leaving the Leiden Observatory in January 1870, failed to get a teaching or observatory position. He then could have gone to work for the Prussian Geodetic Institute, whose personnel were responsible for making astronomical observations for the Prussian mapping project. There, he could have learned of the plans for the Wheeler Survey through contacts with his Prussian colleagues or from U.S. Army personnel who may have been in the field assisting the Prussian mappers at the time.⁴⁶

The U.S. Federal Census of 1880 and the Washington, D.C., City Directory of 1890 indirectly provide the most definitive clue as to the identity of Kampf. C.L.F. Kampf probably got married at about the time he left the Leiden Observatory, as suggested by his reference to "his bride" in his February 15, 1870, letter to Frederik Kaiser. It is reasonable to suppose that he

brought his wife with him when he came to America. She probably stayed on in this country after his death in 1878, for the 1880 census lists a Sophie Kampf residing in Washington, D.C., widowed, working as a clerk in the Pension Office, about age 32, and born in Prussia of Prussian parents.⁴⁷ Furthermore, the city directory a decade later lists a woman who was probably the same person, even though the spelling is slightly different: Sophia Kampf, clerk, residing at 1532 Kingman Place NW, Washington, and "widow [of] Ferdinand."⁴⁸ Neither of the documents mentions children, and so there probably are no descendants of this Kampf family living in the United States today.

Based on available evidence, a reasonable conclusion is that Carl Ludwig Ferdinand Kampf, born in Germany, educated in Prussia and later in Germany, came to America in the early 1870s, joined the Wheeler Survey, dropped the "C.L." of his name, and became known thereafter as "Dr. F. Kampf."

July 15th Commenced the reductions for time observations from this morning. The observations are very satisfactory. Afterwards I made the readings of time signals sent from Santa Fe and Salt Lake. Closed at 6 o'cl. Made determination of time but could not get Santa Fe or Salt Lake.

B

Georgetown

“Arrived in Georgetown June 4th. Found no instruments—no monument—no rations.”⁴⁹ Thus read the entire first entry in Kampf’s “Recording Book” for 1873. It was not an auspicious beginning, and it foretold of many frustrations and difficulties to come during that field season. Lt. Wheeler had given orders to his observers: “A full daily journal will be kept by each observer. Great care will be taken as to the character of the record upon this journal, which should be clear and explicit.”⁵⁰

As far as being “clear and explicit,” Kampf was off to a good start. And for the most part during the month that he was in Georgetown, he kept a “full daily journal.” But it was almost all business—there are few glimpses of personal matters, such as his feelings, social interactions, or impressions of his surroundings. There is no mention, for example, of Fourth of July festivities in Georgetown, or of any extracurricular activities in which he and his men may have participated. Instead, the pages are full of his duties, the weather, instrument problems, telegraph difficulties, data tabulations, references to occasional visitors, even copies of letters that he wrote concerning his official business. As the summer wore on, his entries became steadily briefer. Much of the daily routine was repetitive, and thus it probably seemed unnecessary to repeat all the details in his journal. Except for spelling, his English is generally quite satisfactory, though the German syntax creeps in occasionally, and his handwriting is sometimes cryptic.

In his final published report, Kampf observes that the residents of Georgetown “exceed two thousand” and “are chiefly interested in mines and mining business.”⁵¹ Indeed, Georgetown in 1873 was well on its way to becoming known as the “Silver Queen of the Rockies.” The town had been incorporated 5 years earlier, and the area around Alpine Street (now Sixth Street) had become a bustling commercial district, the principal service and supply center for the surrounding mining region.

Kampf’s published map⁵² of Georgetown accurately portrays the location of the monument site, though the map shows only the streets of “old” Georgetown and omits the commercial area around Alpine Street (fig. 4). The southern boundary of Georgetown that is shown on the map (today’s 8th Street) does mark the former southern boundary of the town; however, by 1873 the section on the map that is labeled “Elisabeth” (actually, it was called “Elizabethtown”) had expanded northward and merged with Georgetown at 8th Street. Upon incorporation in 1868, the merged communities assumed the single name of Georgetown.

Kampf’s field activities at Georgetown were typical of those at the other stations during the summer. The first order of business was to locate a suitable site for the monument. Kampf does not describe the criteria on which he based his site selection, but presumably they included: (1) being on government land or on private land with explicit permission, and (2) having a clear view along the meridian. Georgetown

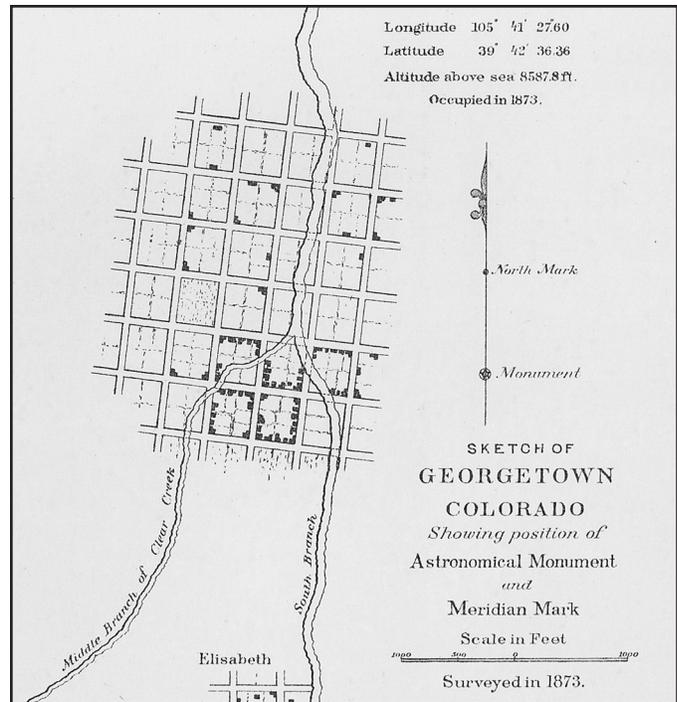


Figure 4. Historic map of Georgetown and monument site, surveyed 1873. *Wheeler (1877), plate 6.* Kampf’s map accurately portrays the location of the monument, though his layout of Georgetown omits the downtown area. By 1873, Elizabethtown (“Elisabeth” on the map) and Georgetown had merged and incorporated as the Town of Georgetown.

was preparing to build a new school building, and Kampf proposed to install the monument on the school grounds; however, “the Board of Directors placed difficulties in the way,”⁵³ and so an alternative site was needed. Lt. Wheeler arrived the evening of June 7, probably to see how his new employee was faring. Together, they selected a monument site “near Zelack’s [sic] Brewery,”⁵⁴ on a knoll at the base of Griffith Mountain, near Alpine Creek (figs. 5 and 6). This site, labeled as “Astronomic Monument” on the modern U.S. Geological Survey quadrangle map,⁵⁵ lies just outside the town boundary and probably was government land in 1873. Much of the surrounding landscape had been stripped of its trees for firewood, mine timbers, and building construction, so the chosen site had an unobstructed view of the skies.

In the meantime, by June 9 the monument, five boxes of instruments, the three men who were to be Kampf’s support staff, and the rations to sustain them had all arrived. The support crew consisted of C.D. Gedney, a civilian; and Privates J. Clancy and J. Meyer.⁵⁶ Kampf does not describe the specific skills of these men. Possibly, Gedney was a meteorologist or a land surveyor, for he participated in these activities for Kampf. Probably, the privates were trained in a variety of technical skills, for they came from the Battalion of Engineers, U.S. Army.

Once the monument site had been selected, Kampf and his crew measured a 2,700-foot baseline along Rose Street,



Figure 5. 1870s photo of Georgetown and monument site, looking northeast. *Denver Public Library, Western History Collection, W.G. Chamberlain, Call No. X-19281.* This 1870s view northeastward across Georgetown by photographer William G. Chamberlain indicates the monument site (circled) on a knoll at the base of Griffith Mountain. The location gave Kampf an unobstructed view along the line of the meridian.

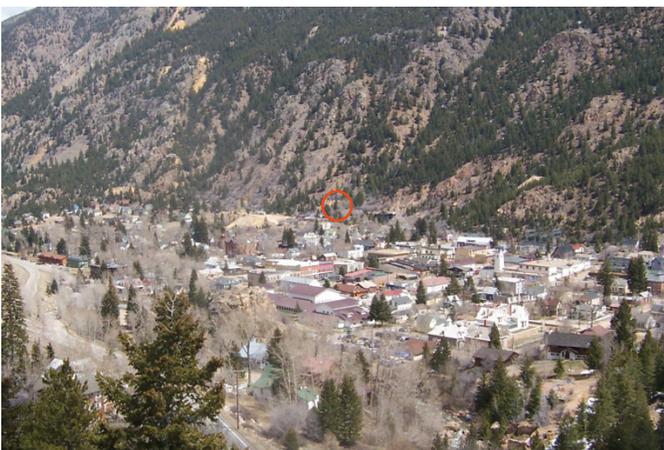


Figure 6. Modern photo of Georgetown and monument site, looking northeast. *Photo by W.E. Wilson.* In this contemporary view, the monument site (circled) has changed little except for increased vegetative growth and more nearby buildings.

starting near the foot of the mountain and ending at today's Fourth Street. As a check, they re-measured the baseline, and the reported difference between the two measurements was "not more than one hundredth of an inch."⁵⁷ According to the *Georgetown Courier* of May 8, 1909, the men consumed champagne as part of a monument dedication ceremony,

and the resulting empty bottles were "entombed at the head of Rose Street to mark the starting point of the baseline."⁵⁸ True to form, Kampf mentions neither of these events in his "Recording Book."

Because of the rocky ground at the chosen site, the monument could not be set with its north and south faces perpendicular to the plane of the meridian, as was the plan, and the stone block had to be set in a slightly diagonal position. It stands about 3.5 feet high, and its cross section is 2.0 × 1.5 feet (fig. 7). It arrived at Georgetown already inscribed. Carved into the south-facing side is the inscription:

