

**Exploring the Field of Cartography with Maps Old and New**

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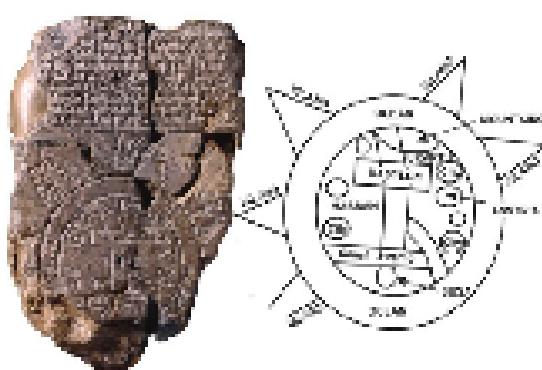
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**Introduction:**

Merriam Webster defines cartography as the science and art of making maps. The desire to create visual and geographic representations of the world around us is ingrained in the human race. Since the dawn of people living on this planet, we have attempted to make maps. Some of the first evidence of human culture and civilization comes in the form of maps. The oldest known visual depiction of space is a map of hunting grounds that shows a meandering river and the mountain slopes of a valley. This first map was engraved into a mammoth tusk and dated roughly 25,000 years ago from the Czech Republic (Svoboda 2017). Maps are magical. They allow us to look into our world with a new perspective and see things differently. Maps control the innate way we perceive our geographies. They can be equally informative as they are abstract. And up until recently, maps were the only means by which we had to see our earth laid out in space as if looking from above. Cartographers hold a very powerful tool in their hands. One of the fascinating things about Cartography as a field is the necessity for its students to be both master artists and scientists. Throughout this paper, the history of Cartography will be explored, the most pressing questions and developments since the rise of Geographic Information Systems (GIS), and a case study on how Cartography has defined our perception and influenced one little valley in Southwest Montana.

**A Brief History:**

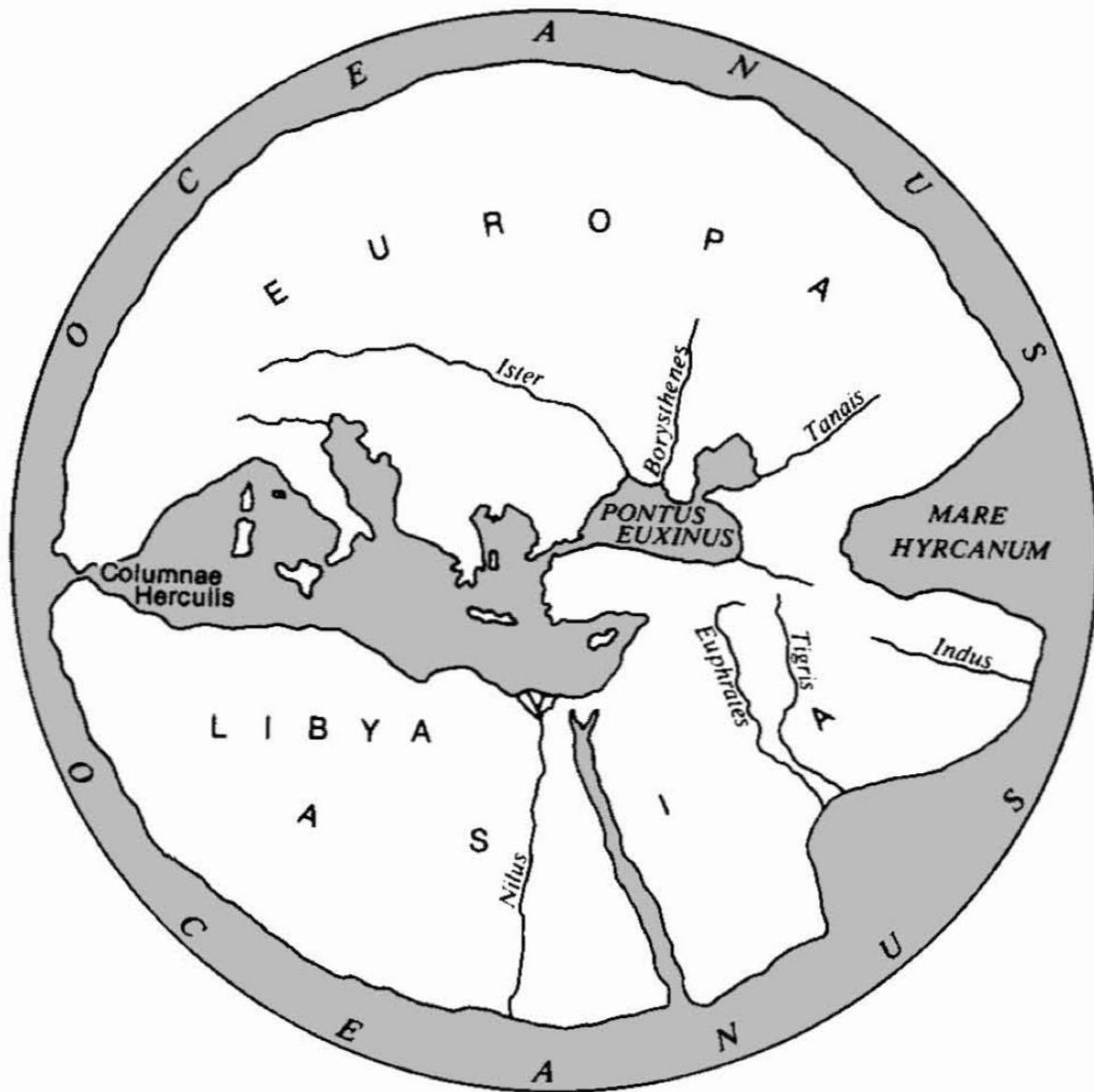
The word “Cartography” is theorized to have first been used by Conrad Malte-Brun in the French “Elementary Treatise on Geography” in 1826. He described the word as the “science of the graphical representation of geographical phenomena on maps” (Van der Krogt 2015). The word “map” was coined, also in French, several hundred years earlier (“Map” n.d.). But just because there was no descriptive language, the making of maps has been practiced since quite literally the dawn of humans as a species (Wolodtschenko and Forner 2007).



