A Narrative Atlas of the Gunnison-Beckwith Survey for the Pacific Railroad, 1853-1854

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Elbie Bentley
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This thesis titled
A Narrative Atlas of the Gunnison-Beckwith Survey for the Pacific Railroad, 1853-1854

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ABSTRACT

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The scientific exploration and documentation of the Pacific Railroad Surveys of the nineteenth century is a subject that has received little attention in historical cartography. Of the surveys, the Gunnison-Beckwith expedition produced a particularly intriguing report containing adventure, illustration, and topographic presentation. This research explores the representation of this significant historical event in an atlas. Drawing on the concept of the atlas as a narrative form, an atlas of maps was created which can be read like a novel. In doing so, the narrative was further structured to reflect the cartographic language of the nineteenth century topographic explorers, and recreated their world of incorporated illustrations, observation, and text within each map. This research clearly reveals the potential of the atlas in a narrative form and demonstrates the technique as both viable and useful for the representation of historical subjects.

Approved: __________________________

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CHAPTER 1: INTRODUCTION

The westward expansion of the American territories during the early nineteenth century marked the beginning of an era of reconnaissance through scientific exploration and documentation. A significant component of these explorations was the surveys conducted for the construction of a transatlantic railway, an exploit undertaken by the Army Corps of Topographical Engineers in 1853. Of the six surveys, the Gunnison-Beckwith expedition survey produced a particularly intriguing report containing adventure, illustration, and topographic presentation. This same survey delineated many of the routes ultimately chosen for the construction of the Central Pacific Railroad.

This expedition was most notable for events surrounding Captain Gunnison’s death at the hands of hostile Natives. This caused considerable controversy between Governor Brigham Young and the Federal Government. Gunnison and seven of his men were massacred by a band of Pahvant (Ute) Indians near Sevier Lake Utah, which was followed by rumors that the attack had been orchestrated by Brigham Young and the secret militia of Danites.

The exceptional topographic illustrations of the route produced by the German topographer Baron von Egloffstein were seen as the most detailed and useful of those produced for the entire twelve volume report. According to Lieutenant Beckwith, these steel engravings provided “an accurate delineation of every portion of the region traversed” and beautifully depicted the country through which the railroad would pass. Later in his career Baron von Egloffstein went on to invent the halftone printing process
for the reproduction of photographs further exemplifying the significance of his participation in the survey.

Despite the historical importance and remarkable content of these reports, which were considered the largest source of geographical information on the West during this era, they remain largely unknown to the public today. A single plate in William Goetzmann’s *Atlas of North American Exploration* (1992) displaying the Pacific Railroad Survey Routes, accompanied by a short description of their content and purpose, is all that represents the impressive expedition undertaken by this group of topographical engineers. The intensity of the stories and the beauty of the artistic products contained within the reports remain largely neglected.

The representation of this significant historical event in atlas form would contribute to historical geography by bringing recognition and understanding to a formerly underrepresented and unexplored subject. The construction of an atlas integrating the report components with new original maps would work to combine adventure stories and visual products with spatial and temporal elements, producing an integrated piece. Furthermore, the use of a narrative technique, including the structuring of this narrative, in the atlas and map design will allow the atlas to be read like a novel, something that has only been theorized in the past. This form will work to engage the readers’ interest, so they can become familiar with the landscape of the explorers’ experiences as they explore the spatial and temporal data of the maps.
1.1 Statement of Purpose and Research Objectives

This thesis is guided by four main research questions:

- **Does the atlas as a narrative form have potential for the production of historical expedition atlases?**

  This question looks at the potential application of the narrative form in historical expedition atlases. How the narrative form lends itself to the representation of historical subjects in the atlas.

- **Can an atlas of maps be organized to be read as a story, rather than as a reference, without sacrificing the data-rich quality of the reference book?**

  This question looks at the production of an atlas of maps sequenced in such a way that they can be read like a novel, and compares it to the question of data representation in the map. Particularly, how can the maps be rich with spatial and scientific data, but narrate a story as well?

- **Can this narrative atlas be structured using the cartographic language of nineteenth century topographic explorers and use their method of incorporated maps, illustrations, and texts?**

  This question investigates the application of a structured narrative in the atlas. Nineteenth century topographic explorers presented their work in an incorporated format of report, map, and landscape illustration to promote geographic understanding. Can this same structure be achieved in a twenty-first century narrative atlas?
• **Can new cartographic techniques, informed by the technique of the nineteenth century topographers, be developed to support this narrative structure?**

This question explores how symbolization techniques in the individual plates can also be used to recreate the nineteenth century cartographic language of the topographic engineers. This includes an exploration of traditional and modern methods and their incorporation into the single map.

This research will not only put previously unexplored theories to work, but will also demonstrate that narrative techniques, and the structuring of this narrative, are both viable and useful in representing historical subjects. Further use of this form could contribute significantly to atlas design for historical subjects as well as exemplify innovative cartographic design techniques developed for this project to support the atlas’s narrative structure. Overall, this research will contribute to the literature of atlas design, historical cartography, and narrative cartography.

1.2 Summary of Research Structure

This thesis is organized into 6 chapters. The second chapter introduces literature in the three supporting subject areas: historical cartography and the atlas, Alexander von Humboldt and the incorporated world, and nineteenth century cartographic language. Chapter 3 presents a history of the atlas subject: the Gunnison-Beckwith Pacific Railroad Survey. That chapter also includes a description of the topographical work conducted by the expedition party. Chapter 4 gives a detailed account of the research conducted and
methods used to produce the atlas. This includes both the production of a structured narrative as well as the development of cartographic techniques complementing this structure. The results of the research are presented in Chapter 5. Chapter 6 discusses the findings of this research within the context of the literature. The final chapter will present the conclusions and areas of future research.
CHAPTER 2: LITERATURE REVIEW

This thesis draws on three bodies of literature as its foundation: historical cartography and the atlas, Alexander von Humboldt and the incorporated world, and nineteenth century cartographic language. These topics will be presented in the following section.

2.1 Historical Cartography and the Atlas

In general, combining a set of maps into atlas form serves two purposes: the first is to keep the maps together in one safe, uniformly formatted and organized place, and the second is to produce an interrelated whole of multiple maps, which goes beyond the content limitations of the single map (Wood 1987, 29).

According to Wood (1987) the aggregation of maps into atlas form can follow three principles of ordering. If the primary purpose is for the sake of neatness, maps can simply be bound randomly, without any particular arrangement. Random organization, the first possible method of arranging the pages of an atlas, is rare, however, because in general, when people go to the trouble of binding a book, they prefer to sort the contents into some order. Maps can also be arranged according to an arbitrary scheme (for example, alphabetically by states), which is the second, and most common system. The narrative arrangement of maps, which uses a sequence of maps to shape a story, and has only been implicitly achieved in the past, is the third and final method of organization (Wood 1987, 29). Despite hundreds of atlases produced throughout history, there has
been little theoretical literature produced concerning either their organizational structure or content.¹

A review of historical atlases of the United States produced within the last 100 years, including expedition atlases, found that they are generally organized according to thematic or chronological structure or a combination of the two. The thematic approach divides the atlas by theme and organizes the maps arbitrarily (usually according to tradition) (Wood 1987, 29). For example, *The Times Atlas of World History* (Barraclough, 1978), which simply divides history into significant time periods and arbitrarily orders the themes into political, physical, and population sections within each, would be seen as a thematic atlas.

The chronological approach, in contrast, organizes the contents of the atlas according to the progression of events through time. For example, the animated atlas, *Antarctica Exploration* (Carleton University, 2005), follows the theme of the exploration of Antarctica as it changes in scope and location through history. The chronological approach has been critiqued for its emphasis on the linear progression of history, as opposed to its circular or regressive nature. In such a view, the progression of history does not look back at the remnants of a previous era or event, but rather marches on without reflecting on the gains or losses (Grossman 1998, 6).

Again, the division between these two organizational structures is often unclear, and a combination of thematic and chronological approaches is quite common. For example,

¹ Most recent literature in historical cartography has been focused on the use of Geographic Information Systems to analyze historical subjects (See for example Knowles, A.K. ed. 2008, *Past Time, Past Place: GIS for History*; Knowles, A.K. ed. 2008. *Placing History: How Maps, Spatial Data, and GIS are Changing Historical Scholarship*).
the *National Geographic Historical Atlas of the United States* (Fisher and Fisher, 2004) is initially divided into thematic sections (land, people, boundaries, economy, networks, and communities) and each of these sections then follows the chronological development of the theme through early to modern history (Grossman 1998, 7). Perhaps the most important concern with this type of atlas structure, according to Grossman (1998), is that the chronology does not represent the continuity of history throughout each theme. Within the traditional atlas, each theme is only represented at its highest point of the development, and the rise and fall of these themes are excluded (Grossman 1998, 16).

For the production of thematic historical atlases, the subjects of structure and content become particularly important because they both eventually influence how effectively the data are shown in each map, as well as how the whole historical narrative is understood by the reader. If produced effectively, atlases cannot only be used as a reference material, but also to tell a story or take the reader on a journey through the landscape (Wood, 1987 cited in Grossman 1998, 14).

The link with traditional academic cartography has been broken by the editors of the *Historical Atlas of Canada* (Harris et al., 1993). Stark representations of quantitative data remain in the form of bar graphs and pie charts, but they are enriched by intermingled architectural drawings, historical maps and landscapes, transporting the viewer into the landscapes of the Canadian past. Here the narrative is allowed to unfold (Harley, 1989) implicitly through the creatively arranged figures and maps (88).

A review of recent web-based historical atlases reveals a variety of approaches to representation and organization of each subject, but all allow the user to explore and
navigate the archive independently. One approach, employed by Anne Godlewska in her 2002 *Atlas of Napoleonic Cartography in Italy*, allows the reader to explore an extensive archive of historical maps in a web-based format (Godlewska, 2002). This archive shapes the historical events and subjects for the reader through new maps, and also allows them to navigate through the original works, which are linked to their respective locations on the new maps, so the readers can easily navigate the historical archive according to their interest. The atlas also includes a series of illustrations as well as numerous texts describing the individual maps and the project as a whole. The atlas does not explicitly seek to narrate a historical event, rather it does so implicitly through the linking of text, image and map, which work to produce a narrative as they are navigated by the viewer.

Another approach to the historical web-based atlas can be found in the *Atlas of the Valley of the Kings* (Theban Mapping Project, 2009). This project sought to produce an online archive of Thebes, one of the world’s most important historical centers, through the use of maps, image, text, and narrative video. That atlas takes a similar approach to the *Atlas of Napoleonic Cartography* (Godlewska, 2002), however, it does not organize the archive by themes, but rather gives the reader an overview map of the site from which the individual tomb locations can be chosen (either from the map or from a drop-down menu above). When a location is selected, the viewer is brought to the location in a larger scale map. Here the viewer can choose to view a video with image and narration, see a historical description and detailed plan (another larger scale map), or view further images of the artifact. This web-based map successfully produces narrative through these
integrated components, but lacks the time-space connection which seems key to the illustration of historical subjects.

The explicit production of narrative in both the content and structure of an atlas has been little explored. The only example can be seen in Denis Wood’s *Dancing and Singing: A Narrative Atlas of Boylan Heights* (Krygier, 2008), a selection of maps which seeks to illustrate the individual elements making up the neighborhood. When completed, this atlas will contain many maps and be organized to be read like a novel (Krygier, 2008). Together, these maps will work in unison to create a greater whole, although the descriptions of this work do not allude to how this will be achieved.

In addition to the organizational considerations for historical atlases, scholars have also examined the discourse produced by and within such atlases. Harley (1989) suggests cartographers should begin to regard maps less as “objective technical representations” and more as texts connected to the “social implications of our discourse” (80). Though cartography is seen as the “most commonly used mechanism for analyzing data and has powerfully affected the manner in which we visualize the past,” it remains a largely unexamined area of scholarship in historical geography (Hamshere, 1987, cited in Harley 1989, 81).

Traditionally, the perception of cartographic science has been as a producer of accurate and objective representations of reality. It is assumed, in this case, that “reality” is entirely knowable and can be simply expressed as a system of facts (Harley 1989, 82). The representation of this reality in maps is the central and largely neglected question. Harley (1989) suggests that cartography is viewed as one of the primary influences
responsible for the uncritical acceptance of maps as semblances of cartographic objectivity. Harley (1989) also suggests that the discipline of geography views cartography as a set of techniques used to produce objective representations, and cartographers, in turn, seem to view themselves as scientists, whose techniques are not regarded as akin to other forms of representation, particularly texts. As a result, we have failed to analyze the map with as much rigor as we do, for example, the syntax of the written word (Harley 1989, 83). Deconstructing some of the aspects of traditional historical cartography can help us develop a better understanding of maps and use them more imaginatively so they can “mediate humanity rather than the statistical abstractions of the past” (Harley 1989, 84).

Maps should be viewed less as a mirror of reality, especially in the case of historical cartography, which seeks to represent events of the past that are no longer accessible and observable, and more as a text. In this case, the atlas’s narrative form would produce a story driven by the topics and organizational structure as well as the content of the individual maps (Harley 1989, 84). These notions have been resisted by the cartographer of the past, perhaps because those considering themselves scientists do not wish to be associated with the field of literature, one that can be proven neither true nor false. Maps, however, can be considered a form of text in a broader sense, as they can be seen as “constructions employing a conventional sign system” (Harley 1989, 85). The case can therefore be made that the mere presence of linguistic elements would not constitute the text, rather the act of constructing the text itself. Among other reforms to map
production, a narrative cartography is called for; maps that can portray a process, tell a story, and in tandem reveal the human relationship with space (Harley 1989, 85–88).

Wood (1987) states that maps are produced exclusively to function as tools of information and facts and are not commonly seen as a source of interest or amusement on their own. On the other hand, flipping the pages of an atlas can captivate, not with facts, but with the subject matter, such a successful presentation in the map can function as a source of amusement (Wood 1987, 25).

This idea is also examined by Wood (1987) within the context of a novel. He suggests that the perceived distance between texts of information and texts of pleasure is essentially nonexistent. On their own, neither texts, nor their subject matter, are inherently interesting to the reader. It is, rather, the text’s character, “its honesty, its excitement, its subtly, its respect for details…,” that works to bring the two together and engage the reader (Wood 1987, 26). This distance, which is probably a relief to those who produce boring maps (it does not need to be enthralling, it was created to present facts), has dominated thought about the role and potential of map and atlas production for the last half century (Wood 1987, 26). As a consequence, no tradition has linked the reading of texts (for amusement) with the reading of atlases (for facts); the idea that a map or atlas could be a source of engagement, where the reader might be seduced by a map, as they are perhaps by a novel or volume of poetry, has yet to evolve (Wood 1987, 26). The relation to the world we know, and the exposure of an unknown world, or a world we could not see without the author’s intervention, is a commonality of map and
text, and the producer of engagement for the reader of both. Both map and novel are mere representations, not the thing itself (Wood 1987, 27).