U. S.
MERIDIAN
AND
LATITUDE MARK
—
EXPLORATIONS WEST
OF THE 100TH MERIDIAN
~~~~~  
WAR DEPARTMENT

The north-facing side reads:

LONG.  
LAT.  
—

U. S. ENGINEERS  
1873

Evidently, the intent was to inscribe the values of longitude and latitude, once they had been determined from the astronomical observations; however, this follow-up never occurred. Today the monument stands on private property, tucked away in a thicket of trees and brush (fig. 8). The surfaces of the sandstone block are weathered, and parts of the inscriptions on the north- and south-facing sides are becoming difficult to decipher.

The exact source of the monument stones used by the Wheeler Survey remains a mystery. Large-scale commercial quarrying did not begin in Colorado until after 1875.<sup>59</sup> Before that date, numerous small and temporary sandstone quarries dotted the area around Labran, but investigations of documentary sources and field sites revealed no single likely candidate.

Once the monument was installed, other chores occupied Kampf and his crew before he could begin making his astronomical observations. Unfortunately, Kampf's observing tent had not arrived with the other equipment. On June 13, Lt. Marshall, who headed Wheeler's Colorado Division, and his field party stopped in Georgetown, where he donated one of his wall tents to Kampf to serve as an observing tent. This tent was set over the monument; it had a flap in the roof that he could open while making his observations and close



**Figure 7.** Modern close-up photo of Georgetown monument, showing inscription. *Photo by W.E. Wilson.* Although the monument inscriptions are mostly quite legible, weathering of the sandstone block is obscuring some of the lettering.

during inclement weather to protect the instruments. Kampf hired a carpenter to construct a wooden frame for the tent; the poles that came with it could not be used, he noted ruefully, “because the wind is always to[o] heavy and I am afraid the tent would be blown [sic] away.”<sup>60</sup> He made repairs to instruments that had been damaged in shipment; he set them up and made adjustments; he created a local loop off the main telegraph wire, 700 yards away;<sup>61</sup> and he made arrangements with the telegraph operator, Mr. John Jay,<sup>62</sup> for use of the main line. Finally, on the night of June 21 Kampf made his first exchanges of time with John Clark, his fellow observer in Salt Lake City.

Astronomical surveyors of the 19th century commonly installed smooth slabs of rock, or capstones, on the tops of their stone or brick monument blocks to provide a suitable surface upon which to set their instruments.<sup>63</sup> If the legs of the transit instrument could not directly fit on the monument surface, a capstone would be used that was large enough to hold the instrument. Also, the top surface of the monument commonly was rough, chipped, or with a corner broken off, and a capstone then provided a smooth and stable surface for the transit. In some cases, a single hole was drilled in the center of the monument in which a metal post was emplaced. The astronomer would place the capstone, also with a hole drilled in the center, over the post. The feet of the supporting



**Figure 8.** Modern photo of Georgetown monument and site. *Photo by W.E. Wilson.* Today the monument sits in a thicket of vegetation.

legs of the transit would firmly be attached to the capstone with plaster of Paris, which was a thick cream prepared with water and poured into the holes made in the bases of the legs for this purpose<sup>64</sup> (fig. 9). The astronomer then could rotate the capstone slightly to align the transit telescope with the meridian. In other cases, two posts were installed in the monument, and the capstone, also with two holes, was placed over it. Although the capstone could not be rotated, such an arrangement provided a more stable surface for the transit instrument. Upon completion of his observations, the surveyor could either leave the capstone in place or remove it (after chipping away the hardened plaster of Paris and removing the transit) and take it along with his instruments to the next monument site.

Kampf makes no mention of capstones in his “Recording Book,” but it is reasonable to assume that he used a capstone at the Georgetown site, and photographic evidence indicates that he used one at the Julesburg site. Today the Georgetown monument has a shallow, funnel-shaped depression in the center of the top surface (fig. 10); this feature might once have been a drill hole that held a metal post that since has been removed. The hole has weathered and filled to its present depth and shape. Because Kampf could not emplace the Georgetown monument block so that it was oriented precisely perpendicular to the plane of the meridian, it would have been useful to have a single-hole capstone so that he could rotate the transit into the correct position.

Kampf’s support crew undoubtedly maintained the camp, cooked meals, and carried out other chores around the site, although Kampf makes no mention of these activities. But the three-man crew also performed an important data-collection function, that of making weather observations around the clock. They rotated on 4-hour shifts and made hourly observations of barometric pressure, temperature, humidity, cloud conditions, wind, and precipitation.<sup>65, 66</sup> The observers

## Granite or Sandstone? From Maine or Colorado?

Oddly, the Georgetown monument became the subject of some debate in the press as to its lithology and origin: Was it granite or sandstone? Shipped from Maine or hauled from southern Colorado? The discussion began on June 12, 1873, when *The Colorado Miner* reported the arrival and placement of the stone monument, “a block of Maine granite...weighing several thousand pounds, and hewn into the proper shape at the quarries down East...It is intended that this rock shall be a permanent land-mark for scientific observations...[and] will probably remain in its place for several years.” Parenthetically, the *Miner* noted with more than a touch of sarcasm, “there is no granite out here, we believe.”<sup>67</sup>

The editor of *The Engineering and Mining Journal* picked up on the irony of importing stone from Maine for use in Colorado. “If there is anything abundant about Georgetown,” he stated in an editorial note in the edition of July 22, 1873, “one would say it is stone.” He further wondered how much it must have cost to blast away granite at the monument site to make room for the imported stone block. The editor correctly observed that the monument is actually made of sandstone, and that such rock is not nearly as durable as the native rock around it. He pondered whether or not Lt. Wheeler intended to import sandstone from Maine for all the other monuments to be erected in his survey; he offered an alternative approach: “We could point out several boulders, here and there, in Colorado, Utah, New Mexico, and Arizona, which can be warranted not to budge.”<sup>68</sup>

This tongue-in-cheek note prompted an indignant retort from Wheeler, who found the editor’s comments to be “indecorous.” As reported in the October 14 edition of the *Journal*, Wheeler emphatically

denied that “the monument was... composed of sandstone from Maine.” The editor was moved to make an “immediate and frank apology” for his earlier criticism, but he justified his “Maine” story by saying that it “came to us from several independent quarters, in the form of current and uncontradicted ‘town-talk’ in Colorado, disarming suspicion as to its authenticity.” But the wording of Wheeler’s denial still left unanswered questions, according to the editor: “Is there no monument? Or did it not come from Maine? Or is it not of sandstone?... Or—horrid, bitter, bitter thought!—were we outrageously sold, by a foul conspiracy of tongues?”<sup>69</sup>

The final volley in this exchange came in the form of a strongly-worded letter from Wheeler, published in the *Journal* on January 10, 1874. He wrote in part, “I will say that the monument at Georgetown, Col., was fabricated at Labran, Col., and shipped by rail to Floyd Hill, 19 miles from the point at which it was set up. Four other monuments used during the season in Colorado were obtained from the same quarry at an expense of 40 dollars each.”<sup>70</sup> The letter did not mention the monument’s lithology.

There the matter lay for more than three decades, until Jesse Randall, editor of the *Georgetown Courier*, raised the issue once again. On July 11, 1908, Randall, in a garbled mix of fact and fiction, stated that Dr. Kampf “planted the famous meridian stone on the east side of town, which is rapidly disintegrating. The monument was represented by the Wheeler expedition to be of granite, and Lieutenant Wheeler himself, in resenting a criticism in *The Engineering and Mining Journal*, contended that it was granite; however, it is sandstone of a very inferior quality, as anyone can see by examining it. It was cut from Maine granite, according to Dr. Kampf, and

weighs several thousand pounds. The freight on the stone from the east to Georgetown amounted to more than the cost of several monuments hewn from Colorado granite. It...was intended as a permanent landmark for scientific observations. So far as known, no scientist ever saw it after it was planted, and it is quite certain it was never put to any use.”<sup>71</sup>

By this time, however, the principals were long gone, and no one knew or cared enough to challenge Randall’s assertions.

## Astronomical Observations

Kampf's primary goal was to obtain accurate values of latitude and longitude of each of the Colorado sites that he occupied during the summers of 1873 and 1874. Both parameters involved making certain observations of stars, and because there were so many potential sources of error, he repeated these observations multiple times a night and over multiple nights at each site to get statistically significant results.

Kampf used what he called a "combined transit-instrument"<sup>72</sup> for making his astronomical observations for determining latitude and longitude. William Würdemann manufactured the instrument. Würdemann had worked as a master mechanic for a division of the U.S. Coast Survey that designed and built astronomic and geodetic instruments; in 1849, however, he left the Survey to form his own instrument business in Washington.<sup>73</sup> Kampf's telescope rotated on a horizontal and a vertical axis and was equipped with a sensitive leveling system and a micrometer. It had a focal length of 3 feet, a radius of aperture of  $2\frac{3}{4}$  inches, and a magnification power of the diagonal eye piece of 40 diameters. On the lens were seven vertical wires (or "threads") for time observations and one horizontal wire for latitude observations.<sup>74</sup>

The determination of latitude was the more straightforward of the two parameters. From an astronomical point of view, the latitude of a point on earth can be considered to be equivalent to the angle between the zenith, or point in the sky directly overhead, and the equator. A rather simple and direct way of determining latitude is first to pre-select a star whose declination, or celestial latitude (given in equatorial coordinates), is known, and then measure the angle between that star and the zenith (the zenith

distance) at the instant the star crosses the plane of the meridian. A simple computation gives the latitude of the site.

A more precise method for determining latitude, called the Horrebow-Talcott method, was in common use in Kampf's time. Peter Horrebow first devised the method in the mid-18th century. Nearly a century later, in 1834,<sup>75</sup> Captain Andrew Talcott, an 1818 graduate of West Point and a member of the Corps of Engineers,<sup>76</sup> independently arrived at the same method. The Coast Survey adopted the Horrebow-Talcott method as standard practice in 1846,<sup>77</sup> and by the 1870s all the Great Surveys in the West employed the method.

With the Horrebow-Talcott method, instead of measuring the zenith distance of a single star, the observer would select two stars with known declinations. These would have approximately the same zenith distance, but be on opposite sides of the zenith. He then would measure the zenith distances of the stars as they passed the meridian within a short time of each other. The observer then could compute the latitude from one-half the difference in zenith distance and the mean of the star declinations. This method, considered to produce results accurate to 0.10 second of latitude, practically eliminates uncertainties that result from the effects of atmospheric refraction, which bends the stars' rays and thus shifts their apparent positions.<sup>78</sup>

In 1873 Wheeler instructed his observers that the observations for latitude "will be conducted through five complete and clear nights, so that there shall not be less than 175 pairs of observations upon 35 separate and distinct pairs of stars..."<sup>79</sup> Frequently, Kampf made his observations for latitude determinations on nights when the telegraph system was giving

problems and he, therefore, could not make observations for longitude determinations.

The determination of longitude was more problematic in the 19th century. The difference in longitude between two points can be expressed both as the angle between the two meridian planes and as the difference in the local times of the two places.<sup>80</sup> The advent of the telegraph in the mid-1840s provided for the first time a way to compare local times, virtually simultaneously, at sites separated by hundreds of miles.<sup>81</sup>

Kampf utilized what had become known as the "American Method," which was the telegraphic method for determining longitude that included an apparatus called a chronograph, for permanently recording seconds of local time and the times of astronomical observations.<sup>82</sup> For Kampf, the setup involved his telescope mounted on the monument; a break-circuit telegraph key, or "finger key;" and a local telegraph circuit. The circuit connected the finger key, a precise timepiece called a chronometer, a chronograph, and a small battery to the main telegraph line. A similar arrangement was established at the Mormon Observatory in Salt Lake City, where John Clark, another of Wheeler's civilian astronomers, was stationed.

The chronograph used by Kampf was similar to the type invented by William Harkness, a Scottish-born astronomer who worked at the U.S. Naval Observatory.<sup>83</sup> The instrument included a cylinder that was 8 inches in diameter and 24 inches long. A sheet of paper covered the cylinder, which made a full revolution every minute. An electromagnet held an ink pen against the paper; the pen was driven horizontally along the rotating cylinder, thereby making a continuous spiral trace on the paper as long as there was power on the

## Astronomical Observations—Continued

local circuit. A device was added to the chronometer that interrupted the local circuit every second, thus resulting in a tick mark on the paper at one-second intervals. When Kampf wanted to record an observation, he tapped the finger key, which also interrupted the local circuit and left a distinctive mark on the spiral trace. The signal was simultaneously transmitted to Salt Lake City and recorded on Clark's chronograph. The time of each observation could be interpolated on each chart to the nearest 0.01 second.

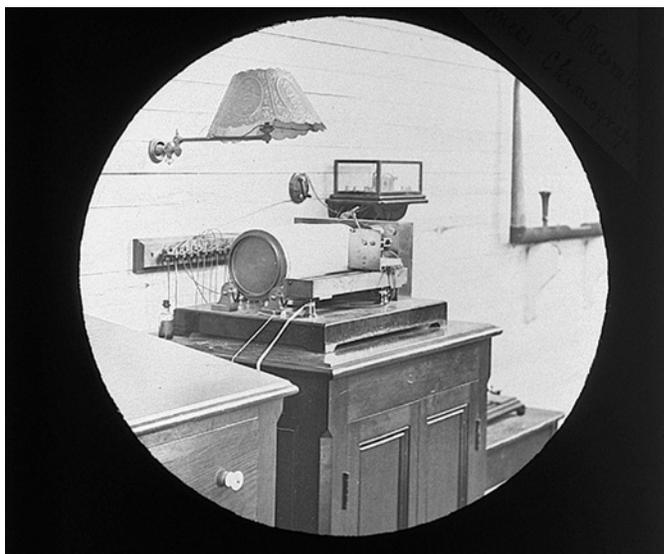
In their reports, neither Kampf nor Wheeler described in detail the procedures that Kampf followed in making his observations for determining longitude; however, the principal steps that he probably followed, under ideal conditions, can be inferred from Kampf's journal<sup>84</sup> and his published data,<sup>85</sup> and from descriptions of standard practices that were published in various reports of the Coast Survey.<sup>86</sup> In preparation for the evening's observations, Kampf and Clark would pre-select stars for observation, make various adjustments to their instruments, and determine the local time at each site by making star observations. Because Kampf was about 340 miles east of Clark in Salt Lake City, the selected stars would cross Kampf's local meridian about 25 minutes before crossing Clark's local meridian. As each star crossed his meridian, Kampf would tap the finger key, thereby recording the local times of star crossings on his chronograph and simultaneously transmitting the signal to Salt Lake City, where they were also recorded on Clark's chronograph.<sup>87</sup> To get additional readings, Kampf probably tapped the key at the instant a star crossed each of the threads on the lens of his telescope. From these data he could compute the precise time that the star crossed the middle

thread, which was lined up with the plane of the meridian.

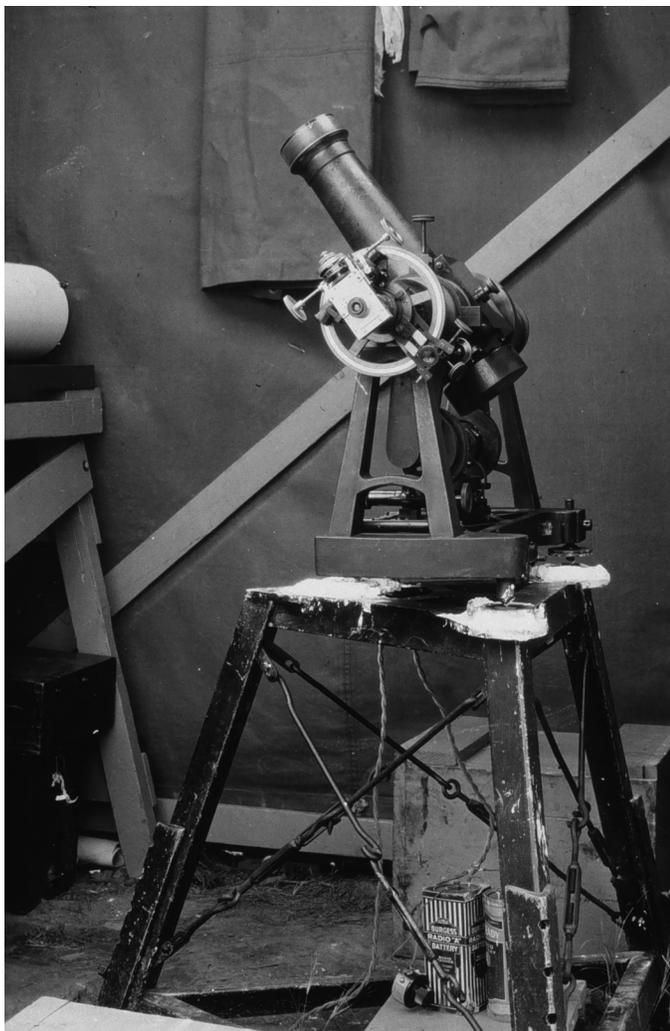
Initially, Kampf's chronometer was the one that was wired into the circuit. Thus, the one-second ticks and the marks indicating the times of star crossings were recorded in Kampf's local time on both chronographs. Then about 25 minutes later, when the same stars approached the meridian in Salt Lake City, Clark would repeat the process, still recording in Kampf's local time. About halfway through the night's readings, Clark's chronometer would replace Kampf's in the circuit, and the two observers would make the remaining readings at both stations in Salt Lake City local time. The result was that each observer ended up with a duplicate record that showed the times of star crossings at the two sites. Ideally, the night's session would conclude with another astronomical determination of local time by each observer, to check the accuracy of their chronometers.

The difference in times of observations represented the difference in longitude between the two sites. George Dean of the Coast Survey had established the true longitude of the Salt Lake City site in 1869, through telegraphic connections with Boston and San Francisco,<sup>88</sup> and so Kampf, after making various corrections, could easily compute the true longitude of each of his Colorado sites.