Early Cartography was limited by the tools of the time and local understanding of the sciences. Native and Neolithic peoples made crudely preserved maps to describe their lives and the lands they subsisted on. As political structures and astrology advanced, detailed estate and regional maps were being etched into clay tablets in Babylonian times (**Figure 1**).

**Figure 1: Babylonian map of the World, *Imago Mundi* 600 BCE**

The Egyptians developed a system of land surveying and recorded maps on Papyrus (Baldock 1966). The Greeks made the first significant advances in Cartography as we use it today. The first map that attempted to convey the whole earth as it was known is thought to have been made by the Greek Philosopher Anaximander around 600 BC (**Figure 2**) (Serres and Lapidus 1993).



**Figure 2: Anaximander's Map of the World, pulled from (Serres and Lapidus 1993)**

The Greeks also discovered the Earth not to be flat as once previously thought. Eratosthenes developed the concept of latitude and longitude to aid in navigating exploratory pursuits ((Cresswell 2013)). The Romans used maps for their military objectives in their own empire and developed world maps. Around the same time, the Arab Empire made strides toward modern

science and geography (Baldock 1966). As the sciences advanced, so did the cartography that went along with it was created to represent those respective fields.

During the “Dark Ages,” cartographic pursuits were so profoundly entangled with religion that it was hard to separate the two (Baldock 1966). By 1400 AD, the printing press was developed in the Western World and the age of navigators kicked off a new wave of cartographic styling and ideas. The maps were decorated with mysterious sea creatures and things from deep within the realm of magic possibilities. This style is exemplified in maps such as Diego Gutiérres’ 1562 map of the Americas (**Figure 3a**) (Hébert 1999) and the Fra Mauro 1450 map of the world, considered the “greatest memorial of medieval Cartography” (Almagià 1944) (**Figure 3b**).



**Figure 3:** 3a Diego Gutiérres’ 1562 map of the Americas. 3b: Fra Mauro 1450 map of the world.

In 1569, Flemish Geographer and Cartographer Gerardus Mercator developed probably the most famous world map projection still in use today. It was called the Mercator projection. It is an incredibly useful tool for navigation at sea, but it has significant area and distance distortion flaws.