At this point, one might argue that a distinction be made between the facts residing in a map and the fictions contained in a novel. If examined closely, however, the only distinction one finds is in their “self claimed fictions and self proclaimed facts” (Wood 1987, 28). Only the novel attempts to portray imaginary characters, who could potentially be roaming the earth, while the map attempts to represent what is found on the earth, though the results are equally invented (Wood 1987, 28). A map captures only a glimpse of an ever-changing landscape. Once readers accept that a map is not an accurate representation, its facts can considered a fiction similar to the characters in a novel. It can become a member of the family of representations (paintings, photographs, movies, histories, essays) and part of their traditions, for example, permitting it to be read as a “text of pleasure” (Wood 1987, 28).

Wood (1987) writes that through the careful sequencing of maps within an atlas, and their juxtaposition as a group of interrelated pieces, a narrative can be created, just as words have been used to create narrative in a pleasurable novel or as scenes are used to produce the engaging sequence of a film (29). Each map would play a role in the meaning of the atlas as a whole, just as a group of paragraphs work in unison to produce a story. “With the map being read, it will soon enough come to be narrated: it cannot be a distant prospect, the atlas as a novel” (Wood 1987, 29).

In addition, this narrative is not generic, but can be structured in a particular way. Pearce (2008a) has explored this idea not for the atlas, but for the individual map. Just as
a novelist produces a story using letter symbols, cartographic symbols can be used to produce a similar narrative within the map. Narrative is not only the telling of a story, but the combination of this story and the related discourse (Abbott 2002, 19). The presentation of a sequence of events and the representation of those events in a particular discourse using the language and grammar of graphic variables, including pacing, focalization, and closure, work to produce narrative in the map (Pearce 2008a, 21).

2.2 Alexander von Humboldt and the Incorporated World

Philosophers of the Enlightenment movement of the eighteenth century strove to dissolve the classical myths formerly framing their understanding of the world and sought to replace them with a reason-based system of universal knowledge. During that era many had lost faith in the church, and other forms of traditional authority, as a means of understanding and organizing the world, and turned their attentions to a more logical system of thinking in solving scientific quandaries. It was thought that truth could be arrived at through logical, objective reasoning, something utilized by enlightenment scientists in their pursuit of intellectual unity and a universal system of scientific knowledge (Godlewska 1995, 6). These ideals also coalesced in Alexander von Humboldt’s methods and philosophies of scientific research, which can be seen as the guiding force behind scientific exploration during this era (Goetzmann, 1978; Krygier 1997, 29).

Humboldt’s numerous expeditions were based on his belief in direct visual observation as the most objective means of gathering scientific data (Goetzmann 1986,
It was thought that vision was the least emotionally affected of the senses and, therefore, the most logical and reasonable (Krygier 1997, 29). “Direct experience” became a key component of his scientific expeditions and influenced many other explorers, who also became focused on this visual epistemology in their research (Krygier 1997, 29).

Humboldt’s field work was also reliant on his use of complementary tools of measurement to further extend objectivity beyond the human observer (Goldlewska 1995, 6; Krygier 1997, 29–30). Numerous instruments, including chronometers, telescopes, sextants, hygrometers, and barometers, as well as multiple makes and models of each to ensure consistency and accuracy, accompanied him on each expedition (Botting 1973, 64; Livingstone 1992, 137). Early on in his career, Humboldt was already aware of how important numeracy would become to the field of geography (Livingstone 1992, 137).

Although accuracy, measurement, and numeracy were major preoccupations of this era, Humboldt himself was less concerned with simply representing his findings on paper. Rather, “his intent was to provide information in a form which would enhance data comparability and analysis from multiple points of view” (Goldweska 1999, 245). Instead of merely cataloging data, as his contemporaries did, Humboldt sought to combine the observed characteristics with x,y locations on the map, which worked to better describe and communicate the broader connections between natural phenomena. For example, figure 1 illustrates the integration of several data representations, maps, graphs, and illustrations, into a single incorporated display. The integration of these datasets into both map and table form changed the nature of map production. Maps were
no longer simple topographic representations; they were reformulated into interconnected products which worked to make a scientific statement or support a theory (Goldweska 1999, 240). The use of measurement instruments and the assignment of these results to locations on the numerically delineated surface of the earth (the graticule), also worked to create a “science of location.” With this emphasis on the display of scientific results, along with the public’s growing use and interest in maps, cartography came to be viewed as central to the production of accurate scientific knowledge (Black 2003, 78).

Figure 1. Thematic Map: A New Form of Integrated Data Representation. Source: Library of Congress: An Illustrated Guide; Geography and Maps.

The numerous comprehensive reports Humboldt produced from his expeditions were also an extension of the Enlightenment philosophy. Largely self-educated, he focused his research on a wide variety of fields in order to find the unity amongst them (Godlewska
The influence of the prominent German philosophers, particularly Johann Wolfgang von Goethe, who encouraged his fellow scientists “to solve the profound mystery of the universe” (Bowen 1981, 217), can be seen in the catholic nature of Humboldt’s expedition reports. Humboldt sought to understand the interconnectedness of each phenomena, in order to gain a better understanding of the universal whole. Each phenomenon he believed should be viewed in relation to those around it in order to form conclusions about how the universe functioned as a cohesive whole (Livingstone 1992, 135). The intertextuality of his expedition reports, just as was seen in his maps, was key to their success as a presentation of scientific information (Krygier, 1997). Figure 2, produced from Humboldt’s Spanish American expeditions, is an excellent example of the use of a combination of media to display scientific results.

Figure 2. Geographie der Pflanzen in den Tropen – Laendern: ein Naturgemalde der Anden. (The Geography of Plants in the Tropical Lands: a Nature Drawing of the Andes).
Source: http://commons.wikimedia.org/wiki/Image:Humboldt1805-chimborazo.jpg
The *Geographie der Pflanzen in den Tropen – Laendern (The Geography of Plants in the Tropical Lands)*, depicts two mountains in the Andes profile in an interrelated format. This includes an illustration of each plant, located according to the altitude at which it was found, and comparative descriptions of the related physical phenomena, recorded at each altitude: measurements of temperature, chemical consistency of the atmosphere, geological relations, and barometric pressure. To this Humboldt commented, “[I] have attempted to unite into a single picture the whole complex of physical phenomena…” (Bowen 1981, 223). Had Humboldt used only one medium to display these results (for example, just one map), a wealth of information about the associated studies would have been excluded. It was the representation of information in context and in multiple forms that Humboldt perceived as the key to understanding nature as a whole.

Humboldt’s monumental South American work, published in 1808, *Voyage de Humboldt et Bonplan 1799–1804*, provides an excellent example of a multifaceted report format. The thirty volumes were roughly divided into three sections. The first section consisted of scientific results (including two atlases), the second a series of treatises on the geography and economy in Cuba and Mexico, and the third a narrative of Humboldt’s travels (including descriptions and illustrations of the region through which he traveled) (Botting 1973, 202). The wide acceptance of these empirically-based and multilayered reports by both the public and scientific community as a means of producing valid scientific knowledge produced new authority in scientific research (Krygier 1997, 31).

In a 1997 article Krygier explored the influence of Alexander von Humboldt and Enlightenment ideals on the reconnaissance expeditions in the American West. His
research revealed the importance of the “representational barrage,” or the series of interconnected forms of representation that make up the reports produced for these expeditions, in the production of scientific knowledge during this era (Krygier 1997, 27–28).

It was this approach of methodology and representation, the “incorporated world,” that was also used by the explorers in the American Reconnaissance Surveys to display and communicate their scientific discoveries of the west. Humboldt’s monumental explorations in South and Central America shaped scientific exploration during this era and he was seen as the guiding force behind pre-Civil War science in the American West (Goetzmann, 1966 cited in Krygier 1990, 39). “All earth scientists were eager for Humboldt’s approbation, not only because of his mighty labors and his colossal preeminence in science, but also because he seemed to grasp the profound unity in nature…” (Goetzmann, 1978 cited in Krygier 1990, 39; Krygier 1997, 29). The comprehensive nature of surveys during this era, as well as the reports they produced, reflected Humboldt’s influence on the science of this era (Goetzmann 1986, 183; Krygier 1997, 29).

The final reports of the Railroad Surveys were published as interconnected representations of text, image, panorama, and map. These were assembled in order to contextualize each piece within the greater whole of scientific knowledge production. Each medium played a role in the production of scientific validity, both individually and
in the report as a whole (Krygier 1997, 32). Figure 3 illustrates the intertextuality\(^2\) of the Pacific Railroad Report products. Beginning in the top left and moving right, the panorama illustration from a peak looking west is directly linked to the map, marked by the letter ‘C’ and all locations marked along the bottom of the panorama are also labeled in the map. These were again linked to the written reports, which described what was found at this location, and the other report components (zoology, astronomical, etc.) by location. Each data format was linked by location so the reader could understand them in context of one another and so the limits of each form could be made up by the others (Krygier 1997, 32). Other government expeditions during this era also used the same Humboltian format, but these incorporated the journal entries and observations directly into the map (figure 4). This allowed the reader to easily link the survey materials to the map without having to leaf through multiple volumes, as in the case of the Pacific Railroad Reports.

\(^2\) Intertextuality is a term generally used to describe the interpretation of texts in relation to one another as opposed to independent pieces. This form of interpretation is believed to allow one a better understanding of the work (Culler 1981, 38 cited in Krygier 1997, 31).
Figure 3. Incorporated Illustration, Map and Text Components.
2.3 Structure of Nineteenth Century Cartographic Language

The structure of nineteenth century cartographic language also informs the structure of cartographic language in the narrative atlas produced for this thesis. The vocabulary of graphic expression in maps is a product of the culture from which it has been developed. Mapping traditions, and cartographic language, therefore, develop differently in different places, depending on the needs and tools available to the people (Pearce 2008b, 110).

The overall objective of nineteenth century mapmakers was to produce maps in a uniform and non-arbitrary way. During this period, improvements in triangulation methods and surveying instruments allowed cartographers to produce more accurate small-scale maps (Imhof 2007, 9). Crews of explorers used chronometers, measuring chains, and
innovative tools like the theodolite, to gather the precise and accurate angle measurements needed for triangulation (see section 3.3).

With technological transition came new language for terrain representation. To achieve the view from above, landforms had to be represented through an aerial, rather than the conventional oblique, symbolization. To achieve this, methods of slope hachuring were explored extensively by both Swiss and German cartographers. The most notable improvements were made by Johann Lehmann who developed standardized methods in slope hachuring. The terrain was represented by depicting steep slope with thick hachures and contrasting areas of gentle slope with thin lines. A line was first drawn in the direction of the primary slope and these slopes were divided evenly so that the remaining hachures could be added at equal intervals across the slope. This method became preferred because it allowed both the identification of slope aspect as well as the differentiation between steep and flat terrain (Imhof 2007, 8–10).

The five rules of slope hachuring for large-scale maps during this era, compiled and summarized by Imhof (2007), are outlined below (214–221).

1. Hachures are “dense zones of small parts of slope lines. Everywhere their direction follows the steepest gradient”

2. “Hachures are arranged in horizontal rows” They need to be broken down into horizontal rows so that consistent density can be maintained throughout the map.

3. “The length of each hachure corresponds to the actual local horizontal equivalent between contours or assumed contours of a certain contour interval.” This
interval was both calculated and drawn simply from the artist’s impression of the land.

4. “The light-dark modulation of the hachure system arises from the principle ‘the steeper, the darker.’ The degree of darkness generally corresponds to the slope angle, as we have already seen in slope shading. Variation in shading intensity is achieved by a corresponding variation of stroke thickness and the interval between strokes. The sum of one stroke thickness and its associated space is constant within the map.” Lehmann developed a guide to follow so the proper ration between stroke thickness and space between strokes could be determined according to slope angle.

5. “The same number of hachures should be placed together all over the map surface for every centimeter of horizontal extent. This number should be selected and adapted to each map.”

This system became widely used in most European topographic maps of the era, particularly those made by the military, until it was eventually replaced by half-tone shading in the second half of the century (Imhof 2007, 10).

Also during this era, a clear and standard cartographic language of feature representation was significantly developed. Visual hierarchy was used to differentiate both the labeling of features and the demarcation of line features. This technique allowed the map reader to differentiate easily between elements while retaining the visibility of weaker features, which risked becoming unrecognizable, during the generalization process.
In summary, each of these three bodies of literature will inform my development of a narrative atlas of the Gunnison-Beckwith Surveys. By interweaving the concepts of the narrative atlas, Alexander von Humboldt’s incorporated world with Imhof’s conceptual and technical approach to hachuring, the atlas explores and expands on historical, theoretical, and technological literature of cartography.
CHAPTER 3: THE GUNNISON-BECKWITH SURVEYS

During the Great Reconnaissance of 1848–1861, the U. S. federal government sponsored expeditions and surveys designed to gather a wide variety of information about the territories of the American West and locate potential routes for a railroad. The goal of these expeditions was to “discover, open up and make accessible the American West” (Schubert 1980, 56). When gold was discovered in 1849, the need for a transcontinental railroad route became essential to connect the nation’s two halves. Congress reacted by passing the Army Appropriation Act of March 1853, empowering Secretary of War Jefferson Davis to direct the survey of the most economical and practicable route across the West. The Corps of Topographical Engineers was to survey four possible railroad routes roughly following selected parallels from east to west; two additional expeditions explored California north to south for potential access routes. The following routes comprised the four main east-west expedition paths: from Kansas to California between the thirty-eighth and thirty-ninth parallels (Volume II, 1855), the thirty-fifth parallel from Little Rock to Los Angeles (Volume III, 1856), between the forty-seventh and forty-ninth parallels from St. Paul to the Puget Sound (Volume XII, 1860), and the final survey followed the thirty-second parallel between Dona Ana, on the Rio Grande, and the Pimas Villages on the Gila River (Volume X, 1859) (U.S. War Department, 1858).

Captain John W. Gunnison was in charge of the initial survey of the thirty-eighth and thirty-ninth parallels. When Gunnison was killed by a hostile band of Pahvant Indians (Ute) while examining Sevier Lake 130 miles south west of Salt Lake City, Edward G. Beckwith took charge for the remainder of the expedition. After wintering with the
surviving men in Salt Lake City, Beckwith continued following Gunnison’s initial route along the forty-first parallel through the Sierra Nevada to the Sacramento Valley in California.

To navigate their path, the party relied heavily on both maps produced from previous reconnaissance efforts (of varying accuracy and quality) and the help of guides hired for each region. Portions of the survey route, especially parts led by Gunnison, followed previously explored routes where forts and settlements catering to westbound settlers were not uncommon. At such settlements, the party could replenish their supplies, hire new guides, and dispatch correspondence to the War Department in Washington, DC relaying their progress, including preliminary data reports, maps, and illustrations (U.S. War Department 1854, v. 2, Appendix A & B).