With regard to the determination of longitude, Wheeler's instructions stated that "the time set for the transmission of signals should be as near 9:30 p.m. local time of the Salt Lake meridian as possible; and great care should be taken that both observers shall be on hand simultaneously, so that as little delay as possible shall ensue in the use of the telegraph-wires." Furthermore, the observer should accomplish "six nights of first-class results" at a station before moving on to the next.<sup>89</sup>



Harkness chronograph. *Photo is courtesy of George Eastman House, International Museum of Photography and Film.* The chronograph used by Kampf was similar to this one. Invented by William Harkness, the instrument recorded on a chart the local time at one-second intervals and the times of the astronomer's observations.



**Figure 9.** Transit instrument held in place by plaster of Paris. NOAA National Geodetic Survey (2009), Web site. Astronomical surveyors often used plaster of Paris to affix the feet of their transits to a solid base, such as a monument, capstone, or, as shown here, a metal stand.

entered the original meteorological data in pencil into field notebooks, and Kampf later transcribed them in ink to other field notebooks.

For almost every night during the summer, Kampf made—or tried to make—his astronomical observations, often well into the wee hours of the morning. But problems beset him, for instrument malfunctions, inclement weather, and telegraphic difficulties seemed to conspire against him. To have a successful exchange of time with Salt Lake City, conditions at both stations had to be satisfactory, and commonly this was not the case. For example, on one evening Kampf reported that Clark thought he could not see even one star that night, so Kampf’s readings “were of no use.”<sup>90</sup>

Kampf’s transit telescope was damaged in transport to Georgetown, resulting in time lost in making repairs. His chronograph gave him fits, mainly because dust would cause



**Figure 10.** Hole in top surface of Georgetown monument. Photo by W.E. Wilson. The funnel-shaped hole in the top surface of the Georgetown monument may originally have held a metal post over which Kampf would have placed a capstone. He could then rotate the capstone, with the transit attached by plaster of Paris, to align the instrument precisely with the meridian.

the pen to malfunction. He even substituted a writing pen for the ink pen of the chronograph, which seemed to solve the problem temporarily. Finally, on the morning of July 4, just before closing up camp, he had a local watchmaker come and clean the instrument, and he reported that now it was working “pretty well.”<sup>91</sup>

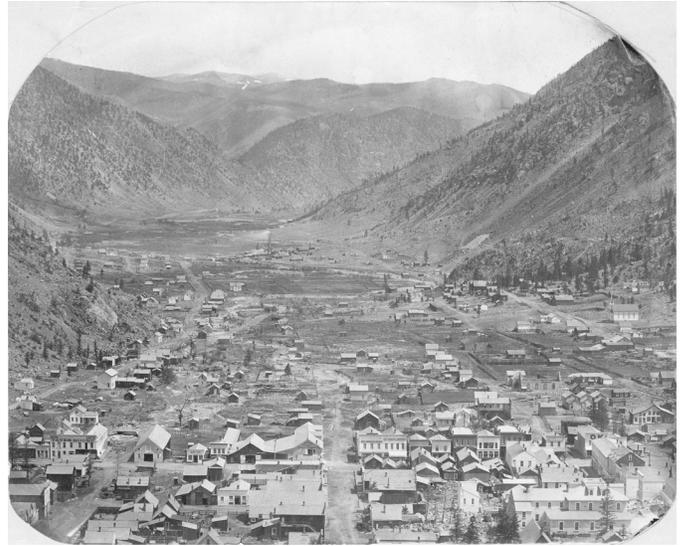
Kampf frequently complained about the wind, which often blew so hard he could not open the tent flap to make his observations. On many occasions, cloudy skies and rain—even snow on the night of June 30<sup>92</sup>—blotted out the stars and caused his nightly observations to be cancelled or delayed. On June 22, he reported that a forest fire in the mountains caused the air to be so undulating that the stars were “nearly invisible.”<sup>93</sup> Kampf concluded, “Owing to the inauspicious state of the weather and the sky, this was the most inconvenient station of the season, and it was with great trouble that the observations were accomplished at all.”<sup>94</sup>

Probably Kampf’s most frustrating times came when the telegraph system failed him. Often wires would be broken or downed, and while that was understandable given the many miles of wire that had to be working properly to make connections with Salt Lake City, it was, nonetheless, aggravating. What caused him most grief, though, was the reluctance or inability of telegraph operators to give him sufficient time on the wire so that he and Clark could exchange their readings. By the 1870s, telegraphic traffic was considerable, and the operators had difficulty making time for the wire to be completely clear over for such a long distance. The connection between Georgetown and Salt Lake City was via Cheyenne. Initially the Cheyenne operator told Kampf that he could use the wire only three times a week. On June 20, Kampf spent the entire day at the telegraph office

negotiating for time on the wire for that night. Toward the end of the day, the operator in Cheyenne told him that his only wire had broken that afternoon because of heavy winds. Finally, when no answer was forthcoming the next day, Kampf sent a dispatch to Wheeler asking him if he would contact the superintendent of the Cheyenne telegraph office to request time. For all his efforts, Kampf was chided by Wheeler: "Lt. Wheeler said in his answer I ought to have found out [the] difficulty sooner. I did so, but would not trouble him before I saw the necessity."<sup>95</sup> Although the issue apparently was resolved satisfactorily, Kampf still was annoyed at the telegraph operators. On June 29, he noted that "Operator was talking with Cheyenne, could not get that wire, to[o] much work in Cheyenne offices! horrible!"<sup>96</sup>

Despite these many difficulties, including an occasional "horrible" one, by July 4 Kampf apparently felt he had sufficient data at Georgetown to meet Wheeler's criteria for making accurate determinations of latitude and longitude. On the day before, the well known photographer, William Henry Jackson, who was employed at the time by the Hayden Survey, took a scenic picture of Georgetown and its valley (fig. 11). The monument site is just off the view to the right, but it is easy to imagine Kampf on-site, wrapping up his Georgetown duties that very day.

One wonders if Kampf took time to participate in the local Independence Day festivities after the watchmaker made his visit and before breaking camp. According to the local papers, in the morning he could have enjoyed ice cream and strawberries at a picnic at nearby Empire; in the afternoon he could have cheered "the victories which the Georgetown ball club will achieve over the simple nine of the Gilpin;"<sup>97</sup> at dusk he could have admired the fireworks from his vantage point on



**Figure 11.** Georgetown, July 3, 1873, looking north. *Denver Public Library, Western History Collection, William Henry Jackson, Call No. WHJ-10668.* William Henry Jackson took this photograph of Georgetown on July 3, 1873. The view is toward the north, down the Clear Creek valley. The monument site is just off the picture to the right. Kampf would have been breaking camp as Jackson took the photograph.

the knoll east of town;<sup>98</sup> and finally he could have closed out the day by dancing away the evening at a ball in Empire. But perhaps he was too much of a recent arrival to this country to have acquired any local patriotism; or perhaps his scientific background (or Lt. Wheeler!) drove him to stick to business.

## A Friendly Visit?

On June 26 and 27, 1873, Ferdinand Hayden and his party visited Kampf at his Georgetown site. Hayden's surveying team was mapping in the vicinity and they sought to obtain some of Kampf's data. Based on Kampf's journal entries for those dates, the tone of the visits seems cordial, even cooperative:

June 26th... (Prof. Hayden came to see the observatory.)

June 27th... At 11 o'clock. Prof. Hayden, Mr. Stevensen, Gardner and any other of the geological

survey-party came to see the instruments and brought an aneroid and a cistern-barometer to compare it with our instruments. They are going to day to Gray's Peak and want a copy of our hourly barometrical observations from to day until Sunday.<sup>99</sup>

Kampf's letter of testimony at the Townsend congressional hearing the following May offered a different view of the visit. In the letter, Kampf wrote, "Hayden said, in effect: 'That if Lieutenant Wheeler was only out of the field, it would be an easy matter for him (Hayden)

to absorb all western explorations and surveys, and that he would look out that no Army officer should ever have anything to do in that line of duty again; further, that he did not consider any Army officer fit to perform such duties, as the assistants of Army officers had to obey orders and instructions, while his (Hayden's) assistants were at liberty to follow their ideas, as they thought best.'"<sup>100</sup> These comments reflected the bitter rivalry that had emerged between Wheeler and Hayden, culminating in highly vitriolic testimony at the hearing.

## Hughes

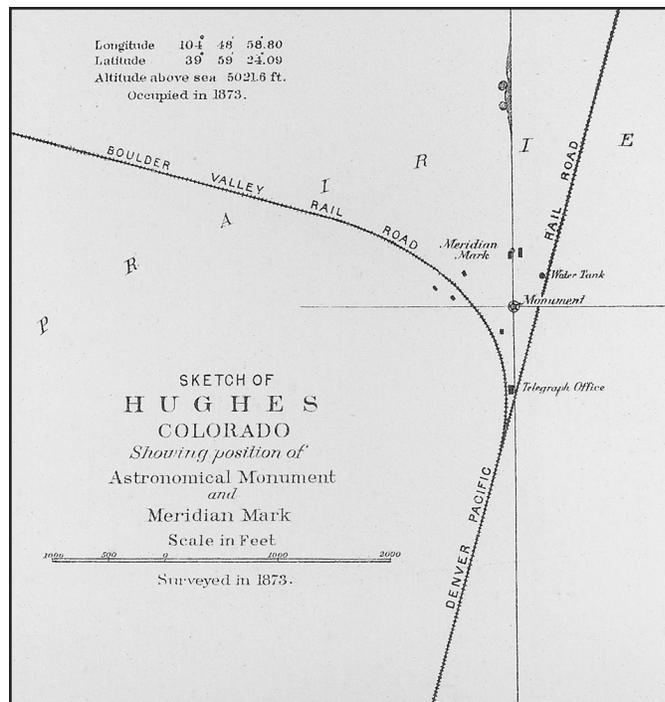
In any event, Kampf did break camp on July 4–5 and set out for Denver and his next station, Hughes (now Brighton, about 20 miles northeast of downtown Denver). He spent the next several days in Denver trying to track down the monument that had been ordered for Hughes. His account reveals his efforts:

July 6th and 7th. I was looking through the whole city for my monument, but no agent or anybody else could tell me about the stone. At last I found Mr. Trotscher[?], who builded [sic] the monument for Georgetown and would order one for Hughes, but he had no stone large enough. July 8th. I sent dispatches to several places to hear whether somebody knew something about the monument, but without any result. So I sent the soldiers to Hughes (9th) to see what kind of place Hughes was and w[h]ether it would be possible to build a monument in another way... the next day in the morning (10th) ... I started myself for Hughes. There is only one station [in] town and one Boardinghouse. No store to find in 20 miles around. Therefore I sent Gedney back to Denver to buy Brick, stones and plaster, nails, ink, pencils, etc. He came to Hughes again in the morning at 11 o'cl. on the 11th of July.<sup>101</sup>

Hughes Station certainly was a contrast to Georgetown for Kampf. He described Hughes as consisting of “the railway office, with which was combined the telegraph office,... two frame houses,...and...a water tank. These buildings constituted the station of Hughes, whose population, exclusive of the few laborers engaged upon repairs of the track, numbered but seven persons.”<sup>102</sup> The station was named for General Bela M. Hughes, who was the first president of the Denver Pacific Railroad and Telegraph Co.<sup>103</sup> The depot was situated in the wye of a spur of the Denver and Boulder Valley Railway and the main tracks of the Denver Pacific Railroad. The spur, which served the coal mines near Erie, had been completed in January 1871.<sup>104</sup> Hughes Station was renamed “Brighton” by Daniel F. Carmichael a decade later, when he platted the first town sites.<sup>105</sup>

After Gedney returned with the building materials, Kampf hired two masons to construct a sturdy brick pier to serve as a temporary platform for his instruments. The site was in the wye, about 135 feet from each of the tracks, north of the railway office and south of the frame houses and water tank<sup>106</sup> (fig. 12). For the next 11 nights, Kampf exchanged times of star crossings with John Clark in Salt Lake City and made observations for latitude. While at Hughes, he also made telegraphic connections with Professor Truman H. Safford, one of Wheeler’s other civilian astronomers, who was making observations in Santa Fe, New Mexico.<sup>107</sup>

At Hughes, Kampf encountered many of the same problems as at Georgetown, though he notes that “as a rule the weather was favorable for this work.” The chronograph was its



**Figure 12.** Historic map of Hughes and monument site, surveyed 1873. *Wheeler (1877), plate 5.* Hughes, merely a railroad stop in 1873, was named for General Bela M. Hughes, the first president of the Denver Pacific Railroad and Telegraph Co. The site now lies within the city of Brighton.

usual balky self—it had been damaged in transport and needed constant attention. “The chronograph works astonishing bad,”<sup>108</sup> he wrote. One of the wires leading into the tent had to lie on the ground, because no telephone pole was available to keep it raised. On July 20, a large hay wagon came across the track and caught the wire, tipping the chronometer onto its side. Kampf was “afraid the instrument is very much troubled by the accident.”<sup>109</sup> Indeed, after all these travails, it is a wonder that the chronometer worked at all, much less with any accuracy. But the next day he concluded that “the chronom. [is not] troubled very much by the accident of yesterday.”<sup>110</sup> Nonetheless, in his final report Kampf described that the event was “much to the vexation of the astronomer and the delay of his work.”<sup>111</sup>

Kampf made his final observations for latitude on the night of July 23, finishing at 3 a.m. on the 24th. He expressed satisfaction that he had determined accurate values for longitude and latitude, so he prepared to set out for Denver, and on to his next station, Colorado Springs. In Denver, he arranged to have his boxes shipped to Colorado Springs on the Denver and Rio Grande Railroad (D&RG). To his surprise, at the freight depot of the D&RG he found the monument that had been intended for Hughes. He then obtained permission from Wheeler’s Quartermaster in Pueblo to have the monument shipped to Hughes. Not until September, after he had finished his observations at Trinidad, did he return to Hughes to set the stone monument: “Sept. 22nd. Left

[Denver] for Hughes. Set the monument in the evening. . . .<sup>112</sup> One might wonder why Kampf would bother to set the stone monument after he had completed his observations; perhaps it was because of Wheeler's desire to have permanent, inscribed markers available for future observations.

Today the wye still exists, but since 1873 the area has become urbanized, three depots have come and gone from the site,<sup>113</sup> and the houses and water tank have long since disappeared. So has the monument, or at least a search of the area revealed no such feature, and some old-timers in town, who were queried, had no knowledge of it.

## Colorado Springs

At Colorado Springs, Kampf set up camp at a point about 650 feet east of the tracks, "on a slight eminence near the freight depot of the Denver and Rio Grande Railroad"<sup>114</sup> (fig. 13).

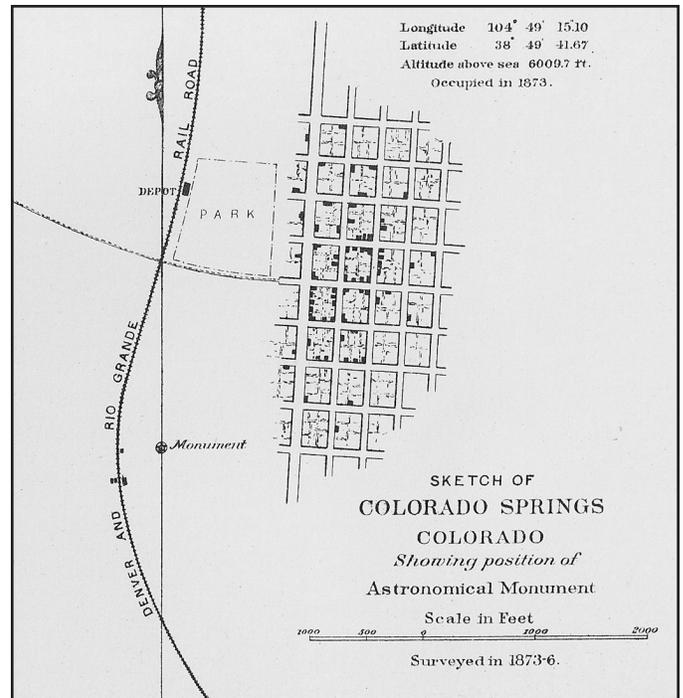
He further notes that "generally speaking, it is inadvisable to have the astronomical station near the railroad-track; but in this case the trains ran only during the day, and the observations were never affected by vibrations of the ground."<sup>115</sup> He describes the setting as follows:

Colorado Springs...has been built up within five years, and has nearly fifteen hundred inhabitants, and the place promises to become one of considerable importance. During the summer-months, the hotels (of which there are quite a large number) are filled with invalids, who flock here on account of the beautiful scenery and the salubrity of the climate. The track of the Denver and Rio Grande Railway passes around the town at a distance from the town-limits of about four thousand feet.<sup>116</sup>

Evidently once again a stone monument was not available, and Kampf "bought brick, stones, plaster, nails, etc."<sup>117</sup>, with which to build a brick pier. The crew constructed the pier and set up the observing tent, while Kampf cleaned the chronograph ("it is now working again pretty well, after the Hughes-dust is out"<sup>118</sup>). From July 28 to August 9, there was no day without rain, often accompanied by thunder and lightning<sup>119</sup>—Kampf usually reported "heavy storm and rain." "In all those days, which I am observing on this place, the air was never good, worse than in Georgetown, and I have to take double care for my observations."<sup>120</sup> Often he was up until five or six o'clock in the morning, waiting for the sky to clear or finishing his observations.

On August 2, the Colorado Springs Gazette reported on the activity of the astronomical party, crediting Kampf with both a title ("Professor") and powers (the ability to make daytime astronomical observations) that he did not possess:

Professor Kampf, who is connected with Lieut. Wheeler's Surveying Expedition, is encamped, with a small party of assistants, near to the Freight Depot, and is busily engaged in making observations. It



**Figure 13.** Historic map of Colorado Springs and monument site, surveyed 1873–76. *Wheeler (1877), plate 5.* Colorado Springs was already a bustling resort town in 1873. The location of the monument site near the tracks was satisfactory because the trains ran only in the daytime, and so no ground vibrations disturbed the nighttime observations.

is intended to make this an 'astronomical point,' for use in all future expeditions, and its position is therefore being accurately determined. Professor Kampf's camp is connected by telegraph, with the Observatory at Salt Lake. Observations of the heavens are made every hour day and night... From here, Professor Kampf will go to Labran, where another astronomical point will be established,—thence to Trinidad, and so on to the Mexican border... [He] will probably remain here about two weeks longer. Lieut. Wheeler is expected to be here in September.<sup>121</sup>

As with the Hughes monument, the brick pier at Colorado Springs was replaced in September by a "solid sandstone monument," this one "furnished by Mr. S.G. Ward, of Pueblo."<sup>122</sup> On September 20, while Kampf was on his way back to Hughes, two of his men stayed in Colorado Springs to set the new monument there.<sup>123</sup>

Today, the old freight station is gone and so apparently is the astronomical monument. Whereas in 1873 the tracks passed nearly a mile west of the town boundary, now they pass through the urban center. The area where the monument probably once stood is mostly paved, with various streets and commercial buildings in the vicinity. With such extensive development, it probably is unreasonable to expect an unused block of sandstone to survive intact.

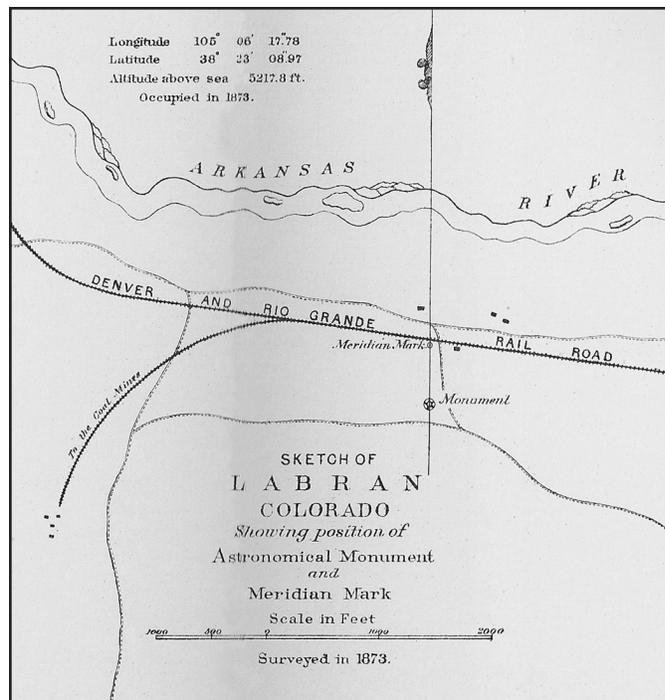