Several things happened that allowed cartography to be brought into the limelight during the 16th century and for techniques to develop relatively fast over the short period that followed. The printing press had allowed the large-scale distribution of maps to people other than academics and explorers. The commercialization and Colonization of much of the world led to the need for detailed territory maps to hold military control (Baldock 1966). Those who had maps of an area had a stronghold on it. Cartography meant power during this period. As nations were colonizing, new maps were drawn regularly to enforce these new political boundaries on the conquered countries. In many ways, the rise of maps happened in conjunction with the rise of the state (Kagan and Schmidt ). The 18th century was marked by a disregard for earlier maps and the development of Cartography in conjunction with science. But the “study of cartographic

expression and dorm as a mode of communication had not yet begun" (Kagan and Schmidt n.d.). But during the industrial revolution, globalization, trade, commerce, improvements in science, and the ability to travel across regions, led to the need for more maps. The early 1800s were marked by a distinct interest in historical and contemporary cartography (Harley, Bagrow, and Skelton 1965). Several notable maps created during this time were William Strata Smith's geologic map of Britain (**Figure 4a**), the first of its kind and revolutionary to the fields of geology and sedimentology. John Smith pioneered the field of disease mapping, and was one of the first to symbolize thematic data on a map to show the 1854 cholera outbreak in London (**Figure 4b**).



**Figure 4:** 4a - William Smith's 1815 geologic map of Britain. 4b - John Snow's 1854 map of cholera outbreaks in London.

In 1915, the National Geographic Society began producing and publishing maps to first go along with their magazine. Their maps have always been known for their artistic beauty, geographic legibility, and unique character. Possibly the most outstanding contribution to this distinct

character was Charles Riddifords' typeface, which is still in use today. Many people will recognize it as National Geographic Style without even realizing it (Dempsey 2013). In 1957 Erwin Raisz pioneered a Cartographic style that combined the detailed drawing of geomorphic and topographic features with a large-scale wall map to create the Physical Landforms of the United States map (**Figure 5**) ("United States -- Physical Landforms (raisz)" n.d.)).



**Figure 5:** Erwin Raisz Landforms of the United States (1957)

Around the same time, Edward Imhof fine-tuned his techniques to visually show topography. A master of light, his mountain expeditions inspired studies of relief shading and great masterpieces of Cartographic understanding. In 1925, Imhof founded the first academic Cartographic training and research program in the world. His relief representation principles were established in the fact that things that are further away in the atmosphere are less bright. Mountain peaks appear in clarity and can also be complemented with hachuring techniques to show individual types of rocks. Such methods are done beautifully in his 1962 Mount Everest Map (**Figure 6**) (Hurni et al. 2015).



**Figure 6:** Imhof Map of Everest with manual shaded relief and rock art drawing style – 1962

Imhof's distinctive style was translated to his students and eventually adopted by the Swiss Federal Office of Topography. This technique is one of the many great reasons swiss cartography is so renowned today ("Eduard Imhof (1895–1986)" n.d.). The International Cartographic Association was founded in 1959 in Bern, Switzerland ("History of the ICA" n.d.).

The availability to collect data; see more of the world by plane or aerial photographs, and develop new technologies aided many cartographers who honed their skillsets in the 1900s. In 1962, Roger Tomlinson, for the very first time, used computers to create a geographic data inventory of all its natural resources. He gave GIS (Geographic Information Systems) its name ("History of GIS" n.d.). From then on, the development of Cartography has been intricately tied with the development of computers. By the late 1970s, the memory size and graphics of computer systems were improving, and in 1982 Esri, now the largest GIS software company globally, launched its first commercial program (GISGeography 2015). But it wasn't until somewhere between 1990 and 2010 that Cartographers were genuinely able to utilize GIS in their fields. But the story of Cartography doesn't end with GIS. This story is just beginning, and Cartographers today have an ever-expanding toolset through which to express their craft.

### **Cartography as it Stands Today:**

Today, Geographic Information Systems makes it accessible for anyone to create maps using informed data, and this practice is no longer just reserved for traditionally trained Cartographers. This ease of use and automation of many processes that used to be done by hand, while an incredible advancement, makes it even more essential to preserve Cartographic design and principles. Even though GIS is used so often, not all maps produced with the software keep the art of Cartography alive. And because cartography is an art form just as much as it is a science, it is just as necessary to refer to its history and future. Today it is increasingly rare to find a strictly "Cartography" position where one does not also do GIS data analysis or social or physical geography work. But that doesn't mean the field is not still thriving. If anything, more techniques are being pioneered today across multiple mediums than ever before. Primary advancements in GIS and Cartography in the last 15 years include the exponential increase in cloud-hosted geospatial data, emerging open-source technology, remote sensing, and geographical statistics, ease of incorporating temporal data and spatial data, and interactive web maps. Graphic design software and the means we have by which to visualize and share data in a geographic sense have also vastly improved, allowing cartographers to reach a larger audience. The ability to be a well-rounded Cartographer in many aspects of the field instead of just specializing in one aspect or style is far more feasible.