Crews of scientists and artists accompanied Gunnison and Beckwith in order to scientifically document the aspects of the landscape and resources that would affect “the solution of the question of location, construction, and support of a railway communication across the continent” (U.S. War Department 1854, v. 2, 3). The crews conducted surveys and gathered data associated with every aspect relevant to railroad construction, such as physical features (mountain passes, rivers and lakes, and natural resources), the location of stone, wood and water, and made an overall cost estimate for each route (U.S. War Department 1854, v. 2, 3; Krygier 1997, 29). “Meteorological and magnetic observations, the hygrometrical, and electrical states of the atmosphere, and astronomical observations for determining geographical points” were also made “in order to develop the character of the country through which the party would pass” (U.S. War
38

Department 1854, v. 2, 3). Data collected from each survey were eventually combined into a twelve volume report, in the form of illustration, map, profile, table, and description, and presented to Congress as an aid to its decision-making process in the railroad location and routing debate (U.S. War Department 1854, v. 2, 3).

3.1 Gunnison’s Survey near the Thirty-Eighth and Thirty-Ninth Parallels

Leaving Westport, Kansas, on 16 June 1853, Gunnison and his party set out to survey the land between the thirty-eighth and thirty-ninth parallels of north latitude from Kansas to California. The survey party was comprised of the following members: Lieutenant Beckwith, third artillery (second in command), R. H. Kern (topographer and artist), Sheppard Homans (astronomer), James Schiel (surgeon and geologist), F. Creutzfeldt (botanist), J.A. Syder (assistant topographer), and Charles Taplin (wagon-master). A number of employees, teamsters, and a military escort of some thirty mounted men also accompanied the party on their journey. The supplies and instruments for railroad surveying, including sextants and artificial horizons, a theodolite, compasses, odometers, mercurial and aneroid barometers, and all other necessary items, were transported along the route by eighteen horse and mule-driven wagons (U.S. War Department 1854, v. 2, 5).

Shortly after departure, just south of Westport, Gunnison and several men split from the main party to travel alone along the Kansas River past Fort Riley. They continued west until they rejoined Beckwith and his party, who had been traveling along the Santa Fé Road to the south, at Walnut Creek. The expedition then proceeded up the Arkansas
River to Apishpa Creek and, traveling westward, met Heurfano Creek, which they continued to follow south to the Sangre del Cristo Pass in the Sierra Blanca. Here they entered the San Luis Valley where they examined several passes as they traveled northwest along the edge of the range. Following Sawatch Creek north, they left the valley and continued down the Grand River, the canyons of which they found they were unable to traverse. Instead, they climbed the mesas to the south in the direction of Uncompahgree Creek, which they followed back to the mouth of the Grand River. The party then moved west along the river until they realized they had drifted too far south, at which point they left the Grand River and crossed the Green River just south of the White River where they turned north (U.S. War Department 1858, v. 11, 74).

The party continued their path westward to the Santa Fé River, where the precipitous topography of the Wasatch Mountains again forced them to turn southward. Eventually crossing the mountains through Wasatch Pass, they followed the Sevier River northward for several miles until they were able to cross into Lake Valley. Turning south, the men crossed the Unkuk-oo-ap Mountains, where they again met the Sevier River near what is today the town of Fillmore, Utah, and here the party again separated. Gunnison, Kern, Creutzfeldt, Potter (the guide), and eight other expedition members set forth to examine potential routes to the west near Sevier Lake. On the morning of October 26, near what is today Delta, Utah, Gunnison and his men were surprised by a band of hostile Pahvant (Ute) Indians. In the conflict, the Utes killed Kern, Creutzfeldt, Potter, and four others. Beckwith and the remaining men arrived at the site to recover the majority of papers and
instruments a few days later\(^3\). They then continued on to Salt Lake City, with Beckwith now in command. Here they spent the winter compiling the observations and field notes collected in preparation to complete Gunnison’s expedition along the forty-first parallel (U.S. War Department 1858, v. 11, 75–76).

3.2 Beckwith’s Survey near the Forty-First Parallel

The crew, along with the surviving members of Gunnison’s party, was joined during the winter of 1853 by F. W. von Egloffstein after his departure from the troubled survey of John Charles Frémont just a few days prior.\(^4\) This crew left Salt Lake City on 3 April 1854 to explore the Wasatch Mountains east of Great Salt Lake (U.S. War Department 1858, v. 11, Appendix B and Krygier 1990, 70). The party proceeded north along the lake shore until they met the Weber River, which they followed east through the mountains to White Clay Creek. Then, continuing northeast, they crossed the Bear River and made their way to Henry’s Fork, where they turned and began retracing their steps as they tried to discover a viable route to the Kamas Prairie and Timpanogos River. They were deterred, however, by excessive snow and rugged terrain. Following the Weber River east to cross the Uintah Mountains and descend to Utah Lake, which they

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3 These items were not actually recovered at the site.
4 Frémont’s expedition roughly followed Gunnison’s until the Grand River where he turned south, but was privately funded and sought to disprove the notion that the route was impassible during the winter months. Winter overcame the party and as they attempted to cross the Colorado Mountains, nearly starved and frozen to death before finally stumbling into Parowan, Utah, on 8 February 1854. It was here that Egloffstein left Frémont and was hauled, with a companion, 300 miles north to Salt Lake City by wagon. Egloffstein continued making topographic notes despite his miserable health and arrived in Salt Lake on the evening of 1 March 1854. Here he met Beckwith the very next evening at the home of E.T. Benson and was offered the position as artist and topographer on the continuing Beckwith expedition. After the expedition, Egloffstein traveled to the eastern US to finish the series of maps for the final reports. (Krygier 1990, 69–70).
examined thoroughly, they returned again to Salt Lake City (U.S. War Department 1858, v. 11, 76).

The expedition resumed again on 5 May. The men left Salt Lake City and, moving west, crossed the Jordan River passing just north of the Oquirrh Mountains into Lone Rock Valley. Continuing southwest, they passed the Cedar and Pi-ja-ro-ja-bi Mountains and then turned west towards Franklin Valley in Nevada. The expedition then progressed from north to south along the eastern side of the Humboldt Mountains and turned west traveling through Hasting’s Pass and again north to the southern fork of the Humboldt River (U.S. War Department 1858, v. 11, 76).

They continued west through the mountains just south of the Humboldt River until they came to Lassen’s Meadow in California. From here they proceeded on to explore the southern portion of the Valley of the Mud Lakes. The men worked their way northwest through the eastern chain of the Sierra Nevada until they met the Fall River. Here they turned south and followed Lassen’s Road east again toward Honey Lake, where they connected with their earlier reconnaissance near the Mud Lakes. Retracing their steps, they continued west on Nobel’s Pass Road through the mountains toward Fort Reading where they camped two nights while replenishing their supplies. On 15 July Beckwith and his men traveled up the Pitt River (Sacramento River), where they nearly connected with their earlier reconnaissance of the Fall River, and then turned south and, moving along Canoe Creek and Nobel’s Pass Road, completed their loop back to Fort Reading (U.S. War Department 1858, v 11, 76). Having successfully connected the survey to the valley of the Sacramento River, already known for its railroad suitability,
Beckwith disbanded his party on 26 July and reported back to Washington, DC by 12 September 1854 (U.S. War Department 1854, v. 2, 67).

3.3 Topographical Work, Maps and Illustrations

3.3.1 Topographical Work

Observations for the survey were collected by Homans, Syder, Kern, and Egloffstein. Astronomical observations and computations to determine latitude were collected by Homan, but longitude was not recorded because the accuracy of the instrumentation was found to be insufficient (U.S. War Department 1854, v.2, 97, 70). The assistant topographer, James Snyder, kept both the distance and meteorological (barometric observations) tables for the route. Kern compiled topographical observations and measurements, illustrations, and sketch maps under the command of Gunnison and, following his death, Egloffstein continued these duties. Our knowledge of the topographical work conducted on the survey is based on Beckwith’s observation of Egloffstein’s field work while under his charge (U.S. War Department 1854, v. 2, Appendix B, 28).

Topographical work for the survey was conducted by Egloffstein and the party as they proceeded along the expedition path. According to Appendix B of Beckwith’s report, observations were made by the party every three to four miles, or about once an hour.

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5 These observations were later used by Lorin Blodget to calculate the altitudes for the route included in the final report.
6 Many field books and instruments were carried off by the Indians, including some of Gunnison’s personal notes, and the sketches and notes of Kern. These were later recovered with the assistance of Mr. Call, president of the settlement, and hastily compiled by Beckwith into what would form the first section of their expedition report (U.S. War Department 1854, v.2 Appendix A, 124).
7 We can assume that barometric, astronomical, and distance observations mentioned in this section were collected by the other party members mentioned above to support Egloffstein’s map and illustration work.
depending on the difficulty of the terrain they navigated. Astronomical observations were taken frequently to help the party locate themselves. Barometric observations were recorded at regular intervals, with more frequent measurements in areas of steep terrain, to determine changes in elevation at each location. Egloffstein took regular compass bearings, using prominent objects in the distance as reference points, to determine directional changes as the party progressed. He also frequently sketched the landscapes surrounding the expedition path. When the party made camp each night, Egloffstein compiled the data he had collected into a “field map”\(^8\) to record the day’s observations, especially the shape and nature of the landforms, before they were forgotten. On this field map, the landscape sketches were filled in with shade lines (hachures), and all observations related to map production were recorded.\(^9\)

### 3.3.2 Maps

Egloffstein produced both the preliminary\(^10\) and final maps (compiled after the expedition’s completion in Washington, DC) for the report from the data he and Kern collected in the field. The first set of maps in the final series were produced from Kern’s field observations and are, therefore, considerably less detailed than the second set, which

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8 Field-work accompanied a “rude copy of the field-work survey” a correspondence sent by Gunnison on 23 September 1853, Cap 72, Bitter Creek, Utah Territory to Colonel J.J. Albert (Chief Topographical Engineer). Gunnison and Beckwith sent several letters to Albert and Jefferson Davis (Secretary of War), included in Appendix A of Volume 2, to report on the progress of the survey and give a summary of operations (U.S. War Department 1854, v.2, Appendix A, 1). These dispatches were forwarded from forts and settlements along the route, generally by the departing guides (U.S. War Department 1854, v.2, Appendix A, 122).

9 The field map was used, along with the observations, to produce both the preliminary and final report maps for the expedition (U.S. War Department 1854, v.2, 128).

10 Homans, the astronomer, produced one of the preliminary maps accompanying Beckwith’s preliminary report, which was sent to the War Department shortly after Gunnison’s death. This map was made based on the late Kern’s field notes and sketches. Egloffstein produced all other preliminary maps for the report (those sent from the field) and the final series in Washington DC (U.S. War Department 1854, v.2, 97).
were produced from his own observations (Krygier 1990, 115). Because the maps were produced from rapidly conducted field work, however, only the extent of the country traversed, including the objects within site of the expedition route, could be displayed with any detail. Unexplored areas were, therefore, included only in outline form, merely to represent the surrounding country and to facilitate future surveys of the same region (U.S. War Department 1854, v. 2, 126).

To elucidate the map production process, Beckwith included an extensive explanation in Appendix B of the report, based on his observations of Egloffstein’s work.

In entering upon the field construction of the map, in order to eliminate all possible errors in the field-notes, the trail was again laid down continuously from the place of beginning to the terminus of the work, on the same scale (three miles to one inch) with the original sketches, without reference to the true meridian; and separate constructions of all the knots of principal bearings to prominent features of the country were made on tissue paper, which from its transparency, affords great facility for the comparison of the different constructions of overlapping sheets, and from these the whole was projected on the trail sheet, reconciling as far as possible all discrepancies. Upon the map thus constructed, all reliable latitudes were entered at their respective places, and connecting lines of latitude drawn through the whole work, thereby detecting by these variable curves any remaining inaccuracies in the work itself. Lines of longitude were then drawn, without regard to the singularity of their appearance, as nearly perpendicular to these irregular curves of latitude as possible, great regard being paid, however, in case of too great deviation of lines of longitude from north and south, to the influential bearings towards those portions of the map.

The depiction of topography was also important to the map production process. To delineate the topographic features, Egloffstein used a system of shade lines (hachures) in the map. As Beckwith described it (U.S. War Department 1854, Vol II, 128):

The scale of shading used by Mr. Egloffstein for the full topography is one to eight, which is simply an expression for the proportions of the maps which are occupied by shading lines, and was determined by taking the sum of the extreme angles of elevation and depression of the country to be represented, and dividing it into eight equal parts; then, so much of the country as ascends or descends at an angle not exceeding that of the first eighth of the whole angle, is represented by
the shading lines in proportion to its change of level, but covering not to exceed one-eighth of the whole surface. The second division is shaded, by the same rule, not to exceed two-eighths; while the eighth division is entirely occupied by the shading lines, and is black. Much character is, however, given to topography by the length of the lines—long lines giving the appearance of long slopes, and broken and short lines short and broken slopes. In the skeleton topography, the scale of shading used in this map does not exceed one to three.

3.3.3 Illustrations

In order to get a better view of the surrounding country during the survey, Egloffstein would frequently leave the party and climb the neighboring mountains. Here he would conduct additional topographic observations for use in both the maps and illustrations. From these locations he would draw profiles and outline sketches of the landscape, giving special attention to the distant views. Egloffstein also measured the angles of elevation of prominent peaks in sight, which he later used to estimate the heights of surrounding mountains from his observation point, and took the magnetic bearings of each prominent feature within view for application to both the maps and panorama illustrations in the final report (U.S. War Department 1854, v. 2, 126).¹¹

The resulting profile sketches (topographical outlines) drawn from these elevated locations formed circular views placing the observer at the center, and were later used, along with the measurements mentioned above, to produce the engraved panorama illustrations included in the final reports. These sketches, just like the maps, were corrected for topographical errors and, being drawn on transparent paper, could be overlayed with their centers corresponding to their respective locations on the map.

¹¹ These observations were later used to calculate the altitudes and distances from the point of observation (in the illustration) to the prominent peaks in the distance as well as the horizontal distances that would occur when observing the landscape from this altitude and distance.
making this correction feasible. Because they covered large sections of the same country displayed in the maps, these sketches could also be used to correct any inaccuracies Egloffstein found during the process of their compilation (U.S. War Department 1854, v. 2, 128).

A discussion of these illustrations was included in Appendix B intermingled with the explanation of the maps. According to this discussion, the inclusion of the landscape illustrations was not to display the beauty and scenery of the surrounding country, but rather to give the viewer an impression of its general character. The goal was to illustrate, through the fewest number of views, the mountains, canyons, valleys, and plains in relation to each other, so suitable passes could be clearly distinguished. These illustrations were connected to the maps through a number system linking them to the position from which the views were drawn. Each was sketched from an elevated position on the landscape, without much attention to the details of the foreground, in order to capture the general impression of the surrounding country. In the bottom margin of each image, near the furthest edges, both the name of the most distant object illustrated and the bearings of that location were given. Between these, extending across the bottom margin, important locations were named, all of which can be directly compared to those marked on the map. The point of these connections was for the two to be compared and elucidated by each other (U.S. War Department 1854, v. 2, 126).