## Labran

General William Jackson Palmer, founder of the City of Colorado Springs and founder and president of the Denver and Rio Grande Railroad, followed a practice that was common among companies with expanding railroads of the time. Palmer would stop his newly-constructed tracks a mile or so short of the nearest town, thereby forcing merchants to either move to the vicinity of the track terminus and buy lots from the railroad, or remain in their current location and lose business.<sup>124</sup> Such was his plan for Labran, about 30 miles west northwest of Pueblo. When Kampf arrived in August 1873, Labran was merely a station at the terminus of the tracks from Pueblo, with only four houses<sup>125</sup> and perhaps a store and a restaurant.<sup>126</sup> But Palmer's goal was to create a town that would displace the nearby small community of Frazierville; however, in this case, Palmer's ploy failed, for a local rancher, James McCandless, decided to plat his own town at the site of Frazierville, which he renamed Florence. With the support of many locals, Florence thrived, and Labran never did develop. On November 26, 1874, the Colorado Daily Chieftain (Pueblo) reported that "the scheme at Labran was given up, and the place is now composed of a railroad warehouse and a few other buildings." In fact, for many years (including 1873) the depot at Labran was simply a boxcar.<sup>127</sup>

Kampf arrived at Labran on August 11 and selected a monument site "...157 feet from the southwest corner of the depot..."<sup>128</sup> (fig. 14). The next day, "Six men and two mules brought the monument on rollers and boards to the place and set it in the ground."<sup>129</sup> After three days of rain, the weather became "tolerably fair," though "the wind was always very strong, and the observing-tent was often in danger of being blown away."<sup>130</sup> As usual, the telegraph system erratically functioned, but Kampf seemed to have mellowed during the course of the summer. On August 18, he reported that he "commenced to observe for time at 6 o'cl. Telegraph operator went to performance of Mr. Robinson and did not come back [so] that I could exchange."<sup>131</sup> The "performance" was Old John Robinson's circus, which appeared in Pueblo on August 18<sup>132</sup>, and was advertised ahead of time in the Colorado Weekly Chieftain (Pueblo, August 6, 1873) as "John Robinson's Great World's Exposition!" Drawing upon his Latin schooling, Kampf philosophically commented regarding the absent operator: *Hac ex re viden duces est omnes jacoshomines enosdam magis amare quam ashonomiam.*<sup>133</sup> ["From this event one must see that some people love all amusements more than astronomy."]

One rainy day Kampf actually took a day off and went to visit the nearby coal mines.<sup>134</sup> By August 27 he had completed the necessary observations, and he packed up and headed for Pueblo and then Trinidad.

The Labran monument could not be located. Apparent contradictions in Kampf's descriptions complicated the search. His text description places the monument 157 feet from the southwestern corner of the boxcar depot; however, the exact location of the boxcar is unknown—no historic



**Figure 14.** Historic map of Labran and monument site, surveyed 1873. Wheeler (1877), plate 5. Kampf's mapped location of the Labran monument site, his description of the location, and the coordinates he determined all seem to indicate different positions. The monument at Labran could not be found.

photos or descriptions could be found that include the depot; furthermore, the boxcar may have been moved from time to time. Presumably though, it was on a siding close to the main tracks at the town site of Labran. On the other hand, Kampf's sketch map, when scaled off on the modern topographic map, places the monument about 600 feet south of the 2010 position of the tracks and about 500 feet west of Route 67. And finally, the monument's coordinates, as determined by Kampf, place the site nearly a one-half mile east of Route 67 and north of the tracks, between East Main Street and the tracks.<sup>135</sup> All three of these areas were searched on foot for evidence of a monument, but with no success.

Although the area is not highly urbanized, numerous activities and developments have occurred since the 1870s that could have impacted the monument. Coal mining; ore-reduction mills; and petroleum drilling, refining, and storage operations all contributed to industrialization of the Florence area in the 1880s and 1890s.<sup>136</sup> In 1906 plans were announced for relocating the tracks toward the south between Pueblo and Florence, to "take out the curves and make the track as straight as possible."<sup>137</sup> If the original tracks at the Labran site were moved later toward the south, that could account for the fact that one of the positions of the monument site now appears to be north of the tracks. More recently, a golf course has been developed south of the tracks, adjoining or within the area where the monument may have been located. The area north of the tracks, which the published coordinates of the monument

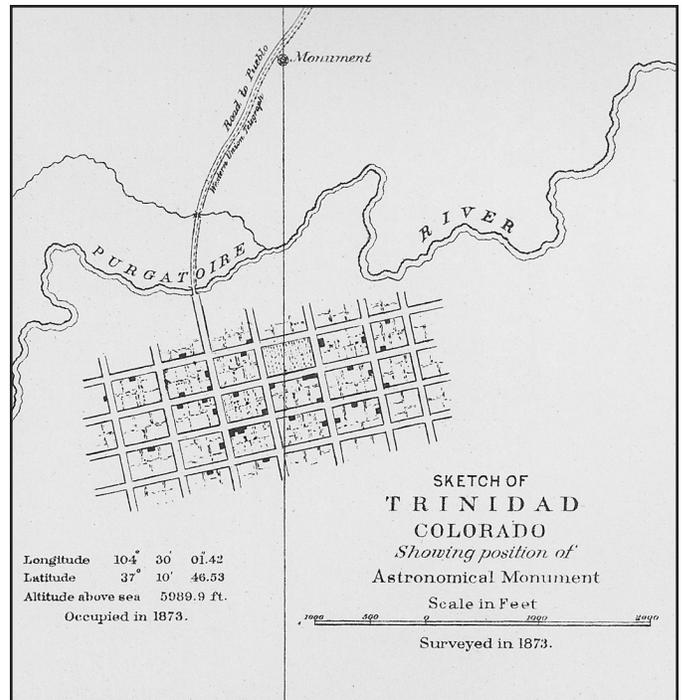
would suggest is the correct location of the site, consists of abandoned alfalfa fields. The property owner of 40 years does not recall ever seeing a monument in that vicinity.<sup>138</sup>

With all these uncertainties, it is not surprising that the monument could not be found. Still, not every square foot of likely areas was searched, and it is possible that the monument is hidden in some unsuspected spot.

## Trinidad

In 1860, some families from New Mexico moved to the rich valley of the Purgatoire River, in what is now southern Colorado, and their settlement eventually became the town of Trinidad. Located along the “Mountain Branch” of the Santa Fe Trail, the town gained a reputation as a rough frontier town. When Kampf arrived in 1873, Trinidad (population about 1,200<sup>139</sup>) had not been incorporated, nor had the railroad arrived; however, the town was maturing “into a major center of commerce and agriculture for southern Colorado”<sup>140</sup> and eventually would evolve “from a small adobe village into a Victorian jewel.”<sup>141</sup> Incorporation occurred in 1876, the year that Colorado became a state, and the Atchison, Topeka, and Santa Fe Railroad arrived 2 years later.

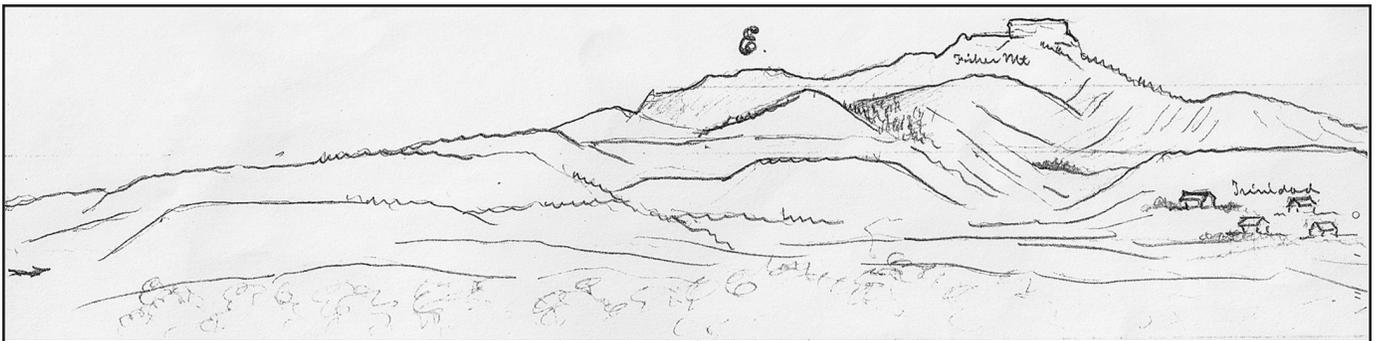
Kampf arrived in Trinidad on August 29 and set about finding a suitable site for his monument, which this time was waiting for him, “in the care of Mr. Riffenberger.”<sup>142</sup> He selected a site on private property, and with the permission of the land owner he made preparations to set the stone the next morning; however, the next day the owner demanded pay for use of the site. Kampf told him that he had “no authorization to pay for such things,”<sup>143</sup> and he therefore resumed his search. With the help of a surveyor, Mr. Sobries, he selected a site on the township line, having been assured by the surveyor that it was on government property. After a delay because of storms, the stone was finally brought to the site “with immense difficulties” and set on September 2.<sup>144</sup> He described the location as being “situated on a hill near the surveyed line of the railroad, at the northeast corner of the township in which Trinidad lies, and about two-thirds of a mile distant from the village”<sup>145</sup> (fig. 15). It is from this vantage point that Kampf



**Figure 15.** Historic map of Trinidad and monument site, surveyed 1873. *Wheeler (1877), plate 5.* Kampf described this site as being on a hill about two-thirds of a mile from the village of Trinidad.

made three scenic sketches of the views to the north, east, and south. The view to the east shows the village of Trinidad, with Fisher Peak (which he labels “Fisher Mountain”) in the background (fig. 16).

Before he could start his exchanges of time with Salt Lake City, Kampf had to find a telegraph operator, for upon his arrival at Trinidad no operator was on duty in the local telegraph office. Evidently, according to Kampf’s succinct explanation, the most recent one had been “engaged in the last hanging case here [and had] left Trinidad without a successor,”<sup>146</sup> suggesting that the operator had found it judicious to leave town after participating in a lynching.



**Figure 16.** Historic landscape sketch of Trinidad area, looking east. *Kampf (1873a).* Kampf must have been struck by the beauty of the views from this location, for this is the only site that he sketched in his “Recording Book.” This view, one of three that he sketched, overlooks the town with Fisher Peak in the background.

Kampf sent letters to Denver and Pueblo asking that the vacancy be filled, but without success. Finally, he persuaded an unemployed operator in Las Animas to come to Trinidad with the promise of 2 dollars of pay per day. The operator arrived on September 10, and set about repairing the line, which was “out of order.” Even after being repaired, the line throughout Kampf’s stay in Trinidad was in “very bad condition and would not transmit signals when the weather was rainy.”<sup>147</sup> Nonetheless, by September 20 he had completed his work, so he packed up his tents and instruments, his Colorado observations completed for the summer.<sup>148</sup>

Today, the monument sits on a bluff overlooking Interstate 25, at the end of a street, near the bluff’s edge (figs. 17 and 18). The monument itself looks quite different from those in Georgetown and Julesburg, in that the Trinidad sandstone block is extremely weathered, rounded, pockmarked, even deformed. Also, unlike the other two, it is set on a rough concrete base.

In June 2004, the letters “L” and “T” (probably a part of “LAT”) were discernable on the northern face, but they were the only visible evidence of any inscription. The substantial change in shape is perhaps the result of physical weathering because of its exposure to the elements; or it could be the result of chemical weathering by air pollutants, possibly derived from nearby industrial activities or automobile fumes from the highway. Historic photos might help identify the period when significant weathering took place, but no historic photos of the monument were located.

Kampf’s departure from Trinidad did not mark the end of his work for the field season of 1873. Instead, he headed for Ogden, Utah, by way of Pueblo, Denver, and Cheyenne, with a side trip to Hughes to set the sandstone monument there. The Wheeler Survey had constructed a new observatory at Ogden to replace the one at Salt Lake City, which had proved less than satisfactory for the observations that Wheeler’s astronomers needed to make. Kampf’s task was to determine the latitude and longitude of the new but still unfinished observatory. He “found the observatory in bad condition,”<sup>149</sup> but he set about making time exchanges with Salt Lake City and Detroit. During October 11–13, Kampf tried to make connections with Clark, who was observing at a main astronomical station at Bozeman, Montana, but he was unsuccessful because the line was “busted.”<sup>150</sup>

According to the last paragraph in Kampf’s 1873 “Recording Book,” on October 14 he left for Washington, D.C., with stops along the way in Chicago, Detroit, and New York. While in Chicago he tried to visit with Professor Truman H. Safford, another astronomer who had worked for Wheeler that summer while on leave from the Dearborn Observatory in Chicago. Safford and Kampf had just finished their first complete field seasons in the American West, and perhaps Kampf wanted to compare notes on methodology with Safford, or to swap stories of making astronomical observations under primitive field conditions, or simply to meet him for the first time. Kampf, unable to locate Safford in Chicago, continued his journey eastward. In his “Recording



**Figure 17.** Modern photo of Trinidad monument with view of Trinidad area, looking east. *Photo by W.E. Wilson.* The view is similar to that sketched by Kampf and shows the modern railroad tracks, the city of Trinidad, and Fisher Peak. The extremely weathered monument in the foreground sits on a bluff overlooking Interstate 25.



**Figure 18.** Modern close-up photo of Trinidad monument. *Photo by W.E. Wilson.* The monument sits on a concrete base and is extremely deformed from weathering. The inscriptions have been almost entirely obliterated.

Book,” he notes that he arrived in Washington on October 26, whereupon he reported in to the office.<sup>151</sup>

The dates of this itinerary conflict with dates provided by the published results of the successful exchanges of time between Clark at Bozeman and Kampf at Ogden. This report states that Clark conducted the observations at Bozeman, and connections were made “with the observatory at Ogden, at which Dr. F. Kampf was observer. Exchanges were made

for longitude on three days, the 29th and 31st of October and the 1st of November...”<sup>152</sup> The tables of data in the same report confirm these dates.<sup>153</sup> Perhaps Kampf wrote his last entry in his “Recording Book” sometime after he returned to Washington, and he simply remembered his travel dates incorrectly. In any event, after he arrived at Washington, he spent the next 9 months or so reviewing and analyzing data and preparing reports.

## A Mixed Blessing—The Mormon Observatory, Salt Lake City

During the field seasons of 1872 and 1873, Brigham Young kindly granted the Wheeler Survey the use of the Mormon Observatory, built in 1869 and located in Temple Square, Salt Lake City. The Mormons primarily used the observatory to determine local time from the sun; Wheeler’s personnel used it to connect telegraphically with the main astronomical stations throughout the West to determine differences in longitude. During the field season of 1873, John H. Clark was the astronomer at the site, and he reported on operations in an 1874 letter to Wheeler, published in 1877.<sup>154</sup>

The observatory site had been chosen for its proximity to the intersection of the Great Salt Lake Baseline and Meridian, and for the relative protection that the walls of Temple Square afforded it from the noise and activity of the city.<sup>155</sup> Unfortunately, the setting was not satisfactory for Wheeler’s purposes. According to Clark, the observatory “is situated in Temple Square, about 100 feet from the southeast corner ... no position more objectionable could have been selected for such a purpose.”<sup>156</sup> Clark continues:

By its location the observatory is subject to the dust and smoke of the city, the noise of travel in the adjacent streets, and, worst of all, to the heavy concussions to which,

from its construction, the Temple is subject. It is so hemmed in that from the position of the instrument nothing terrestrial can be seen but the top of a distant mountain, by which the city is bounded to the northward. In the south there is no horizontal view possible in consequence of the interposition of the wall of the Temple yard. Eastward this wall again shuts off the prospect, but to the west there is an open view past the Tabernacle and over the trees and house-tops to the Great Salt Lake and the adjacent mountains.<sup>157</sup>

The observatory consists of a double house, one enveloping the other. The inner one of these is of frame-work, and was built by the United States Coast Survey; the outer is of adobe material, and was constructed by the Mormons. The observing room presents a space of about ten by fifteen feet and is supplied with two stone pillars, on the western one of which the transit was mounted, and the observations in connection with the various stations

of the season were made. The openings in the roof over the eastern pillar are sufficient for latitude work only, and over the western block they extend no farther than the eaves. This arrangement is enough for the purposes of the owners, as they make no other use of their transit than to get the time by the sun, but it is insufficient for complete astronomical work. The pillars are solid blocks of sandstone, pretty well dressed, particularly the western one. They are firmly planted, and, considering the surroundings, stand remarkably well.<sup>158</sup>

From this account, it is not difficult to understand why Wheeler chose to build his own observatory in Ogden. The Salt Lake City observatory, which stood on Temple Square for nearly a quarter of a century as the Temple rose beside it, was dismantled upon the Temple’s completion in 1892.<sup>159</sup>

## 1874 Field Season

Wheeler and his field parties did not return to Colorado until mid-July 1874. The Rocky Mountain News reported on July 15 that the parties were about to set out from Denver for a rendezvous in Pueblo, where they then would move out to their various field assignments. The lateness in starting field work was a consequence of two outcomes of the contentious hearings that the congressional Townsend Committee had held in April. First, the committee expressed concerns about the inefficiency of the Wheeler Survey,<sup>160</sup> and as a result, the Department of War did not finalize the allocation of funds for the project until early July.<sup>161</sup> Second, the committee requested that the Secretaries of War and Interior, in consultation, organize their surveys “without danger of duplication.”<sup>162</sup>

The consultation apparently took some time, but on July 9, General Humphreys, Chief of Engineers, notified Wheeler by letter<sup>163</sup> that his work for the summer generally would be restricted to the area south of an east-west line through “the highest of the Spanish Peaks in Colorado Territory,” which was “the most southerly point reached by Prof. Hayden’s surveys in the last season.” Certain triangulation stations north of that line were exempted, but more importantly for Kampf, the letter to Wheeler stated:

You are authorized to occupy for astronomical purposes (provided the necessary facilities can be obtained from the telegraph company) the following points along the line of the Union Pacific Rail Road in about Latitude 41°, viz: Salt Lake, Sidney Barracks, Julesburg and the crossing of the 100 Meridian by the Union Pacific R.R., Nebraska....<sup>164</sup>

Wheeler directed Kampf and two assistants first to establish astronomical stations at Las Vegas and Cimarron, New Mexico, which they did during August and early September. Then Wheeler had Kampf stop at South Pueblo, Colorado Territory, where he determined coordinates before traveling on to western Nebraska and northeastern Colorado. In sequence, he established main astronomical stations at Sidney Barracks, Nebraska; Julesburg, Colorado Territory; and North Platte, Nebraska. The North Platte station was intended to be the one described as the point where the Union Pacific tracks cross the 100th meridian; however, the value for longitude that Kampf determined indicates that the station actually is about 40 miles west of that meridian, at about 100 degrees 46 minutes.<sup>165</sup>