In the early 2000s, open-source GIS programs (such as QGIS, MapBox, GRASS GIS, and Python) paved the way for more people to get into the field with fewer barriers to entry. This opened up modern Cartography to those who wouldn't necessarily have access to attending an academic institution or paying for expensive software.

The introduction of "Web Maps" has allowed a whole new aspect of Cartography to develop. Once limited by static data and paper maps, suddenly, there is this ability to release interactive maps to the public. And a whole new field of "Narrative Cartography" has opened up (Caquard and Dimitrovas 2017). ArcGIS Story Maps, Mapbox's Scrollytelling, and others with similar storytelling map integration formats have become increasingly popular in the last several years (Caquard and Dimitrovas 2017). Many media outlets have adopted this "Story Map" template to release news stories online. Works that exemplify this are the Washington Post, such as their

2019 story on the political play in Bears Ears National Monument (*The Washington Post* n.d.). Library of Congress has launched a similar application that creates “engaging online narrative experiences” (Susan n.d.). In some examples, readers can explore geographic and other visual data at their own pace and in ways that interest them. And in other articles, the data itself is not interactive but animated and presented at a specific speed to go along with a more text-focused article, such as the NYT article from 2021 about the AMOC shutting down (Velasquez-Manoff and White 2021). No matter how cartography is utilized, this new series of web tools present unexplored horizons for the industry and new chances for Cartographic development.

The primary journals in the field of Cartography are *Cartographic Perspectives*, published by the North American Cartographic Information Society (NACIS). *International Journal of Cartography* published by the International Cartographic Association, *Journal of Maps*, and *Cartography and Geographic Information Science*, published by The Cartography and Geographic Information Society.

Each of these journals serves different subfields of Cartographic Academia and Understanding. *Cartographic Perspectives* largely encompasses and publishes peer-reviewed research, methods for geo-visualization, tutorials on new techniques, and reviews of books atlases and novel maps. The *IJA* trends a little more academically focused and publishes research in Cartography and GIScience, spatial modeling, cognitive-based GIS, and topography. The *Journal of Maps* is an interdisciplinary forum to showcase maps and spatial diagrams from other physical or social science fields. Cartographic guidelines are given out, but the focus is on the maps themselves as they relate to their respective sciences. *CaGIS* is a little more GIS-focused, with a mission statement to improve upon established cartographic practices while keeping design and mathematical and social science approaches in mind.

Cartography is an exciting field because those that practice it are not necessarily studying it as a science but instead using it as a tool. It makes for an interesting spread of dominant figures because most cartographers are making maps themselves and studying cartography explicitly, or outside of the academic field, through their craft. That being said, the key figures at this moment in time, both in and out of the academic field, include Kenneth Field, Daniel Huffman, Tom Patterson, Nathaniel Douglas, Anton Thomas, John Nelson, and Guthrie Alexander, among others. These cartographers excel in their crafts and have a repertoire within the community because of their excellent maps, from both a scientific and design perspective. One of the beauties of map-making is that it can and needs to occur at all scales, from the backyard scale to the global scale and beyond, into outer space and other planets and galaxies. The bounds are limitless, and if something is spatial, it can be mapped.

Two of the most pressing issues in the Cartographic world as of late regard how to better create unbiased election maps and how cartographers can represent the movement of people in a way that feels more humane. The conversation around election maps has been a long-standing controversy in cartographic and political spaces. With several tumultuous elections in recent years, this conversation has sparked much debate in the Cartographic community over the last decade. The traditional method of showing red and blue counties in a single color at the state or

county level leaves out essential population information. It skews the perception of blue vs. red states. Traditionally, larger metropolitan areas tend to be more Democratic-leaning, and rural areas more Republican. Using only two colors skews the visual perception of majority/minority relationships and leaves out a crucial aspect of elections that should be told; the people. In 2016, NYT published an article on how they have attempted to map election results (Parlapiano 2016). Kenneth Field, an expert in thematic mapping and long-time professional ESRI Cartographer published an article in 2013 on this same subject (Field 2013). The conversations around Brexit, particularly the 2016, and 2020 US elections, have caused uproar and re-evaluation of the current way we display electoral data (Forest 2018).

The conversation surrounding people is both a cartographic and humanitarian question. How can statistically represent something that conveys feeling and shows a human life for its worth, not just a number. Symbology that has historically been used to describe the movement of people (such as large directional arrows) has recently been called into question. Particularly around how cartographic symbology controls our perception of the war in Ukraine. Nothing has been published in the academic sphere yet, but a conversation has been developing on Twitter this March. It details both the duty of cartographers to have to accurately represent what is happening on the ground during a war and can show the movement of refugees more humanely than just using area fills (Westerveld 2022)(Field 2022).