According to Krygier’s (1990, 1997) research on Egloffstein, the accurate representation of the landscape within the maps was clearly an area of great concern to Egloffstein, whose methods of topographic survey were meticulously scientific, and
reflected the Humboldtian traditions of exact measurement and data collection (Krygier 1990, 118). The measurement of longitude proved to be difficult. Beckwith reported that their instruments proved so inaccurate for determining longitudes that for their map production they relied on comparisons with other public surveys of the region (U.S. War Department 1854, v. 2, 97 and 70). Also of great concern to both Beckwith and Egloffstein was the accuracy of their landscape depictions. In Appendix B, Beckwith noted that an accurate representation can only be made after repeated observations of the landscape under varying conditions. In order to rectify this problem, Egloffstein “endeavored to give such a character to his topography as to present a distinct representation of the country as it appeared to him when taking his notes in the field” (Krygier 1990, 115; U.S. War Department 1854, v. 2, 126). Beckwith reported (U.S War Department 1854, Vol 2, p 126):

The character of the slopes of the mountains and of their outlines in full, whether precipitous or gentle, and of the deep mountain chasms of the water-courses wherever they occur, and also the character of the summits of the mountains, whether rolling masses, sharp peaks, or serrated edges, is taken from nature, and if successful will convey to the reader a correct idea of the country as seen by the observer.

Egloffstein’s concern with the varying impressions of the landscape working their way into the map, led him to produce the most accurate representation of the topography as it appeared to him in the field. The view of the explorer, the “being there,” which was so key to the Humboldtian method, was clearly stated in the appendix accompanying the maps and illustrations (above quote). Linking the panorama illustrations to the maps also reinforced the idea of the direct observer. This reinforced the point that the panoramas
were illustrating real locales within an actual landscape, all of which could be located on
the map (Krygier 1990, 107; Krygier 1997, 40).

3.4 Reports

The multifaceted composition of the survey reports relied heavily on the incorporated
world of illustration, map, and description to communicate the scientific data displayed in
context (Krygier, 1997). The main body of text includes narratives of the expedition path
as well as the scientific descriptions of their observations. The text is accompanied by a
large number of graphs, tables, and charts which report the geologic, atmospheric, and
biological data gathered along the way. Panorama illustrations directly linked to the
maps formed another component of the report. Critical locations illustrated in these
panoramic views, such as a mountain pass or river, were labeled with a latitude and
longitude measurement that directly linked to the same feature on the corresponding map.

The resulting reports would “provide an outstanding opportunity for science to
influence national policy” (Schubert 1980, 57) and represented “an encyclopedia of
western experience” (Goetzmann 1984, 179). They were subsequently published by the
United States War Department between 1855 and 1860, and presented to both the House
and Senate in order to inform their decision for the location of the transatlantic railroad.
For this purpose, however, they were practically useless; each survey party deemed their
route the most practical and cost-effective (Goetzmann 1986, 175). Congress
subsequently deadlocked over the issue, with members still favoring their regional routes.
Not until 1862 did they pass the Pacific Railway Act, which authorized construction to
begin by the Union Pacific and Central Pacific Companies. The publication of these
documents cost two and half times the cost of the explorations themselves, which demonstrates their immense importance during this time (Taft, 1953 cited in Krygier 1997, 31).

The public response was overwhelmingly positive; people were transfixed by the beauty of this incorporated world that transported them to the landscapes of the America West. (Krygier 1997, 31). “Their ultimate significance derived not from any individual fact, image, map, or diagram, but from the entirety of the reports and their carefully interconnected representational barrage” (Krygier 1997, 32).

The original report series was to be published in seven volumes. Due to the bulk of materials collected in the field, however, the staff of the War Department quickly realized that to accommodate this bulk of information, additional volumes would have to be added. As a consequence, by the time publishing was complete, the volumes had increased from seven to twelve.

The first seven volumes, published by the Government Printing Office in Washington DC between 1854 and 1859, included an introduction to the surveys and a preliminary review of their viability as railroad routes (Volume I). The individual expedition reports, which were spread throughout volumes II through VII of the initial set, included a specific report for each expedition as well as reports related to the botany, geology and ethnography of each proposed path. The next three additional volumes, printed by Beverly Tucker of Washington, DC, between 1857 and 1859, were devoted to the general zoology of the survey. In order to avoid the replication of collected zoological materials, samples were periodically sent to the Smithsonian Institution, where they were stored
until the completion of the expeditions; drawings and descriptions of these samples were compiled according to species, as opposed to location, into the general zoology report. The first two volumes of the zoology set were devoted to these general reports and the third volume held additional expedition-specific reports which organized samples according to location. The oversized materials for the report, including maps, profiles, and panorama illustrations, were compiled in Volume XI, published by George W. Bowman in 1861. The final volume, Volume XII, published by Thomas H. Ford in 1960, contained the northern route expedition report, including both the zoological and botanical components (U.S. War Department 1854–1858).

As a consequence of these volume additions, the materials associated with the Gunnison-Beckwith survey were scattered throughout the 12–volume set. The bulk of their expedition findings, including the expedition reports, multiple color illustrations, meteorological and geological observations, and an illustrated botanical report, were included in Volume II of the series. Additionally, the expedition’s specific zoological report was included in Volume X (the third volume of the zoology set), which included descriptions, tables of locations and full page illustrations of each specimen (birds, animals, fish, reptiles, etc.). Additional samples from their surveys were scattered throughout the general zoology reports found in Volumes VII and IX. Volume XI, the maps and views report mentioned above, housed the oversized materials associated with their report. These materials included four panoramic illustrations from selected locations measuring approximately 20×76cm each (engraved by C. Schumann), one large format profile measuring 60×160cm, depicting individual profiles at various scales.
spanning the entire route, and eight maps at the scale of 1:760,320 (varying in size from 53cm×48cm to 80cm×60cm) spanning the entire expedition route from the boundary of Missouri at the mouth of the Arkansas River, to the Pacific Ocean in California.\textsuperscript{12}

\textsuperscript{12} Volumes were also published in Senate Ex. Doc. No. 78, 2\textsuperscript{nd} Session 33 Congress.
CHAPTER 4: METHODS

Producing the atlas in a narrative form involved three main phases: archival research, interpretation of archival materials, and the production of the atlas (including atlas design, maps, and cartographic language) based on an interpretation and analysis of the elements of the novel.

4.1 Archival Resources and Data Collection

A review of historical atlases, cartographic techniques, and published materials covering the reconnaissance expeditions constituted the preliminary research for the production of the atlas. Archival research, focused on original documents and reports from the expeditions, was the second, and greatest, portion of the research conducted.

For the archival research I consulted only formal resources (those produced for public consumption) (Sharmer-Smith 2002, 115). First, the entire twelve volume set of the “Reports of Explorations and Surveys, to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean,” (1854–1859), which is available for viewing in both digital and original paper form, was consulted. Although exploring all twelve volumes of the report in their complete form was useful to gain a general perspective of the contents, the main source of materials for the atlas were those volumes containing products of the Gunnison-Beckwith expedition. Volume II, containing the bulk of the Gunnison-Beckwith report, including text, observations, and the expedition’s botanical report, Volume X, including the expedition’s zoological report, and Volume XI, including the oversized maps, profiles and illustrations, were the main
sources for the materials included in the atlas. A second resource, J.B.Krygier’s (1990) master’s thesis, *The Landscape Images of Baron Frederick W. von Egloffstein, Topographic Artist in the American West, 1853–1859*, was also used to enhance Baron von Egloffstein’s character in the atlas. Egloffstein remains an elusive and largely unknown figure in American history; therefore, this document served as an essential source of information about his life and role in the survey. The most representative products from these resources, mainly the landscape, the scientific drawings and sketches, as well as the most representative pieces of text from the survey volumes and the thesis, were chosen for inclusion in the atlas (see section 4.3, General Format Decisions).

### 4.2 Interpretation of Narrative Form

Formal resources were also interpreted in order to articulate the two aspects of narrative, *story* (what happened) and *discourse* (the way in which the story is told and presented) (Abbott 2002, 19), within the individual maps, and the atlas as a whole.

First, formal resources were consulted to interpret the story component of the narrative. This included both the day-to-day events of the Gunnison-Beckwith survey and the products (maps, landscapes, and texts) of these events.

Second, these resources were used to interpret the discourse component of the narrative. This analysis included, for example, an examination of narrative voice, Egloffstein’s use of cartographic language, and modes of representation such as
illustration, map, and profile. The development of these aspects of narrative form within the atlas is outlined in the following section.

4.3 General Format Decisions

At the outset, several questions had to be answered about the general format of the atlas. First, the question of atlas size was addressed; the atlas needed to be large enough to accommodate the maps, but also small enough to be held in the hands and read with ease (Lin 2000, 3). I chose the size of 11" × 14" which I found met these requirements perfectly.

Second, title and introduction pages were included following a standard book format. Each of these pages were also designed following the same cartographic language found in the atlas; for example, typefaces and hues chosen for the title page and introduction were the same as those used in the set of maps.

Third, a table of contents was included to orient the readers within the expedition and show them how to follow the progression of the path within the individual pages (figure 5). The design of the table of contents mimics that of a traditional atlas: each plate is featured within the larger map displaying the entire expedition route and is numbered according to its place within the plate sequence. The numbers correspond to those in the map titles, so the readers can easily locate themselves within the greater path of the expedition at any time.
Lastly, due to the length of the route, the entire expedition could not be included in the atlas, therefore only the highlights, mainly the locations where the most materials were produced and the most interesting events (according to my interpretation) took place, were chosen for display. In order to choose these locations from the 1,500 miles of expedition path, a system was developed.

The first part of this process involved many weeks of exploring the report volumes to locate and organize the materials, and the second part involved locating and plotting these materials on the map. The entire expedition report was read and all interesting passages were marked within the text. Then, all materials associated with the expedition, including the illustrations and appended reports, were scanned and labeled according to title and location. Next, large maps of the region were printed and tiled together at a scale large enough to accommodate multiple sticky notes (about 3’ × 6’). The expedition route was then marked on this map with corresponding camp sites and dates, which would to be used as locators for the associated illustrations and texts. Areas I found
interesting were then marked on the map (generally in one week sections) and all materials (which had their titles and locations written on sticky notes) were placed on their respective locations in the map. Plate extents were then chosen from the areas most densely populated with materials using a 11"×14" piece of paper as a stencil to mark out the boundaries of each plate. The size of these areas also helped determine the scale of the maps. A test map was then made, including the extent of a chosen region and print outs of the images placed within the area of the map to determine the likelihood of fitting them within the allotted area of the plate.

4.4 Development of Narrative Form in the Atlas

The narrative form was developed in three components of the atlas, including the overall design, individual plate formats, and cartographic language. These aspects represent the story and discourse elements of narrative form according to my analysis in 4.2 (above). Each component is also summarized in Table 1.
Table 1: Summary of Narrative Elements.

<table>
<thead>
<tr>
<th></th>
<th>Story (Wood)</th>
<th>Discourse (Krygier)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atlas Design</strong></td>
<td>• Plate organization</td>
<td>• Incorporated World/Intertextuality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Legend</td>
</tr>
<tr>
<td><strong>Individual Plate Layout</strong></td>
<td>• Use of arrows to encourage linear movement across the page</td>
<td>• Use of written text</td>
</tr>
<tr>
<td></td>
<td>• Narration of events as they occurred</td>
<td>• Linked products (landscape illustrations to map, map to text)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Extent of their experienced landscape</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Projection</td>
</tr>
<tr>
<td><strong>Cartographic Language</strong></td>
<td>• Arrows and dates</td>
<td>• Narrative voice</td>
</tr>
<tr>
<td></td>
<td>• Hue</td>
<td>• Typography</td>
</tr>
<tr>
<td></td>
<td>• Expedition path</td>
<td>• Points and symbols</td>
</tr>
<tr>
<td></td>
<td>• Themes</td>
<td>• Hue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hachuring</td>
</tr>
</tbody>
</table>

The story component of the atlas was developed in the atlas design, individual plate layouts, and cartographic language. In contrast to the discourse component of the narrative, which is based on nineteenth century representation forms, the story design components are based on the interpretation of Wood’s (1987) notion of the atlas as a narrative form, and on the way in which atlas organization and cartographic language can be used as a means to this end (Pearce, 2008a). In general, the story was developed in three components of the atlas: the description of the survey route and the main events of each day, the incorporation of observations and illustrations produced each day, and the locations of each evening’s campsite. The representation of these components was
developed through innovative cartographic techniques in the atlas and maps, and are further outlined in the following section.

4.4.1 Story

First, the story of the expedition itself was developed through the overall organization of the atlas’ plates. This included the organization of individual plates in a chronology that works to develop the story as the reader turns the pages. The expedition moved westward, so each spread, with two exceptions, is to be read from right to left instead of the traditional western left to right. The exception is the circular movement of plate 6, *From the Great Salt Lake to the Round Prairie*, where the expedition moves from Salt Lake eastward through the mountains and then back again along the same path. The second exception is plate 5, where there is a pause in the action after the tragic event; this plate divides the atlas into two main parts to highlight significant events: Gunnison’s death, the resumption of the expedition under Beckwith’s command, and the arrival of the artist topographer Egloffstein. This directionality is explained by the table of contents which shows the reader from the outset where each plate fits and should be read within the context of the others.

Second, the story aspect was further developed through devices in the layout of the individual plates. To move the story along, arrows were used sparingly to signify movement through both time and space. The narration of events also developed a sense of progression as the story unfolds in each plate. This narration, when possible, refers to observations and measurements taken as well as the illustrations made by the party members, which serve the development of the story component. In order to create a
narrative voice to tell the story of the expedition, the texts of the original report were interpreted and condensed into the most interesting events that took place.

Third, the story component of the narrative was further developed through the cartographic language of the individual maps. Point symbols indicating campsite locations were used to develop chronology within the plates, and the sequence of events were reinforced by the date labels of these campsites (figure 6). Hue also played a significant role in the symbolization of the story aspect. Slate blue was used to represent Native elements (discussed further below), sage green to represent scientific data and linked illustrations (Egloffstien’s cartographic language), and dark brown to represent the elements associated with the expedition path and story narration. Brown links the texts and the expedition path, so the reader can follow the story and path through the plate and green links the scientific data, images and locations (figure 7). Lastly, a “start” arrow outside the neatline of the plates was used to guide the reader to the beginning of the expedition path on each new spread.