## South Pueblo

Kampf arrived in South Pueblo in mid-September, 1874, and prepared to make his astronomical observations; however, he was not the first to make determinations of coordinates at this community. Lieutenant Ernest H. Ruffner, Corps of Engineers, had been there in May 1873, with the goal of determining longitude. Ruffner was stationed at Ft.

Leavenworth, Kansas, where he served as the engineering officer on the staff of the commander of the Department of the Missouri. Although Ruffner did not participate in the Wheeler Survey, undoubtedly Wheeler and Ruffner were well acquainted with each other, for the two overlapped at the U.S. Military Academy—Ruffner graduated in 1867, just a year after Wheeler.<sup>166</sup> Thus Wheeler probably was quite aware of Ruffner’s earlier work in the Pueblo area, and he made a late decision to take advantage of this work and supplement his database by piggy-backing on Ruffner’s results.

Ruffner was working in Colorado because of trouble that had been brewing between prospectors, who were swarming into the San Juan Mountains of southwestern Colorado, and the Ute Native Americans, whose reservation occupied much of the region. In the summer of 1872 the Utes asked the federal government to have the miners evicted. At that time, an effort for cession of the disputed territory was attempted but failed. The next spring, as a new flood of prospectors seemed imminent, the Utes demanded that the intruders leave or war would follow. Ruffner noted that the consequences of such a conflict “would be dire.”<sup>167</sup> As a result of this threat, the Indian Bureau requested that the miners be removed from the reservation, and the military was ordered to enforce this request.

The problem was that the position of the eastern boundary of the reservation—defined as the 107th meridian—was unknown. To effectively carry out their directive, the Corps ordered Lt. Ruffner to map the position of this line of longitude in southwestern Colorado and to “furnish a full descriptive report of this district.”<sup>168</sup> The 107th meridian runs through the eastern part of the San Juan Mountains, close to today’s Pagosa Springs and about 4 miles west of Creede. Aware of the ruggedness of the region, Ruffner stated that this meridian was “probably as difficult a line to establish as could have been chosen.”<sup>169</sup>

Ruffner’s plan was to start with the known longitude of Ft. Leavenworth and to determine differences in longitude westward through a series of astronomical observations by telegraph, ending in South Pueblo. Then he would use South Pueblo as his base and carry the longitude westward into the mountains by using standard land-surveying techniques.

In the fall of 1872 the Corps assigned the astronomer Professor T.H. Safford to assist Ruffner. Safford, who was on leave of absence from the directorship of the Dearborn Observatory in Chicago, had just completed a star catalog for the Corps. During September and October 1872, in preparation for the next field season, Ruffner and Safford established the differences of longitude between Ft. Leavenworth, Ft. Hays, and Denver, with additional exchanges with a crew stationed in Ft. Wallace, Kansas. Ruffner was the observer in Ft. Leavenworth, whereas Safford was the observer at Ft. Hays and Denver.<sup>170</sup>

Ruffner resumed his Colorado project in May 1873, when he and his party arrived in South Pueblo, ready to carry out their mission. At the time, South Pueblo and Pueblo were independent communities, separated by the Arkansas River.

The Denver & Rio Grande Railroad had arrived in Pueblo from the north in 1871 and had been extended to South Pueblo by early 1872.

Ruffner had a “brick post” built to serve as a platform for his instruments.<sup>171</sup> He notes that the “post...is referred to the southeast corner of the new brick depot of the Denver and Rio Grande Railroad.”<sup>172</sup> In 1874 Kampf occupied the same site, which Wheeler later described as “...situated on the top of the bluff near the railroad station in South Pueblo.”<sup>173</sup>

Some uncertainty exists about the location and construction materials of the South Pueblo passenger depot that existed when Ruffner and Kampf were making their observations. Chief Engineer J.A. McMurtree, in his annual report of 1883, describes all the South Pueblo buildings that the D&RG owned at the time that he took over in early 1873; included in the inventory is an “Office and passenger depot, 16×24” valued at \$500.00.<sup>174</sup> This small building, probably constructed of wood, likely served as the initial and temporary depot in South Pueblo. By the time of Ruffner’s arrival in the spring of 1873, the railway recently had completed a handsome triangular-shaped brick structure that housed the Division Office and telegraph office. Perhaps by Ruffner’s arrival in May, the initial wooden depot had been abandoned, and this new building was serving not only as offices, but also as the “new brick depot” that Ruffner mentioned. This would have been the same building that Wheeler later described as the “railroad station” that was near Kampf’s site in 1874. Not until 1876 did the railway build a separate, sprawling, wood-frame station nearby, known as the Union Depot<sup>175</sup> (fig. 19).

Ruffner’s initial position was in soft ground that would not hold his protective tent in place. After the wind blew the tent over and nearly damaged his instruments, he moved his position to where a large frame warehouse was being built. “During my observations, I used one of their stone posts, which were simply made of flat stones laid in mortar to a convenient height.”<sup>176</sup> After making his observations each night, he packed up his gear and put his instruments in the warehouse, where they would be safe.

Ruffner determined longitude of his site by exchanging times by telegraph with Safford, who was again stationed in Denver. Safford occupied the same monument that he had erected the preceding fall, near the Denver and Rio Grande depot and 2,061 feet northeast of the flagstaff of the “United States branch mint at Denver.”<sup>177</sup> Ruffner and Safford each observed for local time until 9 p.m., and then they made telegraphic connection between the two stations. Signals were sent every 5 seconds by an ordinary talking key and were received and noted by ear at the other end. About 60 signals were sent each way using the eye and ear method on each of three nights.<sup>178</sup> After reviewing the data and considering the difficult conditions under which he was working, Ruffner proudly concludes that “the result shows my work [to be] as good as I have ever done with the heaviest post and more elaborate precautions.”<sup>179</sup>

On May 7, while Ruffner and Safford were still making their observations for longitude of their South Pueblo

astronomical station, field parties set out westward toward the Ute Territory. Ruffner’s civilian first assistant, Henry G. Prout, a civil engineer, led this expedition.<sup>180</sup> The group ran two independent lines between South Pueblo and Ft. Garland, and thence up the Rio Grande River to the 107th meridian, about 90 miles northwest of Ft. Garland. After some reconnaissance of the surrounding region, they returned to Ft. Garland to restock provisions, only to learn that the government had signed a new treaty with the Ute Native Americans. In it, the Native Americans agreed to relinquish the area under dispute, thereby negating the need to map the position of the 107th meridian over the full length of the San Juans.<sup>181</sup> Prout’s party then proceeded to carry out its other objectives, by examining the headwaters of the Rio Grande, Gunnison, and Arkansas Rivers and identifying all practical approaches into the Ute country from the east.

Ruffner returned to Ft. Leavenworth on May 14, 1873, and Safford followed him 2 days later, already having reduced all observational data and forwarded the results to Prout, at Ft. Garland. Prout resigned his position at some point before the survey was completed, so Ruffner used his assistant’s notes to prepare a reconnaissance map and report, which he submitted to the Chief of Engineers later in 1873. The map and report were published the next year as Executive Document No. 193 of the House of Representatives.<sup>182</sup>

When Wheeler sent Kampf to South Pueblo in September 1874, it primarily was to determine latitude, which, when combined with Ruffner’s longitude value, would provide the complete coordinates of the station. Wheeler’s annual report for 1875 indicates that Kampf proceeded to “rebuild” the astronomical station previously occupied by Ruffner, and that Kampf made zenith-telescope observations for latitude on September 14, 15, and 16, 1874.<sup>183</sup> Presumably Kampf’s station, on the bluffs west of town, was located at the site of



**Figure 19.** Historic photo of South Pueblo showing brick telegraph building (right) and wooden Union Depot (left). *Date and photographer unknown. Photo courtesy of Lawrence R. Green, Security, Colorado.* The triangular telegraph building may also have served as a temporary depot until 1876, when the railroad built the sprawling Union Depot. The brick building probably is the “new brick depot” referred to by Ruffner as well as the “railroad station” referred to by Wheeler.

## Truman H. Safford, Noted Astronomer

In late 1865 Truman Henry Safford accepted a position as the first director of the Dearborn Observatory in Chicago and as professor of astronomy at the old University of Chicago. The great Chicago fire of 1871 brought financial ruin to many, including those whose private munificence supported Safford's salary. Consequently, Safford, without a source of income, requested and was granted a leave of absence. As he noted, "Family cares made it necessary for me to attend to a more practical department of astronomy from 1871 to 1876, in which year I accepted the Field memorial professorship [Field Memorial Professor of Astronomy] in Williams College."<sup>184</sup>

No extensive biography of Safford exists, but various biographical sketches in, for example, obituaries and encyclopedias provide the basic outlines of his life.<sup>185</sup> He was born in Royalton, Vermont, on January 6, 1836. He soon became known as a child prodigy, for as a youngster he possessed extraordinary powers of arithmetic calculation—for example, at age 8 he reportedly in his head could square numbers with 23 or 24 digits. When Safford was 10, Harvard's president Edward Everett and astronomy professor Benjamin Peirce took an interest in him. His family moved to Cambridge, so the two Harvard officials could supervise his preparatory education. He later entered that college as a junior, graduating in 1854 at age 18. Safford immediately was employed at the Harvard College Observatory, where he remained for 12 years. In 1865, after the death of the director, Professor George P. Bond, Safford was for a short time in charge of the observatory. After he accepted the position at the Dearborn Observatory, he devoted himself to observations of nebulae with the 18-inch equatorial telescope at that

facility, until he took his leave of absence in 1871. Safford resigned from the Dearborn Observatory in 1876, at which time he accepted the position at Williams College, becoming the second director of the Hopkins Observatory there.

During his leave of absence from the Dearborn Observatory, Safford worked first for the U.S. Army Corps of Engineers and then perhaps for the U.S. Coast Survey (renamed the U.S. Coast and Geodetic Survey in 1878) or other government agencies. His first assignment for the Corps was to prepare a star catalog. He did this during 1871–72, working under the direction of Brevet Brigadier General C.B. Comstock, in charge of the U.S. Lake Survey.<sup>186</sup> The Secretary of War published Safford's catalog of 981 stars in 1873.<sup>187</sup>

After Safford completed the catalog in the fall of 1872, the Corps assigned him to Lt. Ruffner's Colorado project. He was in the field with Ruffner during that fall and again in May 1873, and he perhaps worked with Ruffner reducing data during the intervening months. His next assignment was with Wheeler in New Mexico, during the summer of 1873. Before reporting to Wheeler, Safford made a whirlwind trip, traveling from Denver to Ft. Leavenworth in May and then on to his home in Chicago, before turning around and heading West again in June. According to his field notebook for 1873, he left Chicago on June 15 and arrived in Santa Fe on June 22, traveling via Denver and Pueblo.<sup>188</sup>

Safford was one of five civilian astronomers that Wheeler had hired for that field season. He was in charge of astronomical party 4, and he made observations for telegraphic determinations of longitude at Santa Fe and Ft. Union, New Mexico, during June–August, 1873.<sup>189</sup>

In the spring of 1874 Wheeler testified before the Townsend

Committee that his personnel with the survey for the upcoming field season included "2 astronomical assistants, Dr. F. Kampf and Prof. T.H. Safford...."<sup>190</sup> However, Safford may have taken another job at about that time, for Wheeler later noted that his two astronomers during the 1874 field season consisted of Kampf and John Clark.<sup>191</sup>

For the next four seasons (1874–77), Kampf was the only astronomer on Wheeler's staff. During much of this time, Safford's whereabouts and activities are uncertain. Some biographical sketches and obituaries state that various government bureaus in Washington, including the U.S. Coast Survey, employed him.<sup>192</sup> His obituary in the *New York Times* of June 14, 1901, for example, although it fails to mention Safford's association with the Wheeler Survey, does note that in 1874 "he became connected with the Geodetic and Coast Survey. He directed the surveys of the boundaries of New Mexico and Utah."<sup>193</sup> However, these and similar claims could not be confirmed by any contemporary documents. For example, a search of the indexes of the annual reports of the Coast Survey for 1871–78 revealed no mention of Safford, although his name might not show up in such a listing if he worked part time, in a minor capacity, or as a consultant. Furthermore, the Coast Survey was not working in the interior of the United States until about 1878, and thus was not concerned with the boundaries of New Mexico and Utah at the time stated.<sup>194</sup>

In 1876 Safford ended his leave of absence by resigning from the Dearborn Observatory and joining the faculty at Williams College, but 2 years later he resurfaced with the Wheeler Survey. Wheeler's annual report for the fiscal year ending June 30, 1878, states that three astronomical parties were prepared

## Truman H. Safford, Noted Astronomer—Continued

to take to the field for the upcoming season: "Prof. T.H. Safford and John H. Clark have received temporary field appointments as astronomical observers and computers, and are assigned to main field and connecting stations."<sup>195</sup>

Wheeler assigned Safford to the observatory in Ogden, which served as the connecting station for others making observations at various new main astronomical stations that year in Texas, New Mexico, Oregon, and Washington. To make sure of the rate and errors of his chronometers, Safford made observations for time on nearly every night for the next 3 months.<sup>196</sup>

In August, Safford received a visitor at the observatory, British scientist T.E. Thorpe, who was taking a magnetic survey of the Fortieth Parallel between the East Coast and Utah. Thorpe later reported:

Our next station was Ogden, in Northern Utah, at the observatory directed by Lieutenant Wheeler, of the United States Engineers, and on the spot selected by the French astronomers for their observations of the recent Transit of Mercury. The observatory was then in [the] charge of Professor Truman Safford, of Williams College, who also rated our chronometers and otherwise did all in his power to facilitate our work.<sup>197</sup>

Safford left Ogden on October 21 and reached his home in Massachusetts on November 1, 1878.<sup>198</sup> Because Congress terminated field operations of the Wheeler Survey effective July 1, 1879, Safford had no opportunity to participate in any further field work for Wheeler. He continued his distinguished career at Williams College until he suffered an

incapacitating stroke in 1898, and he died 3 years later, on June 13, 1901.<sup>199</sup>

Biographer K.H. Parshall summarizes Safford's professional status and accomplishments: "Although not an astronomer of the first rank, Safford made solid contributions to the field, especially in the areas of star positions, proper motions, and orbits."<sup>200</sup>



Portrait of Truman H. Safford (1836-1901). <http://www.klima-luft.de/steinicke/ngcic/persons/safford.htm>. Safford worked as an astronomer for the Wheeler Survey in 1873 during his leave of absence from the directorship of the Dearborn Observatory in Chicago. He later became professor of astronomy at Williams College, and he rejoined the Wheeler Survey for the field season of 1878. Photographer and date of photo are unknown.

Ruffner's first and short-lived station. Because Wheeler did not provide an inscribed sandstone monument for this site, Kampf's pier probably was, like Ruffner's, constructed of bricks.

Kampf also determined a longitude value for the South Pueblo site; however, he did not use the telegraphic method, but rather obtained it by "trigonometric connection" with the main astronomical stations at Labran, Colorado Springs, and Trinidad.<sup>201</sup> Kampf may have made this determination back in his office in Washington, D.C., during the subsequent winter season.

The values of longitude determined by Ruffner and Kampf are in reasonably close agreement, especially considering that they were obtained by different methods and by different observers. Ruffner's value places the station 10.13 seconds of longitude, or about 800 feet, east of where Kampf's value places it.

In his reports, Ruffner makes no mention of computing a value for latitude while he was at South Pueblo. Nonetheless, he does include a latitude value in a table in his reconnaissance report of 1874.<sup>202</sup> When the two sets of latitude and longitude coordinates are plotted on the modern USGS topographic map of the area, Kampf's point is within the probable general area of the monument in South Pueblo, but Ruffner's point is about 2.25 miles to the south, indicating a significant but unknown source of error in Ruffner's reported latitude value.