### **Documenting the Bitterroot Valley Through Maps:**

Because cartography is essentially geographic storytelling, it makes perfect sense to look at the history of an area from a geographic perspective. The story of Bitterroot Valley, as shaped by different people groups and land use values, is a wonderful case study. In the next portion of this report, Hamilton Montana will be explored through the lens of Cartography, the maps and Cartographers that have shaped it over the last several centuries years. In conjunction with this paper, a graphical abstract was created that shows Hamilton's story from a cartographic perspective and explains the subfield as it exists today by telling the story of the Bitterroot Valley, referencing historical mapping and Cartographic techniques. This was done because Cartography is an innately visual and map-centric field; I thought it would only make sense to describe it in the context of the maps that have shaped what the field is today.

This next section of the paper can be read with reference to the graphical abstract. And it will be referenced by timestamp according to the period cartographic material is being pulled from.

Traditional academic “Cartography” didn’t exist in the Bitterroot Valley until Lewis and Clark arrived in 1805. But that idea leaves out an essential part of this story. Because even though we don’t have documented paper maps from this time, Native peoples were making maps and had names to describe their geographies long before white settlers arrived. They practiced their traditional forms of Cartographic understanding. Hunting trails, cultural sites, and stories tied with place names, mountains, valleys, and rivers have been passed down through storytelling for generations. 1500 Salish and Pend de’Orielle place names were recently documented by the Seliš u Qlispé cultural committee (Walk 2019). This ethnographic project opened up a broader

understanding of the Salish language and geographic history for many people within the tribe itself (Walk 2019).