Figure 6. Campsite Locations and Date Labels.
Finally, early on in the process of making the atlas, the significant role of Native peoples in the exploration of the American West became apparent. As a result, it seemed necessary to represent Natives as a separate theme within the narrative, both by differentiating Native features included in Egloffstein’s maps and by interpreting the texts to create and locate symbols related to Native events and geographies. These distinctions were made through the use of a slate blue hue, so the features of the theme could be easily located in the map. For example, the symbolization of native guides, as interpreted from the text descriptions, and their placement at the date where they joined the expedition, allows the reader to see the significant role Native peoples played in guiding the explorers across the west. The farms and villages that the men passed and mentioned in their reports, but did not care to symbolize in their maps (only Christianized villages were symbolized), were also symbolized and included at the locations they were mentioned in the text (figure 8). Features labeled in the maps with original Native names were also differentiated from the non-Native features in the map, using the original maps and texts as a reference (figure 9).
Interactions with Native peoples played a significant role in guiding the explorers across the desert and were also included as a significant component of the texts for each map. For example, many of the most interesting portions of the text were narrations written about the explorers’ encounters with the native peoples who they met along the way. These included extensive description of the Native’s appearances and habits, and events in which Native peoples were involved; for example, one evening the party was joined by more than twenty Natives by their campfire where they passed the night together.
4.4.2 Discourse

The discourse aspect of narrative was incorporated into the atlas design and the individual plate layouts according to my analysis in 4.2 (above). In contrast to the story component of narrative, which was based on my interpretation of Wood’s (1987) theorized narrative atlas and how atlas organization and cartographic language can be used as a means to this end, the discourse component was developed from my interpretation of Humboldt’s data design formats as well as the design of the Pacific Railroad Reports themselves, and the cartographic and artistic style of Baron von Egloffstein. To develop discourse, I focused on retaining the historic voice of the explorers’ products and presenting these products in the same format, only in this case, within the single map. Developing the discourse component within the components of the atlas demonstrates how the story was being told and represented, how the explorers recorded and presented findings to reflect their interpretation of the landscape, and how they wanted the public to view the landscapes of the West. The historic voice of the expedition reports was preserved within each of the atlas components, as further outlined in the following section.

First, discourse was developed in the overall design of the atlas. The original intent of the Railroad Reports was that their contents be viewed in context of one another in order to reflect the form of the incorporated world of the American West (to produce what was thought to be a more objective form of science). This intent is replicated in the atlas structure. The atlas combines the products of the expedition reports with new original works in an incorporated format to further develop the discourse. It works both as an
integrated whole, to provide a general idea of the expedition and its products, but also it can be broken down into individual but interrelated maps to allow specific comparisons between products and locations.

To introduce the reader to the discourse of the atlas, a legend was included explaining and displaying the ideas behind the idea of the atlas’s content, layout and design (figure 10). In this case, the legend had three functions: to describe and illustrate the way in which Egloffstein’s cartographic language is incorporated into the atlas, to explain how text, image and symbol are included in each plate, and to demonstrate how to read each plate to follow the narrative of the atlas as a whole. To illustrate the use of Egloffstein’s cartographic language, the legend included a comparison of his original symbols to the interpreted symbols, as well as the new symbols created for themes not featured in the original survey maps. The layout of the legend’s two plates mimics the layout of the atlas plates, so the reader can begin learning how to read the format of each plate from the outset. For a complete list of plates see Appendix A.

Figure 10. Legend.
The discourse aspect of narrative was also developed in the layout and content of the individual plates. First, the choice of projection for each plate was drawn directly from the report document itself, the polyconic method. According to the report, Egloffstein used the tables published in the report of Professor A. D. Backe, Superintendent United States Coast Survey of 1854 to calculate the projection values to produce the maps (Volume XI, page 92). The polyconic projection was therefore used for the atlas in order to retain Egloffstein’s technique.

Second, historic design features in the atlas plates were drawn directly from the design of the expedition maps. For example, the inclusion of lines of latitude and longitude and the labeling of the associated degrees outside the neatline of each map, as well as the format and content of each map’s title and scale (figure 11), were based on my interpretation of those used by Egloffstein.

![Figure 11. Scale and Lat/Long Degrees.](image)

Third, the landscape extent for each plate was also drawn from Egloffstein’s cartographic language. Only the areas explored by the men were shown in detail by Egloffstein; all other areas were shown as empty places in the map or in outline form.
For example, if they knew there were mountains in the distance, but they had not measured them, they would appear as an outline in the map. This same idea was mimicked in the atlas plates, where only the extent of their experience and representation is shown within the chosen frame.

Fourth, the original report document linked each component (map, illustration, and written report) in order to create an integrated whole for the viewer. This same relationship was maintained within the individual atlas plates, which connect illustration and text with location to create spatial locations the map; in Egloffstein’s maps and lettering and numbering systems connect locations on the expedition path with the corresponding illustrations from the volumes. Dates and labels at campsite locations, while functioning as aspects of story by marking the chronology of events, also have a dual function as discourse, because the same location-linked system was used in the expedition report (figure 12).

Figure 12. Linked Format of Maps.
Lastly, discourse was incorporated in the individual plate layouts. Through narrative voice, the story is told from the perspective of Egloffstein, the producer of the survey’s beautiful maps and illustrations, using Gunnison and Beckwith’s accounts of the expedition as an information source. Therefore, because Egloffstein only joined the expedition in Salt Lake City, about halfway through the trip, the first half of the atlas is written as if he is imagining what happened to the men before he joined them. When he arrives (these arrival events were drawn from Krygier’s thesis) the voice switches to the first person, and he continues to narrate the story until the end as if he were present. Egloffstein’s point of view can be seen in the way the story is told. For example, on the first leg of the expedition, when he had not yet joined, he describes the situation as: “the men did not make significant progress on the trail that morning;” later, when he was present, he describes the situation as, “we progressed along the trail with ease this morning…” This makes the change in point of view easily identifiable for the reader.

The discourse component was also developed in the cartographic language of the individual plates. Here, the cartographic language sought to mimic the language of the original maps in order to present the products of the expedition in Egloffstein’s mode (figure 13).
First, point and line symbols were created that closely resemble those in the original survey maps. For example, symbols for cities, forts, settlements and campsites, as well as the state boundaries and lines of latitude and longitude, were created to closely resemble those found in the original maps (figure 14). The symbol for the expedition path was also represented similar to that of the original maps; however, in order to create hierarchy in the maps it was made thicker and colored dark brown to match the hue of the texts and move the reader through the plate.
Second, the typography of the original maps, including the typeface choice, size, placement, and hierarchy, was preserved in the atlas maps. This included the labels for natural features, roads, point feature labels, and the narrative texts as well as the lettering and numbering of the linked illustrations. Each of the elements was represented in Egloffstein’s cartographic language, and the discourse of hachure, symbols, and type are indicated in the atlas through the use of grey.

Lastly, topographic hachuring was used to represent the landscape as it was represented in Egloffstein’s original maps. Terrain representation was seen as the most important factor in potential railroad location, so mimicking their techniques in order to produce a similar landscape was important.

Automated methods were researched at the outset, but as a comparable method could not be found, the hachuring techniques for this era were researched and learned until a similar result could be produced. However, in order for the maps to remain accurate, current data were used to guide the rendering of the landscape. This process is described in detail below.

The first component was completed in ArcMap®. First, a projection was chosen and the central meridian of -96 and latitude of origin at 40 degrees was determined. These were determined based on the total extent of the survey area between degrees north and west. A 3ArcSecond NED DEM was then downloaded from the Seamless Server, provided by the United States Geological Society (USGS), which covered the entire extent of the expedition path (figure 15). Water features and state boundaries were also
downloaded for later use (from the USGS National Atlas, including, waterbodies, states, parkways, and rivers and streams). Slope was run for each DEM in the set and classified using Natural Breaks. This classification method produced the most distinguishable representation of slope values in the landscape; others made the landscape either appear too flat or too exaggerated (figure 16). Before these files were exported to Adobe Illustrator®, a grid of lines of longitude and latitude, scale, and north arrow were added for later use (figure 17). In order to preserve the resolution of the images, multiple extents were exported to Adobe Illustrator® and tiled together to cover the area of the two-page spread (figure 18 and figure 19). These images were then printed to size (with the map area at 13.5" ×10.5") on 11"×17" sheets of paper and labeled according to their plate name. Using the original survey maps, the features to be included within each extent were then marked in colored ink so they could be easily differentiated later in the hachuring process (figure 20).

Figure 15. 3ArcSecond DEM.
Figure 16. Slope.

Figure 17. Water Features and State Boundaries.

Figure 18. Single ArcMap® ExportExtent.
Using Lehmann’s hachuring technique (Imhof, 2007) and the original survey maps as a reference, the landscape was drawn on drafting vellum using the DEM beneath as a reference. At the outset, a sample sheet of landform depiction styles was created to aid the process (figure 21). As the project progressed, however, these styles were eventually learned and could be done freehand. In general, as described above, hachure lines were drawn closer together over areas of steep slope and further apart over areas of gentler slopes (figures 22a, b). Once completed, the drafting vellum pieces were scanned in
Photoshop and re-imported into the original slope export files in Adobe Illustrator®. Here the scanned images were rectified to the original DEM’s to preserve the accuracy of the associated scale, north arrow, and lines of latitude and longitude. The lines of latitude and longitude had to be cut and split so the two sides of the image could be offset for the gutter without losing any of the landscape. The old slope images were then deleted from the files, leaving the hachured slope as the basemap (figure 23). Remaining map features were then added to the basemap, with the cartographic language developing as each feature layer was added. This process resulted in about 20 hours of work total per plate, which included the condensation of report texts, and development and symbolization of cartographic language in the maps (figure 24).

Figure 21. Sample Sheet for Landform Depictions.
Figure 22a. Hachuring Process.

Figure 22b. Hachuring Process.
4.5 Elements of the Novel

Section 4.4 of the methodology describes the structure of the atlas according to the elements of the novel. As Wood (1987) envisioned a narrative atlas that would “read like a novel,” the novel’s elements were formally considered and developed in this project.
These elements include characters and point of view, plot and structure, and theme and conflict. The development of each is outlined below.

4.5.1 Point of View

Point of view is particularly important because it determines how elements of the novel will be shaped including how the story will be told (Madden et al. 2006, 91). Within the atlas, the point of view was developed in the narrative texts of each map, to tell the story of the expedition as it progressed. To emphasize the significant role Baron von Egloffstein played in visualizing the landscapes of the American West, he was chosen to narrate the expedition (including the maps and illustrations for the Gunnison-Beckwith survey). Choosing Egloffstein as narrator of the expedition also allowed the details of his biography (the relatively little that is known of him) to be included in the atlas.

Contemporary novels are generally written in either the first person or from an omniscient point of view. Depending on the choice of viewpoint, different effects can be achieved (Madden et al. 2006, 90, 94). In order to develop greater intimacy between the reader and the narrative, Egloffstein’s voice was cast in the first person. This allows the reader to see and experience the events as the narrator does and produces a window into the character’s subjective thoughts. Because the narrative texts were based on Gunnison and Beckwith’s original report texts, written in the first person, an omniscient viewpoint could not have been created without fictionalizing some of the other character’s thoughts and feelings. An omniscient narrator would have been able to explain what was going on.
in different locations at the same time and would have been able to read the minds of the many atlas characters, which would have been impossible to write based on the available materials. In this case, recasting the texts in the first person voice of Egloffstein allowed for an unbiased representation, because he played no part in writing them.

Point of view can also be developed by the author through how the story is told, whether it is being shown in the actions of the characters, or told directly in a summary, presents the material differently for the reader (Madden et al. 2006, 92–93). In the atlas, the story is summarized before Egloffstein’s arrival through his interpretation of the materials collected by the former cartographer and artist for the survey. The illustrations and maps were produced from the work of someone else, so they lack the detail of the direct observer. When Egloffstein eventually joins the survey, he begins showing the reader the events taking place through a more intimate and detailed representations of map and illustration. The illustrations in particular allow the reader to view the landscape from his perspective, which work to show the landscape of his experience.

4.5.2 Plot

The plot or story is the basic outline of events that take place in the novel. A conventional plot includes a beginning, middle, and end, and a major conflict or an intensified event, which is often resolved in the end (Madden et al. 2006, 122–123). Plots can also include other elements, like changes in narration style, the development of sub-plots and multiple plots, and foreshadowing, which produce more interest for the reader. It is no longer necessary for the modern novel to follow this structure, or include
each of these elements, for there are many novels that diverge from this format and are still considered successful works (Madden et al. 2006, 124). Installing some of the key elements in the plot, however, will help keep the reader engaged and interested in a narrative that might otherwise be just an everyday sequence of events.

The atlas does not follow the conventional format of the novel, but several elements of plot can be found in its content and structure. Though the expedition story follows the real life events recounted by Gunnison and Beckwith, a structured beginning, middle, and end were naturally developed in the plotline. The original survey report already featured an introduction of characters, events, and purpose, so these were easily incorporated into the narrative texts and introduction pages of the atlas. These texts also naturally formed a beginning, which helped orient the reader before the men began their expedition across the west. The middle of the story was easily signified in the atlas both through the events taking place in the text and the events’ graphical representation in the maps. Captain Gunnison’s death and the expedition’s halt in Salt Lake City for the winter clearly marks the middle section of the story. This was developed in the texts, which included a summary of business conducted during their winter stay in Salt Lake City, an introduction of the arriving characters and a short introduction to the final leg of the expedition. The middle of the story was also marked graphically by using the maps to split the expedition into two halves. This was followed by a blank page summarizing the death of Gunnison marking the end of the Part I, and a map of Salt Lake City, in order to create a pause for the reader, as the men are pausing in the middle of their expedition. From Salt Lake City, the men continued west to California where they completed their
expedition. The original reports included a short conclusion which naturally produced, in combination with outside materials, the ending of the story.

The table of contents in the first pages of the atlas was included to orient readers and give them a preview of the plotline. This table of contents was designed to reveal the main events to the reader in order to keep them oriented, so they can pay closer attention as the details of the story unfold without becoming lost in the atlas.

A conflict or intensified event usually adds excitement to the story and is expected by the reader as a conventional element of a novel’s plot; this main event can happen anywhere in the story and usually comes to a resolution by the end (Madden et al. 2006, 123). The main conflict in the atlas occurs with Gunnison’s death at the hands of the Natives just south of Salt Lake City, Utah. Usually the events of a story lead up to the main conflict somewhere near the end, but occurrence of this event relatively early on in the plot of the atlas, allows the reader to concentrate on the details of the remainder of the expedition. Gunnison’s death never sees a resolution, however, the men are able to regroup and continue on to their destination, which gives the reader some closure on the events that have taken place.

The plotline can also be improved by changing how events are relayed to the reader throughout the story. Switching between the simple retelling of the story and the character’s reaction and reflection on the sequence of events, for example, is a technique to keep the reader’s interest engaged in both the events and the character (Madden et al. 2006, 123). The events of the atlas were summarized by the narrator in most cases. When the men met settlers or Natives along the way, however, the narrator’s opinion
expresses what he saw and experienced. This method was used to create greater intimacy with the reader, for they are able to view the people and events through the eyes of the explorer during this era. In the reports, for example, when the men met Natives along the way, the Natives were generally described in terms of how Christianized they were, the unchristian being viewed as “wretched savages.” By repeating this language in the atlas narrative text, the reader can become more familiar with how the explorer’s viewed the natives during this time.