In 2009 a search of likely monument sites in historic South Pueblo revealed no brick pier. Unfortunately, there was little to go on to guide the search, because no reports provide any sketch maps, detailed descriptions, or distances and bearings from landmarks. The most definitive clues come from their combined general statements that the site was on top of the bluff near the new brick depot. The search focused on the crest of the bluffs that lie southwest of the river channel, within a segment that one could reasonably consider to be "near" the likely position of the 1873 depot. In addition, the search included the area in the vicinity of Wheeler's published coordinates of the astronomical station. This site is near the tracks in an empty lot in the floodplain of the Arkansas River, southwest of B Street between South Union and South Main streets.

It is not surprising that no brick post could be located, for the crest of the bluffs is highly disturbed. Residential development has occurred all along it—back yards extend to the edges of the bluffs, extensive land bulldozing is evident, and numerous sewer pipes and other conduits penetrate the bluffs. In addition, the vacant lot in the floodplain where Wheeler's coordinates plot has been graded and paved. Furthermore, even if the monument had existed at that site, the Arkansas River flood waters of 1921 undoubtedly would have destroyed it. The flood waters, which tore up tracks and toppled numerous railroad cars, stood more than 10 feet deep in places.<sup>203</sup> Lastly, Kampf may well have dismantled or otherwise destroyed his brick post once he completed his observations, just as Ruffner apparently did with his post the

previous year. Thus, the odds of Kampf's unmarked brick monument surviving the actions of man and nature for more than a century and a quarter truly are remote, regardless of its location in South Pueblo.

## Julesburg

A brochure of the Fort Sedgwick Historical Society notes that "Jules Beni may be the only man to be memorialized through four towns in one state." Not that Mr. Beni, a station keeper for the Overland Stage Company, was an upstanding citizen—rather, all signs point to him as being "a habitual crook and possibly a murderer."<sup>204</sup> Nonetheless, his name persisted as four Julesburgs were established, each replacing the preceding one, at different sites in northeastern Colorado during the latter part of the 19th century. Kampf arrived at Julesburg 3 in October 1874. This community had been established in 1867 at the then-terminus of the Union Pacific Railroad tracks, as the Transcontinental Railway worked its way westward. At the beginning, the town consisted of "40 men, one woman, four tents, and a half-finished eating house."<sup>205</sup> Reportedly, the town grew to 1,200 buildings<sup>206</sup> and 7,000 people,<sup>207</sup> and because of its numerous saloons and gambling houses, it earned the reputation as the "Wickedest City in the West."<sup>208</sup> For a while, it remained a busy shipping point, even after the railroad moved farther north and west into Wyoming.<sup>209</sup> But by 1874, the town barely was surviving, for Kampf noted that "[a]t the time of occupation of this station there were but five houses in the place, and three of these were the property of the railroad company."<sup>210</sup> Julesburg 4 was established in 1881 at the site of the present (2010) town, at the time that the Union Pacific began constructing its Denver Branch. Julesburg 3 then was renamed "Weir," after the man who was the section boss of the Weir Siding.<sup>211</sup>

In the summer of 1869, Oliver N. Chaffee, surveyor and astronomer, set up an astronomical station at Julesburg 3 as part of a boundary survey for Nebraska. His site was about 140 feet east of the Union Pacific Depot. He determined the latitude and longitude of the site and probably left a stone monument, using it as a starting point for surveying northward to the 41st parallel and eastward to the 25th meridian west of Washington, D.C., or about 102.05 degrees west of the Prime Meridian in Greenwich. These are the coordinates of the boundaries between Nebraska and Colorado Territory. Chaffee reported that the state boundary was 5,916.90 feet north of the monument, but the monument no longer exists and its exact location is unknown.<sup>212</sup>

Wheeler probably picked Julesburg 3 as the site for one of his main astronomical stations because at the time there evidently was still some question, despite Chaffee's earlier survey, as to whether or not the town was in Nebraska or Colorado. In his final report, Wheeler noted that the survey results indicate that Julesburg is south of latitude 41 degrees, not north of it as shown on some government maps.<sup>213</sup> In

1875 D.B. Ball, U.S. Deputy Marshall in Omaha, Nebraska, wrote the General Land Office in Washington, D.C., for information about the Wheeler monument at Julesburg.<sup>214</sup> S.S. Bendell, Commissioner of the Land Office, referred the letter to the War Department. In his reply to Ball, William W. Belknap, Secretary of War, provided the coordinates of the monument “as shown by the records” (though the value of longitude that he gave is different from the one published by Kampf<sup>215</sup>). Belknap further stated that “so far as known this stone is not intended to mark the boundary between Nebraska and Colorado. The results show that the monument stone is situated in Colorado.”<sup>216</sup>

Kampf’s “Recording Book”<sup>217</sup> covers only the field season of 1873. If Kampf prepared a similar book for 1874 and if it still exists, it perhaps is filed in one of the many repositories for the Wheeler records,<sup>218</sup> but its location is unknown. Therefore, details of Kampf’s 1874 daily activities, including any travails, are not available. Although Kampf’s final published report<sup>219</sup> provides no map of the Julesburg site, Wheeler’s annual report for fiscal year 1874–75 does include a sketch map<sup>220</sup> (fig. 20), and Kampf does describe the specific location of the monument: “The astronomical station was established at a distance of about 45 feet from the side-track of the Union Pacific Railroad, and 27 feet from the southwest corner of the warehouse belonging to the same.”<sup>221</sup> This position probably is not far from the site of Chaffee’s earlier monument. Perhaps Kampf was unaware of Chaffee’s survey, or perhaps Chaffee’s monument already was gone, or maybe Kampf simply preferred to establish his own site. In any event, he made his astronomical observations October 7–11, during which time the weather was fair except for 2 days, when it rained. He offers no hint of any problems with the telegraph system: “The use of the Atlantic and Pacific Telegraph line was kindly granted by the superintendent at Omaha...”<sup>222</sup>

Today the monument sits in the grasslands of northeastern Colorado, between U.S. Highway 385 and the tracks of the UP Railroad (fig. 21). The National Geodetic



**Figure 21.** Modern photo of Julesburg monument and site. *Photo by W.E. Wilson.* Set on the plains of northeastern Colorado, this side of the monument shows minimal effects of weathering, for the inscription is clearly legible. The National Geodetic Survey installed the nearby survey marker.

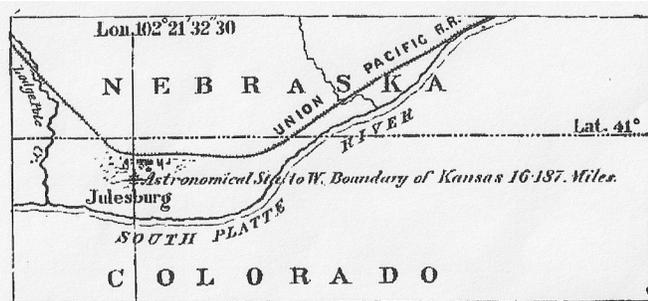
Survey has placed a “Witness Post,” or survey marker, nearby, urging visitors not to disturb the area.

Like the Georgetown monument, this one is inscribed on two sides; however, the text is different from that of the Georgetown monument. The inscription on the south-facing side reads:

WAR DEPT  
CORPS OF ENGINEERS  
U.S. ARMY  
1874

The north-facing side reads:

LONG  
LAT  
ALTITUDE



**Figure 20.** Historic map of Julesburg area and monument site. *Wheeler (1875), p. 928.* The map shows that the monument site lies between the railroad tracks and the South Platte River. The map also demonstrates that Julesburg is south of the Colorado-Nebraska line (that is, south of latitude 41 degrees), a matter of some question at the time.

As with the Georgetown monument, the data for longitude, latitude, and altitude never were inscribed. Although the sandstone block has not weathered extensively, some of the writing, especially on the north-facing side, has become difficult to read. Unfortunately, the sandstone block has a major longitudinal fracture through its center.



**Figure 22.** Modern photo of fracture and steel posts in Julesburg monument. *Photo by W.E. Wilson.* The occurrence of the fracture threatens the long-term stability of this monument. The two posts held a capstone that provided a broad, smooth surface for the instruments.



**Figure 23.** Historic photo of Julesburg monument, showing capstone fragment. *Photo and information courtesy of the Fort Sedgwick Historical Society-Archives, Julesburg, Colorado.* Henry “Uncle Harry” Entriiken, Civil War hero and popular saloonkeeper during Julesburg’s rowdy days, poses beside the monument. At the time of this photo, part of the capstone remains set in place over one of the posts. Date of photo is unknown, but probably is about 1899, on the basis of another photo taken that year showing Entriiken looking about the same age and wearing what probably is the same cap.

A striking feature is that two metal posts, 5 inches long and 1 inch in diameter, protrude from the top of the monument (fig. 22). At one time, these posts held a capstone, about 5 inches thick, that rested on top of the monument; a fragment of the capstone appears in a historic but undated photograph on file at the Fort Sedgwick Historical Society (fig. 23). This rock fragment is absent in a 1972[?] photograph of the monument in the collection of Western History Photographs at the Denver Public Library.

From Julesburg, Kampf and his crew moved on to North Platte, Nebraska, thus ending Kampf’s work in Colorado.

## Conclusions

Wheeler and his parties mapped nearly one-fourth of the region west of the 100th meridian, more territory than any of the other great surveys of the West.<sup>223</sup> By Wheeler’s own count, his survey determined the heights of 395 named peaks at altitudes above 10,000 feet, plus 754 other named peaks at 5,000–10,000 feet; located and profiled 202 mountain passes; and surveyed at least 90 rivers and thousands of minor streams.<sup>224</sup> He produced 12 quarter-quadrangle topographic maps that are entirely or partly in Colorado; he also published many of them as land-classification and geologic maps.

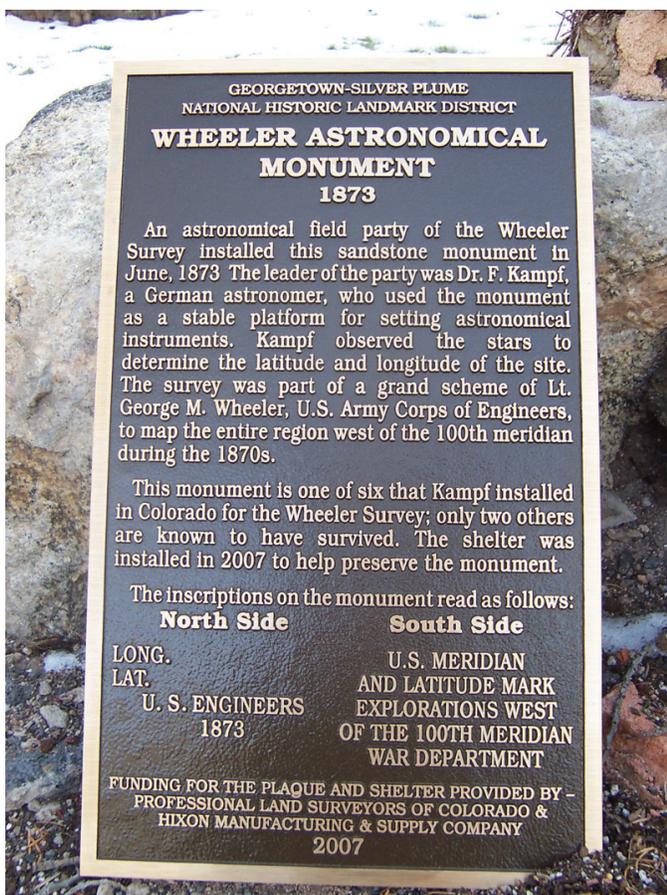
As expressed by Robert Karrow, Wheeler’s principal contribution may be in his “conception of a uniform and systematic map of the West....”<sup>225</sup> Karrow laments the loss that came with the premature ending of the Wheeler Survey: “With it went our last, best chance to have the cultural features of the old west at the close of the frontier era systematically recorded for posterity ... what a resource the western historian would have had!”<sup>226</sup>

Generally lost among the accomplishments of the survey are the products of a young German astronomer, known only in a few obscure publications as “Dr. F. Kampf.” Carl Ludwig Ferdinand Kampf came to America as a 31-year-old new Ph.D., his only professional experience having been at two observatories in a relatively civilized European environment. He was thrust into the “wild West,” where he generally had to fend for himself, seeking to make precise astronomical observations in an often hostile environment. Bad weather, faulty instruments, and uncooperative telegraph operators seemed to conspire against his having much success. Yet he overcame his frustrations, and through his dedication and detailed work managed to accomplish his assigned tasks. Although Kampf was not the only astronomer on Wheeler’s staff, certainly Kampf’s results were included in Powell’s glowing praise of the astronomical work of the Wheeler Survey.

Sometime during the field season of 1877, probably while working in Utah, Kampf suffered a field accident that later proved to be fatal. Wheeler, in his annual report of 1878, notes with great regret that “The Survey has sustained the loss of a valuable member in the person of Dr. F. Kampf, who died



**Figure 24.** Georgetown monument with steel shelter and bronze plaque. *Photo by W.E. Wilson.* A handsome steel shelter protects the monument from the elements, thus retarding the weathering process. A bronze plaque sits nearby.



**Figure 25.** Close-up view of bronze plaque at Georgetown monument site. *Photo by W.E. Wilson.* The bronze plaque explains the background history of the monument and records the inscriptions on the north- and south-facing sides.

at his residence in Washington, D.C., April 27, 1878, after a short illness, being a relapse subsequent to the severe mental and physical prostration occasioned by a blow on the forehead received while on field duty.<sup>2227</sup> Kampf died just a month shy of his 36th birthday; he left a widow, Sophie (or Sophia), whom he had probably brought with him from Prussia when he came to America.

Today the only field evidence of this work in Colorado is the existence of three astronomical monuments out of the six that originally were installed by Kampf at main astronomical stations in the state. These remaining sandstone blocks show varying signs of deterioration because of weathering—the inscription of the one at Georgetown is becoming obscure, the one at Trinidad is deformed almost beyond recognition, and the one at Julesburg has a major crack through it. These historic treasures deserve preservation, and steps have been taken in Georgetown to do just that. The Professional Land Surveyors of Colorado, Historic Georgetown, Inc., and the private landowner of the property where the block is located have collaborated to install a steel shelter to protect the Georgetown monument from the elements. In addition they have placed a bronze plaque at the site to document its history and inscription (figs. 24 and 25).

Although the monuments have not served Wheeler's long-term purpose of being permanent markers that future surveyors would use, no doubt he and Kampf would be pleased if they could only realize that at least one of these markers is now recognized for its historic value.

## Notes

<sup>1</sup>Dupree (1957), p. 203.

<sup>2</sup>Hayden (1877). The four statewide maps are those that show triangulation, drainage, economic features, and general geology.

<sup>3</sup>Bartlett (1962). His map on p. xvii shows the areas covered by each of the surveys.

<sup>4</sup>Townsend Committee (1874), p. 51.

<sup>5</sup>Wheeler (1889), p. 333.

<sup>6</sup>See, for example, Macomb (1885), p. 11.

<sup>7</sup>See, for example, Wheeler (1889), p. 671. Oddly, in this list of main stations, Wheeler incorrectly includes Denver and Cañon City but omits Georgetown, Labran, and South Pueblo.

<sup>8</sup>Rabbitt (1989), p. 10.

<sup>9</sup>Rabbitt (1989), p. 14.

<sup>10</sup>Bartlett (1962), p. 369.

<sup>11</sup>Phillips and Axelrod (1996), p. 1,638.

<sup>12</sup>Stegner (1953), p. 127.

<sup>13</sup>Bartlett (1962), p. 369.

<sup>14</sup>See, for example, Bartlett (1962), p. 369; Karrow (1986), p. 152–153; and Lamar (1998), p. 1,205.

<sup>15</sup>Karrow (1986), p. 152–153.

<sup>16</sup>Goetzmann (1966), p. 467.

<sup>17</sup>See, for example, Bartlett (1953, 1962), Brown (1955, 1956), Dawdy (1993), Dewing (1964), Dupree (1957), Goetzmann (1959, 1966, 1991), Guth (1975), Karrow (1986), Koep (1986), Lamar (1998), O’Sullivan (1983), Phillips and Axelrod (1996), Rideing (1876, 1877, 1879), Schmeckebier (1904), Schubert (1980), Townsend Committee (1874), Wilson (2004, 2007b).

<sup>18</sup>Beers (1942) and Web site.

<sup>19</sup>Lamar (1998), p. 1,205.

<sup>20</sup>Schubert (1980), Web site.

<sup>21</sup>Wheeler (1889), p. 45–46.

<sup>22</sup>Bartlett (1962), p. 350–351.

<sup>23</sup>Bartlett (1962), p. 337.

<sup>24</sup>Dupree (1957), p. 197.

<sup>25</sup>Karrow (1986), p. 136.

<sup>26</sup>Wheeler (1873), p. 1,211.

<sup>27</sup>Wheeler (1889), p. 668, 672.

<sup>28</sup>Wheeler (1889), p. 1,423.

<sup>29</sup>Wheeler (1889), p. 58.

<sup>30</sup>Wheeler (1889), p. 670.

<sup>31</sup>See Dawson (1920) for the story of the discovery of Marshall Pass.

<sup>32</sup>Kampf, C.L.F. (1868b).

<sup>33</sup>Kampf, C.L.F. (1868a).

<sup>34</sup>Kam, van Hennekeler, and Kampf, C.L.F. (1870); and Kampf, C.L.F. (1870).

<sup>35</sup>D.M. Baneke, Leiden Observatory, written commun., emails of February 4 and 5, 2009, and January 13, 2010. Baneke kindly provided scanned copies of some of the letters, partial translations of their contents, and descriptions of other letters. All letters are from the Leiden Observatory Archives (files FK 61 and FK215).

<sup>36</sup>Probably Kam, van Hennekeler, and Kampf, C.L.F. (1870), according to D.M. Baneke, written commun., email of January 13, 2010.

<sup>37</sup>D.M. Baneke, written commun., email of February 5, 2009.

<sup>38</sup>Wheeler (1878a), p. 1,437.

<sup>39</sup>Wheeler (1878a), p. 1,425.

<sup>40</sup>Wheeler (1878a), p. 1,533.

<sup>41</sup>Wheeler (1873), p. 1,213.

<sup>42</sup>Much of this account is adapted from Wilson (2007a).

<sup>43</sup>The original field notebook is in the archives of Norlin Library, University of Colorado, Boulder, Colorado.

<sup>44</sup>T.E. Bell, written commun., email of Oct. 24, 2007.

<sup>45</sup>Comstock (1877), p. 140.

<sup>46</sup>In fact, the Army did regularly send engineers abroad to assist in or observe foreign projects (Michael J. Brodhead, written commun., email of April 19, 2007; Dr. Brodhead at the time was Historian, Office of History, U.S. Army Corps of Engineers). For example, General Cyrus B. Comstock, Corps of Engineers, was sent “on professional duty in Europe...July to Nov. 19, 1874” and later was “...on leave of absence in Europe, June 17, 1877 to June 11, 1878” (Cullum (1891), p. 605). So it is plausible that some U.S. Army personnel were in the field during the Prussian investigations and prior to Kampf’s departure for America.

<sup>47</sup>U.S. Bureau of the Census (1880), Web site.

<sup>48</sup>Washington, D.C. (1890), Web site.