Sub-plots are a technique which progress alongside the main plot, and either work to complement or distract readers from the main sequence of events (Madden et al. 2006, 123–124). Several sub-plots can be seen, ranging from developed to partially developed, in the texts and symbolization of the atlas. The Native theme became the most well-developed subpot in the atlas; Native geographies and encounters are symbolized within the atlas in an exclusive hue and highlighted in the narrative texts. The reader can easily follow the Native subplot through its graphic and textual representation as they make their way through the main plot of the expedition.

A double plot including previous and concurrent surveys was also developed within the atlas, although only partially. The reader is made aware of the other three surveys proceeding in the same direction with the same purpose, but these are not developed any further within the content of the atlas. John C. Frémont led several expeditions of the same region, which are mentioned in the atlas. A number of men on the Gunnison-Beckwith survey were a part of Frémont’s failed survey of the San Juan Mountains in 1849, which is only briefly mentioned in the atlas when they pass this point. Egloffstein
also joins the Beckwith survey after leaving another of Frémont’s troubled expeditions which ended several hundred miles south of Salt Lake City where he joined the men. I developed these plots, if only in a minimal manner, as an interesting aside of events to contextualize the characters and their role in other surveys during this era.

Plots can be enhanced through the foreshadowing of events to come; this is most often done by planting clues which can give a signal to the reader (Madden et al. 2006, 107). Within the atlas, I foreshadowed Gunnison’s death. The reports Gunnison himself receives when he rides to the San Pete settlement to hire guides for the next leg of their journey make it clear to the reader that the men are in danger. Here he finds the settlement condensed into the central buildings for protection against the hostile Natives who have recently attacked them, stealing their goods and driving off their livestock. The obvious hostility of the Natives in the story is, however, completely ignored by the explorers who do not see it as a threat. It is easy for the reader to see the men are in dangerous territory and that some unfortunate event is on the horizon.

4.5.3 Character

Characters are developed in the novel through their actions, words, and how they react, feel, and are changed by events through the course of the novel (Madden et al. 2006, 101). The ability of the reader to feel empathy with the characters is developed in these various aspects, and is said to largely determine the success of the story. I recast Egloffstein in the first person to allow the reader to become more intimate with the experience of the narrator. Reading the story from the point of view of someone who
was present at the event creates a much more intimate experience, especially in the instances where they are experiencing hardship, with the character. The narrator’s description of events and interactions with people the party met along the way also allows the reader to become intimate with his thoughts (even though they are the thoughts of those who wrote the reports) and view the world from his perspective.

4.5.4 Conflict

The development of minor conflicts helps energize the sequences of events in the novel. These conflicts are hierarchical; for example, there can be major recurring conflicts, or many minor individual conflicts, both of which arise and resolve themselves during the course of the novel (Madden et al. 2006, 106). In the atlas I developed several forms of conflict in the plates which occurred during the expedition. The first was the recurring conflict of human verses nature. As the men make their way across the American West they were in constant conflict with the natural forces that greet them; this includes the landforms, but also the weather. When conflicts arose, for example, when the men were forced to cross a rapidly rushing river with their wagons, interest and excitement are inherently produced for the reader. These conflicts are eventually resolved on their own when the men reach the flatland and can again travel with ease.

The second major conflict in the story occurred when the men meet the natives, beginning with Gunnison’s death and continuing with the party’s recurring encounters along the expedition path. The Gunnison conflict was so major that it reshapes the remainder of the expedition, although the recurring conflicts are more subtle. With each
meeting along the trail, tension arose between the party and the Natives, even though it is only caused by the two party’s unfamiliarity with each other. In most cases the Natives are afraid of the survey men; they either are stricken with fear, run and hide, or watch them from a distance for some time before approaching them cautiously. The outcomes of these encounters, at least as they are described in the report, were always peaceful; the men generally shower them with gifts from the east or leave them happy after trading goods with them for horses. Smaller conflicts also arose occasionally between the men on the survey. For example, on several occasions, there were disagreements amongst the men which resulted in discharges from the survey. I included these smaller, more frequent conflicts to add excitement to the story by creating a dynamic between the expedition characters.

4.5.5 Time and Space

A novel’s characters and events take place within a time-space matrix: these elements are developed through the techniques of tense, setting, atmosphere, and creation of tension in the novel (Madden et al. 2006, 108).

Tense can affect the intimacy that the reader feels with the characters in the story (Madden et al. 2006, 108–109). I wrote the narration in the past tense. I did not include dialogue among characters, a common method of regaining intimacy with the reader when narrating events long past. Instead, the dialogue between characters merely is described; for example, when the men leave the main party and travel to a settlement in search of a guide, they spend the night with a family of settlers. In this case, the
interactions and conversations between the characters are described, and even though I did not use direct quotations, the reader is still allowed into the conversations.

Setting, including the time and place where events occur, is also an important element in defining the novel. Time, as a component of setting, is understood as the actual time period when the events are took place, and it shapes what and how events play out in the story (Madden et al. 2006, 111–112). For example, the expedition takes place in the 1850s, so the story is significantly influence by the technology and understanding of the West during this era.

Place, as an element of setting, refers to the location of events and how this location is defined and shaped by the characters, and, in turn, how they are shaped and defined by it. Place plays an important role in the development of the setting, because it can act as either a backdrop to the story, or it can have a more porous role as an interactive part of the story (Madden et al. 2006, 111–112). Within the atlas, I developed place as both simple graphic backdrop across which the characters traveled and as an interconnected piece of the narrative, developed through interaction and conflict. The relief of the landscape represents the nature against which the men spend so much time and energy struggling, so it plays a significant role in shaping the narrative of the atlas. The symbolization of the data collected in the map also links the setting graphically to the narrative. For example, when the men come upon an area of abundant water, this element of setting is symbolized through both its representation as a river or stream in the map and through a scientific symbol chosen to mark these locations. The graphic
representation of the landscape links the setting with the narrative and helps the reader visualize the events of the story and link to the landscape.

Another element that lends itself to the novel is the development of tone within the narrative. Tone is an element deliberately produced by the author and conveyed through the character’s attitude (e.g., sad, tragic, or happy) (Madden et al. 2006, 112–113). The interpretation of the expedition reports and their recasting through the first person voice of the topographer for the route, produced the tone of the atlas texts. Atlas plate extents were chosen to highlight the particularly dangerous or strenuous sections of the expedition and areas featuring interactions among characters, like settlers or Natives they met along the way. Shaping the narrative by consciously choosing which texts would be included helped set an exciting and eventful tone for the story. Recasting these events using Egloffstein’s voice helped further develop this tone, allowing the reader to experience the events through his response.

Another important element in the time/space matrix of the novel is the development of tension. Tension is created when two conflicting elements in the story work to draw the reader in different directions (Madden et al. 2006, 113). In the literal and metaphorical sense, tension is created in the atlas in both the story and in the graphical representation of the events. The representation of the report products in the maps alone causes tension for the reader as they move through the various elements (images, symbols, and landscape representations) and are forced to make sense of the pieces as linked representations. Tension can also be seen in the use of both digital and hand-drawn techniques of the cartographic representation. The unconventional use of both
technologies in the same map causes a conflict for the map viewer who is accustomed to seeing the use of either historic or contemporary forms, but not their combined use.

4.5.6 Structure

The events of a novel are generally broken into structured parts, chapters, and scenes which create more easily understandable pieces for the reader (Madden et al. 2006, 125). The decision as to where these pieces would begin and end and how each piece would be shaped worked well in the atlas. The events of the expedition broke the atlas naturally into two main parts, and these two parts were easily broken down further into the form of chapters represented within each two-page spread. Each chapter was chosen to highlight the most interesting events and products of the expedition, so the reader would not have to wade through many dull events before reaching the interesting ones.

The parts and chapters of a novel are further structured to feature a beginning, middle, and end. In this project, the expedition was naturally structured with a beginning, middle, and end, so the atlas as a whole inherently followed this same structure. These elements, however, had to be actively developed within the parts and the chapters of the atlas through an interpretation of the report texts. From these texts, an introduction or exposition was created to orient the reader in each new part or chapter, narrative texts for each day were created for the plates, and conclusions were created to inform the reader of what happened to the men when they left the map.

Each chapter (two-page map spread) was further broken down into scenes, which were emphasized through episodes, situations, or panoramas. In the case of the atlas, the
use of panoramas in both the texts and images drew the scenes of each plate together. Each map includes at least one scene describing one of the explorers looking west towards their destination or east to where they have been. This has the effect of pulling back from the story to bring the strands together and provide a wider view of the events for the reader. This is also seen in the panorama illustrations; Egloffstein has meticulously reproduced the details of every distant peak in a panoramic format, so that more of the landscape can be gathered into one view than is possible for the human eye to view at one time. These views pull back and give the reader a broader view of the physical landscape the men have experienced and will experience, but also work to reiterate and recapture what the men have experienced in one frame. Creating this distance from the landscape also produces a moment of omniscience for the reader and this is probably what they were trying to produce in the reports, humans trying to conquer nature through science.

Pace and rhythm work in the structure of the novel to regulate the plot. Purposefully pacing readers to slow them down, for example, through the writing of long passages, or accelerating the pace of the story, through shorter more concise passages, can affect how emotions and tensions build in the narrative (Madden et al. 2006, 130, 135). Within the atlas, pacing was produced graphically through the symbolization of events. For example, when Gunnison’s death occurs, there is a flurry of activity near that location in the map, symbolized though many texts and many arrows leading the reader in all the directions that the men suddenly took as they scattered up and down on the expedition path. The pace is quickened and a sense of urgency and confusion ensues within the
map. Devoting a single map to Gunnison’s death also focuses the reader in the flurry of the event. Directly after the event an entirely blank page has been added to bring the readers to a stop after all the drama so they can have time to reflect on the events that have passed.

The slow pace of the events was also graphically shown in the map; areas of little activity are often empty and ‘look slow,’ representing a lack of activity for the reader. The expedition spent an entire winter in Salt Lake City, so the plate representing these events was produced specifically to slow the reader down. The plate is empty except for a focused area on the city itself and only contains a long narrative about how the men occupied themselves over the winter and how Egloffstein was able to join the expedition.

Text also paced events in the map; in areas with many events or conflicts, there are many text areas that work to slow the readers down and promote concentration on that section of the map, and, in contrast, areas with fewer events and fewer campsites (because the men could travel quickly over the flat land) have fewer texts allowing the reader to read more rapidly through these areas.
CHAPTER 5: RESULTS

This section outlines the results of the theories and methods employed to produce the atlas according to the original set of research questions. The first section addresses the general question of whether the narrative atlas has potential uses for producing historical expedition atlases, and the following sections address more specific questions about the outcome of the process and techniques employed in its production. The second section addresses the issues of producing an atlas as a sequenced set of maps that work together to produce a narrative. The third section looks at structuring the narrative in the language of the nineteenth century explorers. The final section addresses the cartographic techniques used to produce a structured narrative within the individual maps. Please refer to thumbnails for atlas plates for overall reference in Appendix A.

5.1 Does the atlas as a narrative form be developed for the production of historical expedition atlases?

The product of this research clearly illustrates the potential application of narrative for the production of historical expedition atlases. The results of research question one are outlined below.

In order for a narrative to be produced, the traditional format of the reference atlas was broken, and in so doing a new format emerged which allowed the expedition story and products to be read as a novel. Instead of simply arranging the images, maps, and text within each page’s grid, I combined these atlas elements into an integrated narrative that worked to tell the story and display the products of the expedition using the historical
voice of the nineteenth century surveyors. Narrative form did not come about from the outset, rather, it came about through the exploration of atlas design and cartographic techniques.

Creating a narrative atlas also promoted the combination of materials, stories, and landscape representations, using the historic voice of the surveyors, into a single map. The combination of these materials produced an engaging graphic narrative for the reader. By viewing the landscape through various formats, and reading the description of events as in a novel, the narrative is allowed to unfold further in an unexpected way. In contrast to the novel, which contains only words, or the reference atlas, which does not link description to maps, the narrative atlas uses a combined representation of narrative elements to help the reader conceptualize and visualize the expedition is space.

5.2 Can an atlas of maps be organized to be read as a story, rather than as a reference, without sacrificing the data-rich quality of the reference book?

An atlas of maps sequenced in a way that allowed them to be read as a book, without losing value as a reference material, was achieved through design and cartographic technique. This was achieved through the sequencing of maps, individual map design and symbolization in the individual maps. The results of research question two are outlined below.

The resulting atlas allows the reader to turn the pages and read the story as if they were reading a novel, allowing the readers to make their way through the sequence of events, while observing the spatial and temporal data of the map. Data observations were
displayed in each map as if it were a reference map, but also to help tell the story, so the reader can move sequentially through the narrative of multiple perspectives and data formats.

The resulting maps are equally as rich as reference, perhaps richer through their variety of representation forms. Even though the reports were greatly condensed to produce the atlas, the individual maps are nevertheless extremely data-rich. When people think of reference maps, they think of the map being limited to the representation of a small number of themes. For example, a country map is generally limited to the representation of landforms, water bodies, and feature and place names. These features, by themselves, are limited in their ability to produce narrative. The narrative atlas, however, produced a variety of themes in one map, through application of elements of the novel.

The atlas was intended to be structured as a novel, but not all elements of the novel lent themselves to mapping. As described in Section 4.5 above, the elements of point of view, plot, character, conflict, time and space, and structure worked well in the atlas. Other elements, such as theme or truth, style, symbolism and imagery, did not find a place.

Producing the sequence of maps to promote the narrative structure of the atlas became reliant on several atlas features to make them understandable to the reader. First, a detailed legend and an overview map-table of contents, had to be included so the reader could understand how the plates were sequenced. In this case, difficulty in orienting and teaching the reader how to make their way through the maps was the greatest challenge.
This required the development of symbolization in the maps, particularly the arrows at the beginning of, and along the expedition path, so the reader could easily see the overall direction of the survey on the page from the map overview. This helps readers stay oriented in the map as they move through the details of the page. The sequencing of texts and the dates associated with the texts also complemented the sequencing of the maps. Texts were written and placed in the map according to the sequence of events that took place and because of this work to create a sequenced novel effect. These texts also work to link the elements together within the map; texts link description of data collection experience to the pieces of data represented in the map (illustrations and observations made by the men). Overall, the reader can experience the landscape in a sequence (and the elements of the narrative work together to produce the explorers’ experience), unlike a reference map, in which the reader can start anywhere and does not acquire a sense of the explorers’ experience.

5.3 Can this narrative atlas be structured using the cartographic language of nineteenth century topographic explorers and use their method of incorporated maps, illustrations, and texts?

Structuring the atlas as a narrative resulted in an atlas that not only tells the story of the events, but also presents these events in the cartographic language of the topographic explorers. This language is known for creating an “incorporated world” of text, map, sketch, and table, intended to be read together in order to tell a complete geographical story (Krygier, 1997). In the atlas, rather than merely compiling these elements as
separate sections, I created the idea of an incorporated world within the spaces of the individual plates. To do so, I developed techniques for both story and discourse. The results of research question three are outlined below.

5.3.1 Structuring Story

Within the individual atlas maps, the narration of events, the products and observations from each day’s survey, and the locations of each campsite worked to build the chronological development of the story. This chronology was also complemented by the use of symbols, for example, in the use of arrows to denote the beginning of the expedition party’s path in each map. A combination of these elements in both atlas and maps resulted in a sequence of maps that worked to create the story component of the narrative.

Developing the story component through symbol was explored during the mapping process. There was initial difficulty in drawing the reader through the story in the maps, but this was graphically solved through symbol including hue, text blocks, and the conversion of observational data to point symbols. In each map, arrow, date, and line symbols are linked so the reader could easily associate the pieces. Line, arrow, and text are linked by the color brown, and the campsite dates are further linked to the texts by date. These distinctions came about because of initial difficulty following the materials in a sequence through the map. My reluctance to lose the viewer resulted in a repetition of dates in the map, to help the reader follow the story, especially when space limited the
location of the text boxes (some had to be placed farther away from their corresponding event locations in the map).

The symbolization of the survey products (including data tables and profiles) within the map worked well to show the viewer the products associated with their location on the landscape. Their symbolization, however, was difficult purely because there were too much data associated with the survey. At the outset more data were to be included from the charts and tables of the reports (including the charts themselves) as well as the extensive profiles of the expedition route. When other elements of the map were added (texts, images and topography), it became apparent that adding more data elements would be impossible. In the end, only those data included in the original maps and specifically mentioned in the texts were added to the atlas maps.

This compromise became true for the images as well. I attempted to add the greatest number landscape images possible; but some were, nevertheless, left out. The extensive volumes of flora and fauna images proved challenging to reduce enough to fit in the map. As a result, only the best images, mainly those in color, and a selection of the sketches were included in the maps.

Symbolizing the water and timber observations taken from the expedition texts seemed like a good idea at the beginning, but they became irrelevant as I proceeded through the maps. Whether water or timber was abundant or sparse, or was not mentioned at all, became relative to the party’s location. For example, in the desert, a small stream would be labeled as abundant, because comparatively it was, but the same
size stream in the Sierra, where water resources are quite abundant, would be characterized as scarce.

The use of hue to differentiate Native themes, particularly the Native landform names, played out in several ways. These were added to help the reader see the similarities and differences between the Native names recorded by the party and the contemporary ones in use today. The place names also draw attention to the locations by showing which features were significant and in the path of the survey party. They also highlight how Native geographical knowledge played a role in the naming and mapping of the West. They detail how original names were lost in renaming; both Native place names and explorers re-namings were later again. The latter, for example, can be seen in the Franklin Lake, later changed to the contemporary Ruby Lake.

5.3.2 Structuring Discourse

The development of the discourse component of the narrative resulted in maps that present the expedition as it would have been presented by the explorers themselves. This played out, just as the story did, in the overall design of the atlas as well as the individual plates. The atlas is an integrated whole of many individual maps which work to give the reader a general idea of the expedition and the products it produced. It allows the elements to be viewed in context of the others in the series, and the components of each map can, in turn, be viewed in context of each other.

Within the individual plates, structuring the discourse component further developed the idea of the incorporated world of the explorers’ representation technique. The
resulting maps incorporated the report materials into the new maps using the same location linked format. Illustrations were also linked to their locations using number and letter symbols so the reader could visualize the location from which the illustration was made. Incorporating observation, text, and illustration linked by location in the single map allows the viewer to see and understand each component within the context of the others, reflecting the format of scientific data designs of this era.

Presenting the information, data, and narrative allows the viewer to learn about historical data representation formats and geovisualizations of the early American West while also learning the story of the Gunnison-Beckwith Survey. The inclusion of these also helps the viewer visualize the landforms and personalize them, connecting the viewer with the place in the map through the multiple forms of representation.

Choosing which images to use, where to place them, and how to connect them to the location from which they were made in the map did pose some problems. The railroad reports contained more images than could possibly be included in each map, so only a selection of the best ones, giving priority to the landscapes, were chosen. The images were also difficult to fit in the map, without covering the illustrated landscape. Priority was given to the color images, because of their visual appeal and their popularity; these color images were one of the reasons that the reports were regarded as spectacular during this era when most printing was done in black and white. Other botanical illustrations were included.

There was also some discrepancy in the information associated with the images in the reports, which made some of them more difficult to add to the maps. The information for
each image varied greatly. For example, for some images an exact location and date was given, where as others had only a very general location (e.g., the “Sierra Nevada”) making it difficult to locate and label them in the map in such a way that would allow the reader to understand these discrepancies. As a result, I gave priority to including images (other than the color images) with exact locations and times simply so they would be more understandable to the reader and follow the format of the rest of the maps. Using the format of the original reports, however, gave me greater ability to include images in the plates, because they were labeled and associated with each location along the expedition path.

In the original reports, only the panorama illustration locations were symbolized using letters in the map. I carried this idea over to the regular format illustrations (associated by names of locations in the map) and used numbers to associate them with their locations on the expedition path. This was done with the hope that the reader would learn to look for an illustration somewhere on the page (often located near the edges of the map where fewer features competed for space) each time s/he came to a number or letter along the expedition path.

5.4 Can new cartographic techniques, informed by the technique of the nineteenth century topographers, be developed to support this narrative structure?

New cartographic techniques were developed in order to support the structure of the narrative within the atlas. This included the development of both digital and hand-drawn techniques to reflect the cartographic language of the nineteenth century topographer’s
techniques, producing a series of maps similar to their original style. The results of research question four are outlined below.

5.4.1 Combining Digital and Hand-Drawn Techniques

Combining a hand-drawn landscape with digital overlays produced a satisfying outcome, but the process of fitting the two together within the same map did not advance without meeting several challenges. At the outset, there was some concern that combining the technologies would not produce a cohesive final product; perhaps there would be some discord between the two techniques on the page. But this did not come about as expected. Instead, challenges developed as a result of the attempt to mimic the historic style of the original reports too closely. As explained previously, in order to maintain the explorer’s historic style, the symbology and typography used in the atlas maps were created to resemble those in the original survey maps. However, when this style was closely followed in the new maps, problems arose with both. First, the hachured landscape image was drawn in black, the original color of the era; as a result, the map was so dark that the other features and labels could not be seen on top of it. This problem was easily solved by making the image slightly transparent, which produced a much subtler background for the rest of the map. This had the unintentional consequence of causing the digital image to become too fair, so the original hue of the type and symbols (black) had to be altered as well. The type was lightened from a black to a shade of grey dark enough to stand out against the hachures, but light enough to sit on the landscape. This was the same case for the symbols sets; hues were chosen and, in almost
every case, considerably lightened for incorporation with the rest of the map. These alterations created better visual hierarchy among features and helped produce a more cohesive final product while still preserving the historic voice of the original maps (figure 25).

Figure 25. Comparison of Visual Hierarchy: Original map, *From Santa Fe Crossing to Coo-che-to-pa Pass*, Compared to a Detail of Plate Number 2 in the Atlas. Source: David Rumsey Collection.

An aesthetically rich product was created using the combination of the two technologies. First, the original expedition maps were drawn in black ink, which produced a beautiful representation, but one lacking in the visual hierarchy generally produced through hue, which viewers are accustomed to today. This became especially significant to the differentiation of the label texts and other symbols from the landscapes (figure 26). Using digital techniques allowed me to both create more hierarchy in the landform labels and use hue to differentiate the significant themes within the maps. For example, Native themes were developed in slate blue, so the reader could easily
distinguish the associated features from the other labels and symbols in the maps. In the original monochromatic maps, this differentiation by hue would not have been possible. Secondly, combining technologies also allowed the report’s beautiful color images to be incorporated into the atlas plates. The result was that, unlike the expedition report’s monochrome maps, illustrations could be included as fully integrated pieces (figure 26). Overall, the combination of technologies allowed a much richer and more compelling map to be produced.

Figure 26. Atlas Map Visual Hierarchy.

5.4.2 Inconsistencies in Cartographic Representation

In order to closely follow the cartographic language of the explorers, each of their symbols needed to be digitally recreated. While exploring their maps, I soon found that their methods of representation, aside from the relief representation, were inconsistent
throughout the map. I therefore standardized their language as best I could, so the reader of the atlas maps would not be confused by these inconsistencies. The resulting symbols are standardized and mimic their historic look while conveying the information in a consistent manner.

The same problem was found in the relief representation of their maps. I wished to use their method of representation, so I first studied their maps to learn how they represented the various landform types. I soon found that their hachuring varied greatly from the first maps, which were rather inaccurate and generalized, to the final maps, which were quite detailed and much more accurate. I therefore created a standardized method and went about hachuring the new atlas maps. Much to my surprise, I produced much the same result. The first maps I produced were too generalized, and although not very good, were quite true to the historic method. The final maps I produced were more detailed and much more accurate, but diverged significantly from their method, which was actually rather abstract. Overall, between these two outcomes, I was pleased with the hachure results and their capacity to reproduce the cartographic language of the nineteenth century relief representation.
CHAPTER 6: DISCUSSION

This research sought to produce a narrative atlas of a largely unrepresented historical subject. Producing an atlas as a novel revealed both the possibilities and limitations of the form. Using cartography to produce the narrative allowed the graphic representation of the narrative elements in both the texts and the maps, but their development was limited by the historical materials and my limited knowledge of writing and literature. The purpose of this discussion is to explore the outcome of the methods employed to produce narrative within the atlas.

6.1 Atlas as a Narrative Form

During the 1980s the narrative form was envisioned first by Wood (1987) and then by Harley (1987). Part of this original vision was breaking out of the traditional organizational structures (random or arbitrary), which are followed in modern atlases, to create a new narrative form (Wood 1987). They proposed that, instead of producing atlases as ordinary reference materials (Harley 1989), they should instead be designed and formatted with the purpose of engaging the reader in their contents, just as they would be in a film or novel (Wood 1987; Harley 1989). A short review of historical atlases showed us that they commonly feature a map (made using contemporary digital techniques and designs), a text box (describing the historical event), and are accompanied by historical images (generally either an original map or illustration) within each single page spread (Grossman 1998). Such formats rely almost completely on the original
images to add the historic content and voice, and other components merely complement
the original pieces with historical information. Overall, this common format displays
little cohesion and absolutely no narrative between the contents of each page; these are
simply displayed together wherever they will fit within the grid format. Drawing on
Wood’s (1987) and Harley’s (1989) ideas I was also able to break out of the traditional
atlas format.

In the development of the Gunnison-Beckwith atlas these ideas of form were brought
to life, but instead of merely sequencing the pages to produce a narrative as Wood (1987)
suggested, the narrative was further structured through the aspects of story and discourse.
The structuring of the narrative, formerly only explored in the single map by Pearce
(2008a) allowed the story of the expedition to be told in the voice of the nineteenth
century topographers. In this case, the story element was created to narrate the series of
events and the products of these events and the discourse element was created to
represent incorporated world of the nineteenth century topographic explorers. Data
representation during this era followed a Humboldtian format, as described by
exploration and data representation was particularly noticeable in the Pacific Railroad
Reports, which displayed observations an incorporated format (Krygier 1990, 1997).
These ideas were used to create the historic voice in the atlas.

The notion of a historical narrative atlas provided the perfect opportunity to break the
format of the traditional atlas and create a historical narrative through the presentation of
these components using the historic voice of the era. Conveniently, the original reports
provided the maps, texts, data, and illustrations, all of which were connected by location, which allowed for the easy combination of elements into the narrative of the single map.

This narrative can be seen at both the micro and macro levels within the atlas. The macro view, or global view, in this case the atlas as a whole, and the micro view, the individual plates, work to communicate complex ideas (Tufte 1990, 38). At both the micro and macro levels, unlike other historic atlases, a narrative is produced that works to lead the reader through the atlas of historically represented interconnected pieces. This narrative was developed in the atlas design, as an interconnected set of individual maps mimicking the incorporated style of the original expedition reports, and at the micro level within the individual maps, which incorporated materials in an interconnected narrative design.

6.2 Exploring Cartographic Techniques in the Atlas Format

Retelling the expedition through Egloffstein’s cartographic language was a significant part of producing narrative in the atlas and offered an excellent opportunity to develop new cartographic techniques. It became apparent at the outset that the first task in preserving the historic voice in the maps would be to reproduce Egloffstein’s method of landscape representation. An exploration of hachuring techniques employed during this era revealed that, though most cartographers followed Johann Lehmann’s general guidelines for hachuring, each cartographer had their own individual hachuring style. As a result, each map produced was unique. With this in mind, automated techniques were
first explored. When a suitable technique could not be found through automated methods, a hand-drawn method had to be developed.

Drawing on the cartographic techniques of the era, as discussed by Imhof (2007), I developed my own hand-drawn representation. To achieve this, I used the original expedition maps and Eduard Imhof’s (2007) hachuring guide as a reference. In particular, Imhof’s reproduction of Johann Lehmann’s hachure guide and accompanying description were useful for initially learning the method of this era. I soon found that, due to the unique nature of the expedition maps, which actually showed significant differentiation in hachuring styles within the four-map set, and time constraints, I would not be able to follow Imhof’s guidelines exactly for my maps. Instead, I decided that specific elevation accuracy would not be the primary concern for the landform representations in the atlas maps themselves. Instead, a hand-drawn representation was accurate enough for this purpose. The resulting landscape worked to translate a historical representation within the atlas, but required the combination of modern digital and historical, hand-drawn techniques (Photoshop® and ink) to produce the final maps.

The atlas’s obvious space advantage of over the single map offered it as an excellent venue to develop and test new cartographic techniques. The multiple page format allowed a great deal of space for features like the two-page explanatory legend and the ability to display repeated page layouts and symbol styles in a variety of contexts (see figure 10 above). In the case of the legend, there is no universal standard to define the visual vocabulary of each map, the legend simply has to work as a means of producing a common visual language for the symbols in the map to be interpreted by the reader
In order to produce narrative within the atlas, and have it be understood by the reader, it was particularly important to include an extensive legend to help the reader understand the atlas design and the cartographic language used in each plate. It was also important to the narrative that comparisons between the original cartographic and the newly developed cartographic languages be displayed for the reader. In contrast to the single map, where space is extremely limited, the atlas format allowed for a complete breakdown of symbols and design aspects providing the reader with a better ability to understand the narrative and historic voice intended to be provided by the atlas. The multi-page format of the atlas also had the advantage of allowing the reader to encounter map layouts and symbol styles repeatedly as they turn each page; this repetition allows the reader time to learn and understand the format and design of the atlas as well as the symbols. In comparison, the single map would only give the viewer one chance and one context to view the symbols and design features, instead of multiple contexts, were they can take on new meanings and develop greater understanding through their repetition.