<sup>49</sup>Kampf (1873a), entry for June 4.

<sup>50</sup>Wheeler (1874b), p. 81.

<sup>51</sup>Kampf and Clark (1877a), p. 213.

<sup>52</sup>Wheeler (1877), Plate 6.

<sup>53</sup>Kampf (1873a), entry for June 5.

<sup>54</sup>Kampf (1873a), entry for June 7.

<sup>55</sup>U.S. Geological Survey (1957; rev. 1974).

<sup>56</sup>Kampf and Clark (1877a), p. 215.

<sup>57</sup>Kampf (1873a), entry for June 11.

<sup>58</sup>Anon. (1909), p. 5, c. 5.

<sup>59</sup>Richard Lippoth, written commun., email of June 19, 2006.

<sup>60</sup>Kampf (1873a), entry for June 13.

<sup>61</sup>Kampf and Clark (1877a), p. 214.

<sup>62</sup>Kampf and Clark (1877a), p. 214.

<sup>63</sup>G.A. Thomsen, written commun., emails of August 21 and 22, 2007.

<sup>64</sup>Dean (1856), p. 167–168.

<sup>65</sup>Kampf (1873b).

<sup>66</sup>Kampf (1873c).

<sup>67</sup>Anon. (1873b), p. 4, c. 6.

<sup>68</sup>Anon. (1873f), p. 56.

<sup>69</sup>Anon. (1873j), p. 248.

<sup>70</sup>Wheeler (1874a), p. 27.

<sup>71</sup>Anon. (1908), p. 4, c. 3.

<sup>72</sup>Kampf (1874), p. 51.

<sup>73</sup>NOAA (2007a, 2007b), Web sites.

<sup>74</sup>Kampf (1874), p. 51.

<sup>75</sup>Theberge (1998), NOAA Web site; and Abrahams (2002), Web site.

<sup>76</sup>Malone (1836), p. 281.

<sup>77</sup>Abrahams (2002), Web site.

<sup>78</sup>Hodgson (1931), p. 222.

<sup>79</sup>Wheeler (1874b), p. 81.

<sup>80</sup>Hodgson (1931), p. 225.

<sup>81</sup>Bell (2002), p. 15.

<sup>82</sup>Bell (2002), p. 19; Nelson (2002), p. 2.

<sup>83</sup>Kampf and Clark (1874), p. 13.

<sup>84</sup>Kampf (1873a).

<sup>85</sup>Wheeler (1877).

<sup>86</sup>For example, Beall (1925), Bowie (1913), Dean (1856), and Schott (1882). Other descriptions of the equipment, setup, and procedures that were used in applying the “American Method” in the second half of the 19th century occur in various references, including Bell (2001, 2002), Hodgson (1931), Karrow (1986), Nelson (2002), and Stachurski (2003).

<sup>87</sup>Although the transmission at the initiating end of the circuit was instantaneous, the reception at the receiving end was not. By the 1870s it was well known that the telegraphic signal did not travel instantaneously but rather at a speed of 15,000 miles per second (T.E. Bell, written commun., email of October 24, 2007; Stachurski, 2005, p. 6). Thus between Georgetown and Salt Lake City, a correction of about 0.02 second was needed to account for transmission time.

<sup>88</sup>Dean (1871), p. 441–442.

<sup>89</sup>Wheeler (1874b), p. 81.

<sup>90</sup>Kampf (1873a), entry for June 24.

- <sup>91</sup>Kampf (1873a), entry for July 4.
- <sup>92</sup>Kampf and Clark (1877a), p. 214.
- <sup>93</sup>Kampf (1873a), entry for June 22.
- <sup>94</sup>Kampf and Clark (1877a), p. 214.
- <sup>95</sup>Kampf (1873a), entry for June 21.
- <sup>96</sup>Kampf (1873a), entry for June 29.
- <sup>97</sup>Anon. (1873c), p. 2.
- <sup>98</sup>Anon. (1873d), p. 3.
- <sup>99</sup>Kampf (1873a), entries for June 26 and 27.
- <sup>100</sup>Townsend Committee (1874), p. 63.
- <sup>101</sup>Kampf (1873a), entries for July 6–11.
- <sup>102</sup>Kampf and Clark (1877b), p. 241.
- <sup>103</sup>Brighton Genealogy Society (1987), p. 27.
- <sup>104</sup>Anon. (1871), p. 4.
- <sup>105</sup>Brighton Genealogy Society (1987), p. 116.
- <sup>106</sup>Kampf and Clark (1877b), p. 241.
- <sup>107</sup>Safford, Clark, and Kampf (1877), p. 343.
- <sup>108</sup>Kampf (1873a), entry for July 19.
- <sup>109</sup>Kampf (1873a), entry for July 20.
- <sup>110</sup>Kampf (1873a), entry for July 21.
- <sup>111</sup>Kampf and Clark (1877b), p. 242.
- <sup>112</sup>Kampf (1873a), entry for September 22.
- <sup>113</sup>Brighton Genealogy Society (1987), p. 39.
- <sup>114</sup>Kampf (1874), p. 49.
- <sup>115</sup>Kampf (1874), p. 49.
- <sup>116</sup>Kampf (1874), p. 49.
- <sup>117</sup>Kampf (1873a), entry for July 26.
- <sup>118</sup>Kampf (1873a), entry for July 27.
- <sup>119</sup>Kampf (1874), p. 50.
- <sup>120</sup>Kampf (1873a), entry for July 31.
- <sup>121</sup>Anon. (1873g), p. 2.
- <sup>122</sup>Kampf (1874), p. 49.
- <sup>123</sup>Kampf (1873a), entry for September 20.
- <sup>124</sup>Lewis (2002), p. 90.
- <sup>125</sup>Kampf and Clark (1877c), p. 267.
- <sup>126</sup>The Colorado Daily Chieftain (Pueblo), February 13, 1873 (Anon., 1873a), noted that “Mr. George Whitman has taken a stock of goods and gone up to Labran;” and the Chieftain on July 9, 1873 (Anon., 1873e), advertised for sale or rent “A well established Restaurant doing a flourishing business, situate[d] at Labran Station.”
- <sup>127</sup>References to the boxcar depot occur in Campbell (1972), p. 73; Lewis (2002), p. 90; and Anon. (1972; in which Mrs. Ross Smith of Florence recalls that in 1882 “there was only a box car depot at Florence” [Labran?]).
- <sup>128</sup>Kampf and Clark (1877c), p. 267.
- <sup>129</sup>Kampf (1873a), entry for August 12.
- <sup>130</sup>Kampf and Clark (1877c), p. 267.
- <sup>131</sup>Kampf (1873a), entry for August 18.
- <sup>132</sup>Anon. (1873h), p. 4; and Anon. (1873i), p. 4.
- <sup>133</sup>Kampf (1873a), entry for August 18.
- <sup>134</sup>Kampf (1873a), entry for August 23.
- <sup>135</sup>Note, however, that the coordinate values that Kampf obtained at any of the sites, no matter how accurate at the time of determination, would differ from those determined for the same sites by modern methods. The geometry of the earth affects the results, and thus calculations of the coordinates depend on the understanding of that geometry at the time of observations. Differences exist in knowledge of that geometry between then and now.
- <sup>136</sup>Lewis (2002), p. 90–95.
- <sup>137</sup>Anon. (1906).
- <sup>138</sup>J. Gonzales, oral commun., interview, July 16, 2007.
- <sup>139</sup>Kampf and Clark (1877d), p. 291.
- <sup>140</sup>Sangres.com (2007), Web site.
- <sup>141</sup>Sangres.com (2007), Web site.
- <sup>142</sup>Kampf (1873a), entry for August 29.
- <sup>143</sup>Kampf (1873a), entry for August 29.
- <sup>144</sup>Kampf (1873a), entries for September 1 and 2.
- <sup>145</sup>Kampf and Clark (1877d), p. 291.
- <sup>146</sup>Kampf (1873a), entry for August 31.
- <sup>147</sup>Kampf and Clark (1877d), p. 292.
- <sup>148</sup>Kampf (1873a), entry for September 20.
- <sup>149</sup>Kampf (1873a), entry for September 28.
- <sup>150</sup>Kampf (1873a), entries for October 11–13.
- <sup>151</sup>Kampf (1873a), entry for October 14.
- <sup>152</sup>Clark and Kampf (1877), p. 375.
- <sup>153</sup>Clark and Kampf (1877), p. 376–379.
- <sup>154</sup>Clark (1877), p. 461–467.
- <sup>155</sup>Hales (1996), Web site.
- <sup>156</sup>Clark (1877), p. 461.
- <sup>157</sup>Clark (1877), p. 461.
- <sup>158</sup>Clark (1877), p. 462–463.
- <sup>159</sup>Hales (1996), Web site.
- <sup>160</sup>Townsend Committee (1874), p. 18.
- <sup>161</sup>Humphreys (1874).
- <sup>162</sup>Townsend Committee (1874), p. 17.
- <sup>163</sup>Humphreys (1874).
- <sup>164</sup>Humphreys (1874).
- <sup>165</sup>Kampf and Clark (1877e), p. 451.
- <sup>166</sup>Anon. (1884), p. 84.
- <sup>167</sup>Ruffner (1874b), p. 2.
- <sup>168</sup>Ruffner (1874b), p. 3.
- <sup>169</sup>Ruffner (1874b), p. 2.
- <sup>170</sup>Ruffner (1873), p. 1,224.
- <sup>171</sup>Ruffner (1873), p. 1,242.
- <sup>172</sup>Ruffner (1873), p. 1,243.
- <sup>173</sup>Wheeler (1875), p. 928.
- <sup>174</sup>McMurtrie (1883), p. 38.
- <sup>175</sup>L.R. Green, written commun., email of January 22, 2009.
- <sup>176</sup>Ruffner (1873), p. 1,242.
- <sup>177</sup>Ruffner (1873), p. 1,240–1,241.

- <sup>178</sup>Ruffner (1873), p. 1,224.
- <sup>179</sup>Ruffner (1873), p. 1,242.
- <sup>180</sup>Ruffner (1874b), p. 3.
- <sup>181</sup>Ruffner (1874b), p. 3.
- <sup>182</sup>Ruffner (1874a), p. 623; Ruffner (1874b), p. 2–101.
- <sup>183</sup>Wheeler (1875), p. 928.
- <sup>184</sup>Safford (1887), p. 38.
- <sup>185</sup>See, for example, Anon. (1901a), p. 7; Anon. (1902), p. 248; Northwestern University (1982), p. 1; Parshall (1999), p. 190–191.
- <sup>186</sup>Comstock (1872), p. III.
- <sup>187</sup>Safford (1873a).
- <sup>188</sup>Safford (1873b). Original field notebook in the archives of Norlin Library, University of Colorado, Boulder.
- <sup>189</sup>Safford, Clark, and Kampf (1877), p. 343; Safford and Clark (1877), p. 317.
- <sup>190</sup>Townsend Committee (1874), p. 77.
- <sup>191</sup>Wheeler (1875), p. 926.
- <sup>192</sup>See, for example, Anon. (1901a), p. 7; Anon. (1901b), unpaginated clipping in archives of Williams College; Anon. (1902), p. 248; Fox (1915), p. 4; Jacoby (1901), p. 24; Lewis and Plotkin (1982), p. 55; Parshall (1999), p. 191.
- <sup>193</sup>Anon (1901a), p. 7.
- <sup>194</sup>A.E. Theberge, Jr., written commun., email of January 12, 2009. Theberge, at the NOAA library, researched documents that would associate Safford with the U.S. Coast Survey if he had been employed by that agency. He concludes, “So, in spite of claims in various publications, I can find no scientific article, nothing in Coast Survey Annual Reports, or anything on WWW that gives proof that Safford worked for the Coast Survey. He was certainly peripherally involved with the Coast Survey and probably knew many Coast Surveyors. If he had in fact worked for the Coast Survey in the time frame stated, it would seem that someone of his professional stature would have been mentioned in the Annual Reports.”
- <sup>195</sup>Wheeler (1878a), p. 1,423, 1,425. By this time, Kampf was deceased, and the third party was led by an astronomer named Miles Rock.
- <sup>196</sup>Wheeler (1879), p. 2,243.
- <sup>197</sup>Thorpe (1879), p. 134.
- <sup>198</sup>Wheeler (1879), p. 2,243.
- <sup>199</sup>Anon. (1901a), p. 7.
- <sup>200</sup>Parshall (1999), p. 191.
- <sup>201</sup>Wheeler (1875), p. 928; Wheeler (1877), p. 489.
- <sup>202</sup>Ruffner (1874b), p. 89.
- <sup>203</sup>Follansbee and Jones (1922).
- <sup>204</sup>Fort Sedgwick Historical Society (2003).
- <sup>205</sup>Scenic and Historic Byway Sign at the junction of U.S. Highways 138 and 365 (2004).
- <sup>206</sup>Undated and uncredited booklet, “South Platte River Trail in Northeast Colorado, Scenic and Historic Byway.”
- <sup>207</sup>Fort Sedgwick Historical Society (2004).
- <sup>208</sup>Fort Sedgwick Historical Society (2003).
- <sup>209</sup>Fort Sedgwick Historical Society (2003).
- <sup>210</sup>Kampf and Clark (1877f), p. 435.
- <sup>211</sup>Ball (1908).
- <sup>212</sup>Thomsen (1999), p. 126–127.
- <sup>213</sup>Wheeler (1889), p. 675.

- <sup>214</sup>Ball’s initial inquiry is cited in Belknap (1875).
- <sup>215</sup>Kampf and Clark (1877f), p. 435.
- <sup>216</sup>Belknap (1875).
- <sup>217</sup>Kampf (1873a).
- <sup>218</sup>See Dewing (1964) and Dawdy (1993) for discussions of the dispersal of the Wheeler records.
- <sup>219</sup>Kampf and Clark (1877f), p. 433–448.
- <sup>220</sup>Wheeler (1875), p. 928.
- <sup>221</sup>Kampf and Clark (1877f), p. 435.
- <sup>222</sup>Kampf and Clark (1877f), p. 436.
- <sup>223</sup>Schubert (1980), Web site.
- <sup>224</sup>Wheeler (1889), p. 137–139.
- <sup>225</sup>Karrow (1986), p. 128.
- <sup>226</sup>Karrow (1986), p. 152–153.
- <sup>227</sup>Wheeler (1878a), p. 1,425.

## References Cited

- Abrahams, P., 2002, California’s first observatories, Web site: <http://www.europa.com/~telescope/califobs.txt>.
- Anonymous, 1871, Untitled: Rocky Mountain News, January 18, 1871, p. 4.
- Anonymous, 1873a, Untitled: Colorado Daily Chieftain, February 13, 1873.
- Anonymous, 1873b, Untitled: Weekly Miner, June 12, 1873, p. 4, c. 6.
- Anonymous, 1873c, Independence Day: Daily Colorado Miner, July 4, 1873, p. 2.
- Anonymous, 1873d, Untitled: Daily Colorado Miner, July 4, 1873, p. 3.
- Anonymous, 1873e, New To-day, For Sale or to Rent: Colorado Daily Chieftain, July 9, 1873, p. 4.
- Anonymous, 1873f, Untitled: Engineering and Mining Journal, July 22, 1873, vol. XVI, no. 4, p. 56.
- Anonymous, 1873g, Untitled: Colorado Springs Gazette, August 2, 1873, p. 2.
- Anonymous, 1873h, Untitled: Colorado Daily Chieftain, August 17, 1873, p. 4.
- Anonymous, 1873i, Untitled: Colorado Daily Chieftain, August 19, 1873, p. 4.
- Anonymous, 1873j, Untitled: Engineering and Mining Journal, October 14, 1873, v. XVI, no. 16, p. 248.
- Anonymous, 1884, Records of living officers of the United States Army: Philadelphia, L.R. Hamersly & Co., 478 p.

- Anonymous, 1901a, Death list of a day—Prof. Truman H. Safford: *New York Times*, June 14, 1901, p. 7.
- Anonymous, 1901b, Review of eminent astronomer, funeral arrangements: *Springfield Republican*, June 14, General News.
- Anonymous, 1902, Truman Henry Safford: Report of the Council to the Eighty-second Annual General Meeting, *Royal Astronomical Society*, p. 247–248.
- Anonymous, 1906, Untitled: *Whitehorn News*, January 26, 1906.
- Anonymous, 1908, Untitled: *Georgetown Courier*, July 11, 1908, p. 4, c. 3.
- Anonymous, 1909, Untitled: *Georgetown Courier*, May 8, 1909, p. 5, c. 5.
- Anonymous, 1972, Overland trip on 1882 among memories of Mrs. Ross Smith: *The Florence Citizen*, Pioneer edition 1972, p. 30.
- Ball, D.B., 1908, Letter to County Clerk, Julesburg Colorado, February 18, 1908.
- Bartlett, R.A., 1953, *The great surveys in Colorado, 1867–1879*: University of Colorado, Unpubl. typewritten Ph.D. dissertation, 493 p.
- Bartlett, R.A., 1962, *Great surveys of the American West*: Norman, University of Oklahoma Press, 408 p.
- Beall, S., 1925, *Astronomic determinations by United States Coast and Geodetic Survey and other organizations*: U.S. Coast and Geodetic Survey Special Publication no. 110, 337 p.
- Beers, H.P., 1942, *A history of the U.S. Topographical Engineers*: Society of American Military Engineers, *The Military Engineer*, v. 34, no. 200, p. 281–291, and v. 34, no. 201, p. 348–352. Also Web site: [www.topogs.org/history2.htm](http://www.topogs.org/history2.htm).
- Belknap, W.W., 1875, Letter to S.S. Bendell, Commissioner, General Land Office, March 31, 1875.
- Bell, T.E., 2001, The “American Method”—The 19th-century telegraphic revolution in finding longitude: IEEE St. John’s Conference on the History of Telecommunications, Session 9, July 27, 2001, 9 p.
- Bell, T.E., 2002, The Victorian global positioning system: *The Best of Tau Beta Pi*, Spring 2002, p. 14–21.
- Bowie, W., 1913, Determination of time, longitude, latitude, and azimuth: *U.S. Coast and Geodetic Survey Special Publication no. 14*, 111 p.
- Brighton Genealogy Society, 1987, *The history of Brighton, Colorado, and surrounding area*: Dallas, Curtis Media Corp., 698 p.
- Brown, F.M., 1955, The Wheeler expeditions to the southwestern United States, 1869–1876: *The Lepidopterists’ News*, v. 9, p. 124–126.
- Brown, F.M., 1956, Itineraries of the Wheeler Survey naturalists, 1871—Theodore L. Mead: *The Lepidopterists’ News*, v. 9, p. 185–190.
- Campbell, R., 1972, *Trappers to tourists, Fremont County 1830–1950*: Colorado Springs, Century One Press, 244 p.
- Clark, J.H., 1877, Report of operations at Salt Lake observatory in 1873, Appendix 1 to Part I, v. II, p. 461–467, *in* Wheeler, G.M., 1877, *Astronomy and barometric hypsometry*, v. II, 571 p., *in* Wheeler, G.M., 1875–89, *Report upon United States Geographical Surveys West of the One-hundredth Meridian*, 7 v.: Washington, D.C., Government Printing Office.
- Clark, J.H., and Kampf, F., 1877, Results of observations made by John H. Clark and Dr. F. Kampf in the determination of the astronomical co-ordinates of Bozeman, Montana, season of 1873, p. 371–384, *in* Wheeler, G.M., 1877, *Astronomy and barometric hypsometry*, v. II, 571 p., *in* Wheeler, G.M., 1875–89, *Report upon United States Geographical Surveys West of the One-hundredth Meridian*, 7 v.: Washington, D.C., Government Printing Office.
- Comstock, C.B., 1872, Transmittal letter to A. A. Humphreys, September 20, 1872, p. III, *in* Safford, T.H., 1873a, *Catalogue of the mean declinations of 981 stars between twelve hours and twenty-six hours of right ascension and thirty degrees and sixty degrees of north declination for January 1, 1875*: Washington, D.C., Government Printing Office, 52 p.
- Comstock, C.B., 1877, Notes on Prussian surveys: Chap. III, p. 140–158, *in* Secretary of War, 1877, *Report of the Secretary of War, Engineers, 2nd session, 44th Congress*, v. 2, pt. 3, 1876–77, Serial Set 1745: Washington, D.C., Government Printing Office, 755 p.
- Cullum, G.W., Bvt. Maj. Gen., 1891, *Biographical register of the officers and graduates of the U.S. Military Academy at West Point, N.Y., from its establishment, in 1802, to 1890, with the early history of the United States Military Academy, Third Edition, Revised and extended*, v. II, nos. 1001 to 2000: Cambridge, The Riverside Press, 870 p.
- Dawdy, D.O., 1993, *George Montague Wheeler, the man and the myth*: Athens, OH, Swallow Press/Ohio University Press, 122 p.
- Dawson, T.F., 1920, The godfather of Marshall Pass: The Trail, A magazine “for Colorado,” official organ of the Society of Sons of Colorado, v. XIII, no. 4, p. 5–12.
- Dean, G.W., 1856, Report to the Superintendent by Assistant George W. Dean on details of the method adopted for telegraphic operations to determine difference of longitude,

- with descriptions of the instruments and means employed: Appendix no. 21, p. 167–181, in Bache, A.D., 1856, Report of the Superintendent of the Coast Survey showing the progress of the Survey during the year 1856: Washington, D.C., A.O.P. Nicholson, Printer, 356 p.
- Dean, G.W., 1871, Longitude determinations across the continent: *American Journal of Science and Arts*, Third Series, v. 2, no. 12, p. 441–442.
- Dewing, C.E., 1964, The Wheeler Survey records: A study in archival anomaly: *The American Archivist*, v. 27, no. 2, p. 219–227.
- Dupree, A.H., 1957, *Science in the federal government: A history of policies and activities to 1940*: Cambridge, Belknap Press of Harvard University Press, and Baltimore and London, Johns Hopkins University Press (1986), 460 p.
- Follansbee, R., and Jones, E.E., 1922, The Arkansas River flood of June 3–5, 1921: U.S. Geological Survey Water-Supply Paper 487, 44 p.
- Fort Sedgwick Historical Society, 2003, Jules ?Who?: Brochure, Fort Sedgwick Historical Society Archives.
- Fort Sedgwick Historical Society, 2004, Fort Sedgwick, Colorado Territory: Brochure, Fort Sedgwick Historical Society Archives.
- Fox, P., 1915, General account of the Dearborn Observatory: Introduction, *Annals of the Dearborn Observatory*, v. 1, Evanston, Illinois.