6.3 Atlas Size and Data Density

Though the atlas had an obvious space advantage over the single map, space was still the main limiting factor when including report materials, particularly the texts. The fundamental process of choosing the materials included in each map and the scale of each frame was important for facilitating how the viewer reads and understands the materials. These choices were based on my interpretation of what would be of most interest to the
readers. In the case of the texts, only areas where the most interesting events took place (for example, where the party traversed a dangerous pass), were included in Egloffstein’s narration of the expedition. Illustrations were also chosen according to taste; all landscape illustrations had priority in the map (many flora and fauna illustrations were left out due to space constraints in the map) chiefly because I found them more important in depicting the visual aspects of the expedition. These decisions were largely dependent on the scale of the atlas.

It was immediately apparent that the entire expedition path could not be shown in the atlas; therefore, only the most significant areas were included. Areas with extensive descriptions, especially of the landscape, and many products, usually areas of high mountains or areas that had not been previously explored, were the areas more important to the survey. Negotiating these areas of increased data density became a question of balancing scale and extent, but still caused considerable difficulty in the final stages of atlas organization. The scale and extent were chosen based on an estimation of products per area in the map. However, in the early stages of atlas planning it was impossible to predict how long the texts featured in the map would be, so the plates quickly became overburdened when they were finally being produced. Obviously, the areas with the best and greatest number of products from the survey also had the most interesting texts and, for this reason, were very difficult to condense. As a result, some plates sparsely narrated while others had to be struggled with to squeeze the pieces into place.
6.4 Use of Symbol to Develop Story

The atlas also provided space for the development of the story component through symbol. In this case, symbols took on a new role within the atlas; including, for example, their role in guiding the reader/viewer through the sequence of events or taking on the new meanings found in the story themes. For example, the graphic representation of the observations made during the expedition as well as the location of each campsite also helped develop the story in the individual maps. The symbolization of the campsite locations worked to draw the reader through the map, while the symbolization of the observations data at each location allows the reader to associate observation directly with location. Native geographies were also symbolized from an interpretation of the report texts, instead of mentioning it in text component of the map. Symbolization of the story also draws attention to the significant themes and connects them within the map, so the reader can easily recognize them. This clever use of symbolization could also help to create a significantly richer map, which, though the symbolization may seem overly complex at first, can be better understood as the reader encounters the language through multiple pages of the atlas.

6.5 Elements of the Novel

Developing the elements of the novel in the atlas was largely successful, but was limited by both the content of the report materials and the form of the atlas itself. The content and nature of the report materials did not allow the further development of characters in the novel. First, the development of dialogue between characters was
limited by the text content and the desire not to diverge or fictionalize the historical facts when recasting them in the narrative voice. Dialogue works to bring the reader closer to the narrative, especially when it is being told in the past tense, but it was not possible to be further explored in this case. Second, the development of individual characters in the story, for example Lieutenant Beckwith, was also limited by the tone of the original texts. They were written in a passive scientific fashion, so only minimal particulars about the characters were described. Even with the purposeful inclusion of all texts describing any personal event, for example Captain Gunnison having an attack of his old illness, the characters in the novel are only silhouettes. Lastly, limited space in the atlas did not allow the development of significant subplots. Two were partially developed, but the graphic and textual representation of these in the atlas would have taken up too much space, so it was simply impossible.

6.6 The Historical Atlas and the Historical Novel

If the historical atlas is represented in narrative form, to be read like a novel, then is it the same as a historical novel? On one level, the historical novel is simply a novel set during a particular time period. This can be further defined in the sub-genre of the antiquarian novel, which simply uses the style of the period to present the events. But if one further defines it in terms of the classical form, defined by Georg Lukács in his 1932 work *The Historical Novel*, both similarities and differences arise.

The classical form can be characterized by a number of elements. First, these historical were written primarily by authors who believed history had been made by the
people who live it, so their novels were generally reflective of this idea. Second, the hero would played by indifferent characters in the story, this was usually someone who was not socially significant to history, and did not have a strong opinion about political or social matters going on around them. The hero was also not usually the sole subject of the plot, rather characters surrounding them carried the story as well, following the idea that people create history together (Lukács 1962, 38, 46, 59, 287). Thirdly, events are relayed in a compressed or intensified manner, so the story remains an incomplete report of the events that took place. The focus is given to the characters’ interior landscapes, for example, how they react to the events taking place around them, instead of merely retelling the series of events, so the feeling of what occurred comes through in the narrative (Lukács 1962, 40, 42, 59). Fourth, the story must be written in such a way that it allows the reader to believe the narrative is a part of their own prehistory. Fifth, the historical novel is different than a memoir, because it is not an intimate conversation between the character and the reader, rather, a method of revealing the historical past through a character’s experiences. Sixth, the belief that histories are made from the conflicts and interactions arising between the common people “below” and those historically famous figures “above.” Lastly, the classical form is characterized by an abstraction of figures that exist above, and dictate the lives of, those below (those who create the history through their direct experience) (Lukács 1962, 288).

The atlas is set during the nineteenth century and is told by Egloffstein the cartographer, as an indifferent hero. Though his work was central to the survey’s success, his role as narrator of the atlas was developed to reflect the idea that he is just
one of many surveyors creating the history of the West. Here Egloffstein does not symbolize the history of the west as an individual, rather, the characters as a group symbolize it together.

Histories are based on the telling of an incomplete series of events and the atlas was developed to reflect this idea. Events were condensed from the original report materials and interpreted to produce the texts and cartographic language of the maps. The choice of maps was based on the most exciting and difficult stretches of the survey, so the texts and accompanying materials (images and observations) are a condensed version of the original history.

An important part of retelling events according to the classical form is the recreation of the character’s emotional reaction to the events that have taken place. Within the atlas, this was accomplished in the most inferential sense; by describing the events and graphically displaying the landscape, the reader can imagine the feelings characters involved.

Most historical novels appeal to their readers’ interest in events which are part of each person’s prehistory (this idea is dated and Eurocentric because we all do not share the same prehistory). Having a shared history is important each person’s identity and helps us understand who we are and where we came from. The atlas was purposefully developed to appeal to those interested in the explorations of the American West and particularly the process of building the railroads in that sense, the goal is similar to the classical goal of the historical novel.
The goal of the atlas was also to portray history through retelling the reality of the men who lived it. Within the atlas this was easily developed because the survey was uneven and crisis-filled, just like everyday life. These events were highlighted in the cartographic language (for example, the crisis of Gunnison’s death) and in the texts (for example, those stories describing the coming and going of party members from the survey). These elements further develop the idea that history arises from the daily experiences of regular individuals.

The atlas also tells the story of individuals who were members of the lower ranks of society because they are considered the ones who live history. Within the context of the classical historical novel, those “above” are merely abstract figures delegating and influencing the actions of those below. The figures who remained above, the President and the Secretary of War, though they were controlling the actions of the surveyors, are only briefly mentioned. This keeps them abstract in the atlas, so the reader can focus on the men who are living the history of the surveys. This also allows the reader to connect with the characters in the atlas because it reinforces the shared history of the common man.

There are several elements of the classic historical novel are not applicable, however, due to the limitations imposed by the atlas’s format and the content of the historical materials used for its production. For example, in the historical novel, it is more important to recreate the emotional landscapes of the characters experiencing the events than to simply narrate the events themselves (Lukács 1962, 42). The original report documents, from which the narrative was derived, were written in a very objective
manner, which made it impossible to develop the characters in this way. If more had been known about their personal points of view and their thoughts, this could have been further developed in the atlas. Secondly, within the historical novel, conflicts arising between characters and outside historical forces serve to maintain the accuracy of the story (instead of simply relying on a series of facts) (Lukács 1962, 59). This element, however, could not be developed in the atlas due to the contents of the report documents, which sought to present a complete history of the landscape and the explorer’s experience based almost entirely on the objective fact. So within the atlas, conflicts could only be inferred from the report materials, and, therefore, could not be further developed.

6.7 Altering Cartographic Language and Atlas Structure to Produce User Friendly Maps

In order to develop a more reader-friendly atlas, while preserving the historic voice of the original reports, the symbolization of several features had to be altered. At the outset, the cartographic language of the report maps was followed rigorously, however, it was soon found that the new atlas maps lacked enough visual hierarchy to be understandable and appealing to the contemporary reader. The first example of this problem can be found in the symbolization of the water features; at the outset, the water was represented as a simple hand-drawn outline in grey (the same hue as the hachures and the same style as the report maps), however, it was soon found that this representation did not stand out significantly from the other features in the map and that the symbolization as a grey outline was not likely to be recognized as water by contemporary readers. To solve this problem, the outlines were simply filled with a very subtle shade of blue, the hue most
commonly used in maps to symbolize water, and they immediately took on a water-like appearance. In this case, the hand-drawn technique was again combined with the digital hue fill to produce a cohesive and more easily readable map.

A second example can be found in the symbolization of the expedition path. Here, a similar problem arose, which also had to be altered to produce hierarchy within the map. The original hue and thickness of the line did not guide the viewer along the expedition trail or help them connect the associated texts to location. To solve this problem, the line was thickened and given the same hue as the texts in order to enhance the visual hierarchy. In both cases, the original style was mimicked to preserve the historic voice, yet slightly altered to help support the narrative within the map.

The challenge of maintaining user-friendliness also arose in the overall structure of the atlas. Generally, atlases are seen as reference materials, so it is unlikely that the average reader would initially understand the design or concept behind a completely new form of the atlas. For this reason, until the reader becomes accustomed to this new form, it must be recognized that it must remain simple enough to accommodate the unfamiliar reader. Symbols, themes and texts were simplified in an attempt not to overburden the reader with deciphering their meanings. Hopefully with time, if this format were to become more popular and readers were to become more accustom to this format, it could be used to develop richer and more complex texts, and perhaps with this the purpose of the atlas, as Harley (1989) suggests, could be changed forever. This research could give way to new ways of producing and understanding atlases, particularly within the historical context.
CHAPTER 7: CONCLUSIONS

7.1 Conclusions

This research explored the atlas as a narrative form. This involved designing the atlas to be read like a novel, structuring the internal narrative to reflect the cartographic language of the nineteenth century topographic explorers, and developing cartographic techniques to support this narrative structure. This research was particularly challenging to approach with the training of a cartographer as opposed to the training of a writer. The conversion and condensation the historical events and products of the survey reports into text and graphic was most challenging due to my lack of training in either history or literature. However, the resulting atlas, though perhaps not nearly as engaging as the mystery novel Wood imagined, is a historical narrative rich with experience, illustration and data, and a demonstration of how design and technique can create historic voice in both the individual map and the atlas as a whole.

Overall, the production of an historical atlas in the narrative form demonstrates that such a technique is both viable and useful in representing historical subjects. The story of the Pacific Railway Reports marks a significant chapter in America’s recent history, yet until now this story has been inaccessible to the public. Historical atlases are generally overlooked because they are considered akin to encyclopedias or dictionaries, not places to discover a historical narrative. In this case the atlas is particularly useful to bring the elements of place, space, time and narrative together to help us understand the past. Understanding our nation’s history is essential to understanding the development of
contemporary societies. This project places the Gunnison-Beckwith Survey in a more accessible form that will be useful as both an educational and general resource.

Presented in a narrative form structured to reflect the voice of the era, this atlas works to engage the reader’s interest so the explorations can be read like a novel and the reader becomes engaged with the landscapes of the explorers’ experiences.

7.2 Contribution

This research makes a significant contribution to both atlas production and historical cartography. First, this project contributes to the small but growing literature on narrative cartography. This research explored the atlas as a narrative form and demonstrates the potential of further structuring this narrative to display the historical subject in its historic voice. Bringing these theories to life in the atlas, which had previously only been explored in the individual map, further complements the literature in this area.

Second, this project contributes to the research in cartographic design techniques for historical cartography, particularly in the area of combining digital and hand-drawn techniques in the same map. The recreating of the historic voice of the topographers by re-representing nineteenth century cartographic language, contributes new techniques in symbolization (through relief representation) and design format (through a new conceptualization of the incorporated world).
7.3 Future Research

Of the techniques developed in this project, relief representation stands out as the technique most in need of development. There is a significant need for an automated hachuring technique capable of producing a historic-looking relief representation. Although some work has been done, the results are either contemporary in appearance or overly generalized. Many contemporary cartographers are reluctant to actually draw something with pen and ink, though it remains the only method that actually produces a historic visual representation (by replicating the early method). If more attention was given to developing historic design techniques in cartography and GIS, such techniques would become more accessible and perhaps be adopted by makers of historic maps.

For the narrative atlas to become a familiar genre in cartography, more applications are necessary. If atlases and maps were produced with the specific intent of being engaging like a novel, perhaps the perception of the atlas would eventually change, and people would be more likely to pick them to be read as a book. This could also include more creative combinations of materials, including illustrations, texts and data, to draw the reader through, instead of the simple divided page layouts found in many historical atlases today.

The agency of symbol could also be further explored; that is, allowing symbols to take on more complex meanings than in their conventional usage. For example, the lightness of the camp symbol could be used to display the ease or difficulty experienced by the men to find a campsite that evening; on evenings when they barely made camp the symbol could appear faded and difficult to decipher and on evenings when camp was
easily made, the symbol could appear dark and easily readable. For this purpose, the atlas has the particular advantage over the single map, of offering more space and time for the reader learn and understand symbols and their use. At the outset, the reader could be introduced to the symbol in its purest form (perhaps in the legend) and as the reader turns the pages and views the symbol in its various forms and contexts its meaning would be enhanced with new meanings. The agency of symbol could also be used to further develop the elements of the novel within the map. For example, symbol could be used to foreshadow an event, like the danger imposed on the expedition party by the Natives could have been symbolized by darkening the atlas plate or changing the hue to a blood red, to warn readers just as is done in the texts of a novel. This type of symbolization has great potential in narrative atlases because they would help develop richer maps and stories.
REFERENCES


APPENDIX A: ATLAS IMAGES

The following plates should be read side by side as if in the two page spread of a book (the bottom plate belongs to the right of the top plate).

Title Page
ATLAS
OF
EXPLORATIONS FOR THE PACIFIC RAILROAD
NARRATED BY FREDERICK W. VON RICEYER
ARTIST AND TOPOGRAPHER
1854.
Table of Contents
Narrator’s Introduction
Author’s Introduction and Plate 1
Plate 5
Meanwhile, I had been traveling with Roosevelt's expedition from Wyoming. Despite encountering the Colorado mountains where, due to rain and snow, we had been forced to spend the night in a snowstorm, we continued on our way towards the eastern border of the Uinta Mountains. We traveled for a couple of miles and then turned back to the south, following the winding path of the Soldier River. This path led us to the town of Salt Lake City.

Plate 6
Plate 10
Having successfully completed the survey in the valley of the Sacramento River, already known for its valuable red soil, the Tehalee returned to Fort Ross on July 26 and departed back to Washington on July 29. After 18 months, they had begun working on the map, which was to be a comprehensive effort. The map was finally completed with the help of friends and family, and was eventually turned in with my wife and younger daughter in Texas City, Georgia.

I arrived back in my survey on August 4, 1858, and on September 24, 1858, was called back to survey for the U.S. Army. Our survey was eventually turned in with my wife and younger daughter in Texas City, Georgia.

Plate 11
Plate 12: Conclusion