- Goetzmann, W.H., 1959, *Army exploration in the American West 1803–1863*: New Haven, Yale University Press, 509 p.
- Goetzmann, W.H., 1966, *Exploration and empire: The explorer and scientist in the winning of the American West*: New York, Alfred. A. Knopf, 656 p.
- Goetzmann, W.H., 1991, *Army exploration in the American West, 1803–1863 (Revised Edition)*: Austin, Texas State Historical Association, 509 p.
- Guth, P.L., 1975, George Montague Wheeler: Last army explorer of the American West: Unpubl. independent research project, Department of Earth, Space & Graphic Sciences, U.S. Military Academy, 74 p., 6 figs.
- Hales, J., 1996, A personal history of surveying in Utah: *Weber Studies*, winter 1996, v. 13.1, Web site: <http://weberstudies.weber.edu/archive/archive%20B%20Vol.%2011-16.1/Vol.%2013.1/13.1Hales.htm>.
- Hayden, F.V., 1877, *United States geological and geographical atlas of Colorado and portions of adjacent territory*: Washington, D.C., U.S. Department of the Interior, United States Geological and Geographical Surveys of the Territories, 16 maps.
- Hodgson, V.V., 1931, the determination of geographic positions: Chapter XV, p. 221–242, in National Research Council, 1931, *Physics of the earth—II The figure of the earth*: Bulletin of the National Research Council, 286 p.
- Humphreys, A.A., 1874, Letter to G.M. Wheeler, July 9, 1874:1328/1331/GR1874, Record Group 77, National Archives.
- Jacoby, H., 1901, Truman Henry Safford: *Science*, v. 14, July 5, p. 22–24.
- Kam, N.M., van Hennekeler, A., and Kampf, C.L.F., 1870, *Zenith-Distanzen von Gradmessungs-Sternen*: *Annalen van de Sterrewacht te Leiden*, v. 2, p. 69–93.
- Kampf, C.L.F., 1868a, Ueber die Untersuchung der Microscope und Theilungsfehler an den Kreisen des neuen Aequatoreals der Hamburger Sternwarte: Göttingen, Germany, University of Göttingen, Ph.D. dissertation, 29 p.
- Kampf, C.L.F., 1868b, *Vita*: Unpubl. handwritten document: Archives, University of Göttingen, Germany, 1 p. [In Latin.]
- Kampf, C.L.F., 1870, *Planeten-Beobachtungen, angestellt am Meridiankreise der Sternwarte in Leiden*: *Astronomische Nachrichten*, v. 76, p. 297.
- Kampf, F., 1873a, Recording book of Dr. F. Kampf for the field season of 1873: Unpubl. notebook, Archives, University of Colorado at Boulder Libraries, Box 2–7, Book 24, v. 83.
- Kampf, F., 1873b, Meteorological Records, Georgetown, June 12–July 6, Observers: C.D. Gedney, J. Clancy, and J. Meier: Unpubl. notebook of original records (in pencil), Archives, University of Colorado at Boulder Libraries, Box 3–2, Book 7, v. 25a.
- Kampf, F., 1873c, Meteorological records: Unpubl. field notebook (in ink), Archives, University of Colorado at Boulder Libraries, Box 3–2, Book 8, v. 25b, *copied from* Kampf, 1873b, Meteorological Records, Georgetown, June 12–July 6, Observers: C.D. Gedney, J. Clancy, and J. Meier: Unpubl. notebook of original records (in pencil), Archives, University of Colorado at Boulder Libraries, Box 3–2, Book 7, v. 25a.
- Kampf, F., 1874, Report on astronomical operations, conducted during the field season of 1873, at the main or primary field-station, Colorado Springs, Colorado Territory, and deduction of results, p. 47–79, in Wheeler, G.M., Kampf, F., and Clark J.H., 1874, Report upon the determination of the astronomical co-ordinates of the primary stations at Cheyenne, Wyoming Territory, and Colorado Springs, Colorado Territory, made during the years 1872 and 1873, *Geographical and Geological Explorations and Surveys West of the One-Hundredth Meridian*: Washington, D.C., Government Printing Office, 82 p.

- Kampf, F., and Clark, J.H., 1874, Report on astronomical operations, conducted during the field season of 1872, at the main or primary field-station, Cheyenne, Wyoming Territory, and deduction of results, p. 1–46, *in* Wheeler, G.M., Kampf, F., and Clark J.H., 1874, Report upon the determination of the astronomical co-ordinates of the primary stations at Cheyenne, Wyoming Territory, and Colorado Springs, Colorado Territory, made during the years 1872 and 1873, Geographical and Geological Explorations and Surveys West of the One-Hundredth Meridian: Washington, D.C., Government Printing Office, 82 p.
- Kampf, F., and Clark, J.H., 1877a, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of Georgetown, Colorado, season of 1873, p. 211–238, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Kampf, F., and Clark, J.H., 1877b, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of Hughes, Colorado, season of 1873, p. 239–263, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Kampf, F., and Clark, J.H., 1877c, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of Labran, Colorado, season of 1873, p. 265–288, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Kampf, F., and Clark, J.H., 1877d, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of Trinidad, Colorado, season of 1873, p. 289–312, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Kampf, F., and Clark, J.H., 1877e, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of North Platte, Nebraska, season of 1874, p. 449–458, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Kampf, F., and Clark, J.H., 1877f, Results of observations made by Dr. F. Kampf and John H. Clark in the determination of the astronomical co-ordinates of Julesburg, Colorado, season of 1874, p. 433–448, *in* Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., *in* Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Karrow, R.W., Jr., 1986, George M. Wheeler and the geographical surveys west of the 100th meridian, p. 121–157, *in* Koep, D.P., ed., 1986, Exploration and mapping of the American West—Selected essays: Occasional Paper no. 1, Map and Geography Round Table of the American Library Association, Chicago, Speculum Orbis Press, 182 p.
- Koep, D.P., ed., 1986, Exploration and mapping of the American West—Selected essays: Occasional Paper no. 1, Map and Geography Round Table of the American Library Association, Chicago, Speculum Orbis Press, 182 p.
- Lamar, H.R., ed., 1998, The new encyclopedia of the American West: New Haven and London, Yale University Press, 1,324 p. *See* entry for “Wheeler, George Montague,” p. 1,205.
- Lewis, A.C., 2002, Florence & Cripple Creek Railroad: Forty miles to fortune: Denver, Sundance Publications Ltd., 416 p.
- Lewis, K., and Plotkin, H., 1982, Truman Henry Safford, the remarkable “lightning calculator”: Harvard Magazine, September-October, p. 54–56.
- Macomb, M.M., 1885, Tables of geographic positions, azimuths, and distances, together with lists of barometric altitudes, magnetic declinations, and itineraries of important routes: Washington, Government Printing Office, 265 p.
- Malone, Dumas, ed., 1836, Dictionary of American Biography, under the auspices of the American Council of Learned Societies, v. 18, Steward - Trowbridge: New York, Charles Scribner’s Sons, 657 p.
- McMurtrie, J.A., 1883, Report of J.A. McMurtrie of Denver, Colorado, p. 36–45, *in* Board of Directors, 1883, The First Annual Report of the Board of Directors of the Denver & Rio Grande Western Railway Company, covering operations to December 31st, 1883, New York Office, 32 Nassau Street: New York, William H. Clark, 45 p.
- Nelson, H.E., 2002, Calais, Maine—City on the edge of forever: Maine IS Technology, v. V, issue 11, 3 p., Web site: [www.maine.gov/newsletter/dec2002/calais\\_maine.htm](http://www.maine.gov/newsletter/dec2002/calais_maine.htm).
- NOAA, 2007a, The Bache-Würdemann compensating devise: NOAA celebrates 200 years of science, service, and

- stewardship, Collections, Distance measurement tools, Web site: [http://celebrating200years.noaa.gov/distance\\_tools/theb1645.html](http://celebrating200years.noaa.gov/distance_tools/theb1645.html).
- NOAA, 2007b, Würdemann six-inch theodolite: NOAA celebrates 200 years of science, service, and stewardship, Collections, Theodolites, Web site: <http://celebrating200years.noaa.gov/theodolites/wurdemann.htm>.
- NOAA National Geodetic Survey, 2009, Bamberg transit set up, Astro party of E.J. Brown, Part of World Longitude Campaign, Web site: <http://www.photolib.noaa.gov/htmls/theb1512.htm>.
- Northwestern University, 1982, Records of the Dearborn Observatory, 1863–1967: University Archives, Series 29/2, Boxes 1–59, History, p. 1–4.
- O’Sullivan, T.H., 1983, Wheeler’s photographic survey of the American West: New York, Dover Publications, 50 p.
- Parshall, K.H., 1999, Truman Henry Safford, v. 19, p. 190–191, in Garraty, J.A., and Carnes, M.C., eds., 1999, American National Biography: New York, Oxford University Press, 24 v.
- Phillips, C., and Axelrod, A., eds., 1996, Encyclopedia of the American West: New York, Simon & Schuster Macmillan, 4 v., 1,935 p. See entries for “American cartography,” p. 251–252; and “United States Army Corps of Engineers,” p. 1,638.
- Rabbitt, M.C., 1989, The United States Geological Survey: 1879–1989: U.S. Geological Survey Circular 1050, 52 p.
- Rideing, W.H., 1876, The Wheeler expedition in southern Colorado: Harper’s New Monthly Magazine, no. CCCXII, v. LII, May, p. 793–807.
- Rideing, W.H., 1877, The Wheeler Survey in Nevada: Harper’s New Monthly Magazine, v. LV, p. 68.
- Rideing, W.H., 1879, A-saddle in the wild West: A glimpse of travel among the mountains, lava beds, sand deserts, adobe towns, Indian reservations, and ancient pueblos of southern Colorado, New Mexico, and Arizona: London, Nimmo & Bain, 165 p.
- Ruffner, E.H., 1873, Report of Lieutenant E.H. Ruffner, Corps of Engineers, on observations for the determination of the latitude and longitude of Denver, Colorado, and the longitude of Fort Hays and Wallace, Kansas, and Pueblo, Colorado: Appendix HH, p. 1,224–1,249, in Secretary of War, 1873, Report of the Secretary of War, 1st session, 43rd Congress, v. 2, 1873–74: Washington, D.C., Government Printing Office, 1,250 p.
- Ruffner, E.H., 1874a, Annual report of Lieutenant E.H. Ruffner, Corps of Engineers, for the year ending June 30, 1874: Appendix II, p. 622–626, in Secretary of War, 1874a, Report of the Secretary of War, Chief of Engineers Report, 2nd session, 43rd Congress, v. 2, pt. 2, 1874–75, Serial Set 1637: Washington, D.C., Government Printing Office, 641 p.
- Ruffner, E.H., 1874b, Report of Lieutenant E.H. Ruffner, Corps of Engineers, on the reconnaissance in the Ute country, p. 2–101, in Secretary of War, 1874b, Letter from the Secretary of War transmitting a report and map of a reconnaissance in the Ute country, made in 1873 by Lieutenant E.H. Ruffner, of the Corps of Engineers, Executive Document no. 193, 1st session, 43rd Congress, 1873–74, House Executive Documents, v. 12, Serial Set 1610: Washington, D.C., Government Printing Office.
- Safford, T.H., 1873a, Catalogue of the mean declinations of 981 stars between twelve hours and twenty-six hours of right ascension and thirty degrees and sixty degrees of north declination for January 1, 1875: Washington, D.C., Government Printing Office, 52 p.
- Safford, T.H., 1873b, Field notebook: Archives, University of Colorado at Boulder Libraries, Box 2–7, Book 23, v. 84.
- Safford, T.H., 1887, Nebula found at the Dearborn Observatory, 1866–8: Annual reports of the Board of Directors together with the report of the Director for 1885 and 1886, Appendix C, p. 37–41.
- Safford, T.H., and Clark, J.H., 1877, Results of observations made by Prof. T.H. Safford and John H. Clark in the determination of the astronomical co-ordinates of Fort Union, New Mexico, p. 313–335, in Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., in Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Safford, T.H., Clark, J.H., and Kampf, F., 1877, Results of observations made by Prof. T.H. Safford, John H. Clark, and Dr. F. Kampf in the determination of the astronomical co-ordinates of Santa Fé, New Mexico, season of 1873: v. 2, pt. 1, p. 337–369, in Wheeler, G.M., 1877, Astronomy and barometric hypsometry, v. II, 571 p., in Wheeler, G.M., 1875–89, Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.: Washington, D.C., Government Printing Office.
- Sangres.com, 2007, Trinidad, Colorado—A short history of the early days, Web site: [www.sangres.com/places/lasanimas/history.htm](http://www.sangres.com/places/lasanimas/history.htm).
- Schmeckebeier, L. F., 1904, Catalogue and index of publications of the Hayden, King, Powell, and Wheeler Surveys: U.S. Geological Survey Bulletin 222, 208 p.
- Schott, C.A., 1882, On the determination of time, longitude, latitude and azimuth: Appendix 14, p. 201–290, in Patterson, C.P., 1882, Report of the Superintendent of the U.S. Coast and Geodetic Survey showing the progress of

- the work during the fiscal year ending with June, 1880: Washington, D.C., Government Printing Office, 419 p.
- Schubert, F.N., 1980, *Vanguard of expansion: Army Engineers in the trans-Mississippi West, 1819–1879*: Washington, D.C., Government Printing Office, 160 p. Also, Web site: [http://www.nps.gov/history/history/online\\_books/schubert/chap8.htm](http://www.nps.gov/history/history/online_books/schubert/chap8.htm).
- Stachurski, R.J., 2003, *Longitude by wire: The American Method: Professional Surveyor*, v. 23, no. 11, November, Web site: <http://www.profsurv.com/magazine/article.aspx?i=1147>.
- Stachurski, R.J., 2005, *Hertzian waves: Professional Surveyor*, v. 25, no. 1, January, Web site: <http://www.profsurv.com/magazine/article.aspx?i=1359>.
- Stegner, W.E., 1953, *Beyond the hundredth meridian: John Wesley Powell and the second opening of the West*: Boston, Houghton Mifflin Co., 438 p.
- Theberge, A.E., 1998, *The Coast Survey, 1807–1867* [electronic resource]: *History of the Commissioned Corps of the National Oceanic and Atmospheric Administration*, v. I: U.S. Department of Commerce, NOAA, Web site: <http://www.lib.noaa.gov/noainfo/heritage/coastsurveyvol1/BACHE2.html>.
- Thomsen, G.A., 1999, *Timing space: Determining the western boundary of Nebraska: Nebraska History*, v. 80, no. 3, Fall 1999, p. 123–128.
- Thorpe, T.E., 1879, *A magnetic survey of the Fortieth Parallel in North America between the Atlantic Ocean and the Great Salt Lake, Utah: Proceedings of the Royal Society of London*, v. 30 (1879–1880), p. 132–151.
- Townsend Committee on Public Lands of the House of Representatives, 1874, *Geographical and Geological Surveys West of the Mississippi: H.R. Report 612*, 43rd Congress, 1st session, 91 p.
- U.S. Bureau of the Census, 1880, *Tenth census of the United States, 1880*: Washington, D.C., National Archives and Records Administration, T9, 1,454 rolls, Web site: [www.ancestry.com](http://www.ancestry.com).
- U.S. Geological Survey, 1957 (photo revised 1974), *Georgetown quadrangle, Colorado–Clear Creek County, 7.5 minute series (Topographic), scale 1:24,000, contour interval 40 feet*.
- Washington, D.C., 1890, *City Directory, 1890*: Washington, R.L. Polk Co., Web site: [www.ancestry.com](http://www.ancestry.com).
- Wheeler, G.M., 1873, *Annual report of Lieutenant George M. Wheeler, Corps of Engineers, upon explorations and surveys west of the one hundredth meridian, in Nevada, Utah, Colorado, New Mexico, and Arizona, for the fiscal year ending June 30, 1873*, Appendix EE, p. 1,211–1,218, *in* Secretary of War, 1873, *Report of the Secretary of War, 1st session, 43rd Congress, v. 2, 1873–74*: Washington, D.C., Government Printing Office, 1,250 p.
- Wheeler, G.M., 1874a, *Letter to Editor: Engineering and Mining Journal*, v. XVII, no. 2, January 10, 1874, p. 27.
- Wheeler, G.M., 1874b, *Memorandum of instructions for conducting observations for longitude and latitude at a main or primary astronomical station for the field season of 1873, May 1, 1873*, p. 80–82, *in* Wheeler, G.M., Kampf, F., and Clark J.H., 1874, *Report upon the determination of the astronomical co-ordinates of the primary stations at Cheyenne, Wyoming Territory, and Colorado Springs, Colorado Territory, made during the years 1872 and 1873, Geographical and Geological Explorations and Surveys West of the One-Hundredth Meridian*: Washington, D.C., Government Printing Office, 82 p.
- Wheeler, G.M., 1875, *Annual report of Lieutenant George M. Wheeler, Corps of Engineers, for the fiscal year ending June 30, 1875*, Appendix LL, p. 921–1,108, *in* Secretary of War, 1875, *Report of the Secretary of War, Engineers Report, 1st session, 44th Congress, v. 2, pt. 2, Serial Set 1676*: Washington, D.C., Government Printing Office, 1,254 p.
- Wheeler, G.M., 1877, *Astronomy and barometric hypsometry, v. II, 571 p.*, *in* Wheeler, G.M., 1875–89, *Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.*: Washington, D.C., Government Printing Office.
- Wheeler, G.M., 1878a, *Annual report of Lieutenant George M. Wheeler, Corps of Engineers, for fiscal year ending June 30, 1878*, Appendix NN, p. 1,423–1,666, *in* Secretary of War, 1878, *Report of the Secretary of War, Report of the Chief of Engineers, Executive Documents, 3rd Session, 45th Congress, v. 2, pt. 3, 1878–79, Serial Set 1846*: Washington, D.C., Government Printing Office, 1,883 p.
- Wheeler, G.M., 1878b, *Central Colorado, Atlas Sheet No. 62(A), expeditions of 1873, 1874 & 1876. Topographic map (hachures), 1 inch to 4 miles (1:253,440)*, *in* Wheeler, G.M., 1878c, *Topographic atlas projected to illustrate United States Geographical Surveys West of the 100th Meridian*: Washington, D.C., U.S. Government, maps.
- Wheeler, G.M., 1879, *Annual report of Lieutenant George M. Wheeler, Corps of Engineers, for the fiscal year ending June 30, 1879*, Appendix OO, p. 1,979–2,313, *in* Secretary of War, 1879, *Report of the Secretary of War, Engineers, Executive Documents, 2nd session, 46th Congress, no. 1, pt. 2, v. 2, pt. 3, 1879–80, Serial Set 1906*: Washington, D.C., Government Printing Office, 2,399 p.
- Wheeler, G.M., 1889, *Geographical report, v. I, 780 p.*, *in* Wheeler, G.M., 1875–89, *Report upon United States Geographical Surveys West of the One-hundredth Meridian, 7 v.*: Washington, D.C., Government Printing Office.

Wilson, B., 2004, Georgetown's "astronomic monument" deserves preservation: The Silver Queen Preservation News, Historic Georgetown, Inc., v. 33, no. 4, winter 2004, p. 7–8.

Wilson, B., 2007a, Searching for Dr. Kampf—An exercise in historical research: *mem-ber-a-bil-ia*, Historic Georgetown, Inc., v. 3, no. 1, June 2007, 4 p.

Wilson, B., 2007b, Georgetown's "astronomic monument"—Part II: The Silver Queen Preservation News, Historic Georgetown, Inc., v. 37, no. 3, winter 2007, p. 1, 3.



ISBN 978-1-4113-2985-0



9 781411 329850



Printed on recycled paper