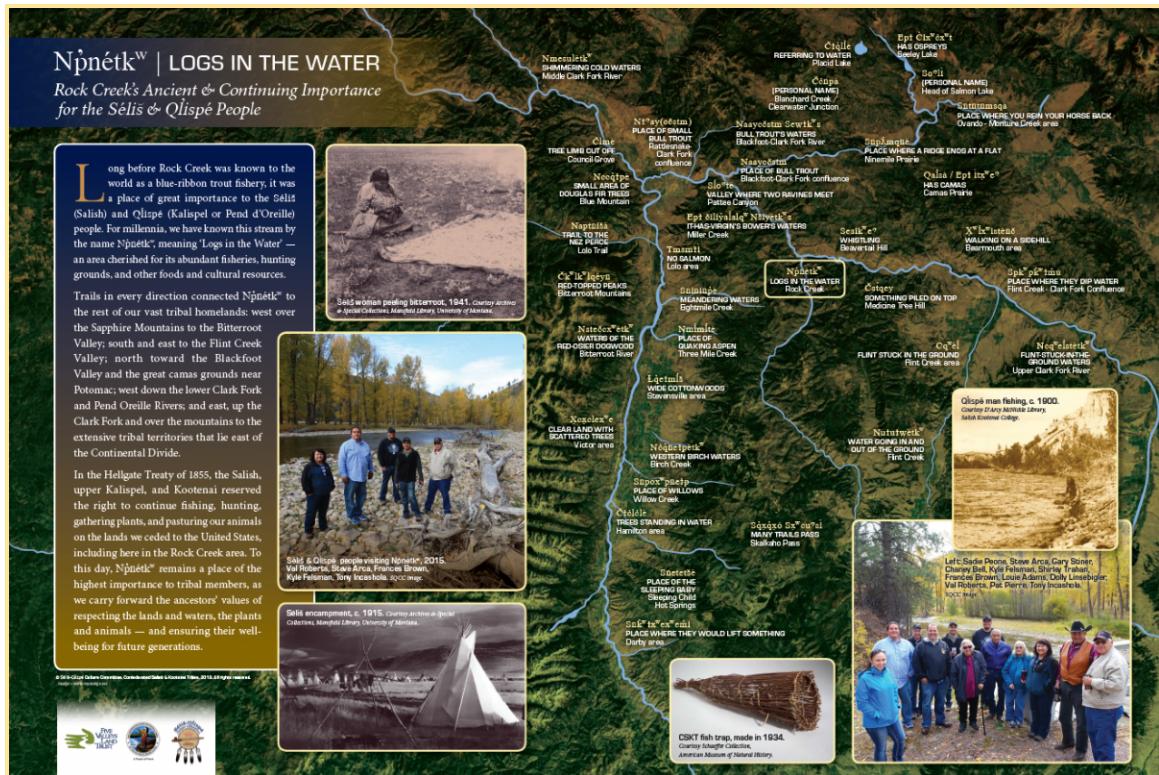
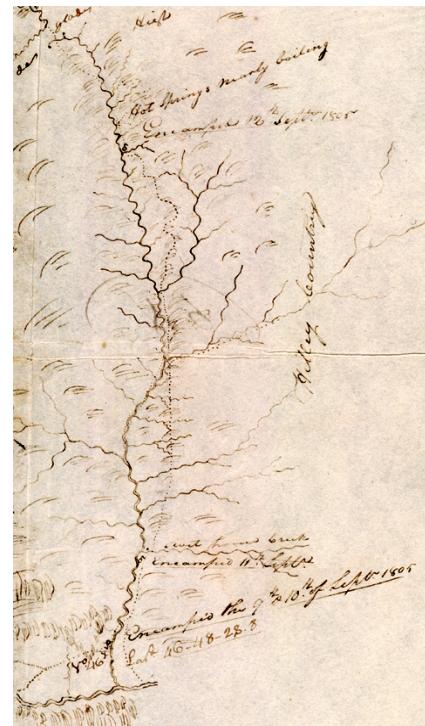
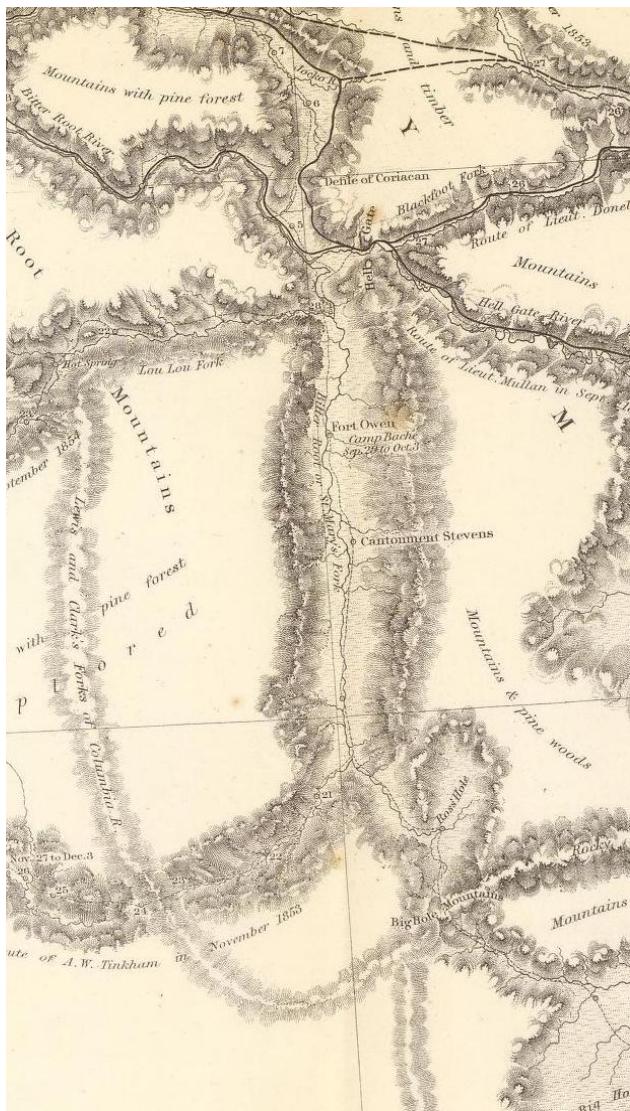


Figure 7: Rock Creek Place Names - Seliš u Qlispé cultural committee

Next up, in the cartographic story of Hamilton is the age of exploration. Two maps from this period must be discussed as their shaping of the Bitterroot Valley had monumental effects. The first is William Clarks' map of the Bitterroot Valley on their 1805 westward expedition (**Figure 8 - Right**). Lewis and Clark's initial maps of this area signified a new era of exploration of the West and a potential passageway for future travelers. These maps were also incredibly detailed, especially from a hydrologic perspective. Even though they were drafted rough and fast, they represent an essential turning point in American Cartographic history. Also important to note, in most cases in this part of the country, Lewis and Clark were following trails already established by Indigenous peoples and often being led by them (Kris 2021).

The second vital map to consider from this early age of exploration was created by Lt. John Mullan, who was hired under Issac Stevens to survey a potential route for a railroad

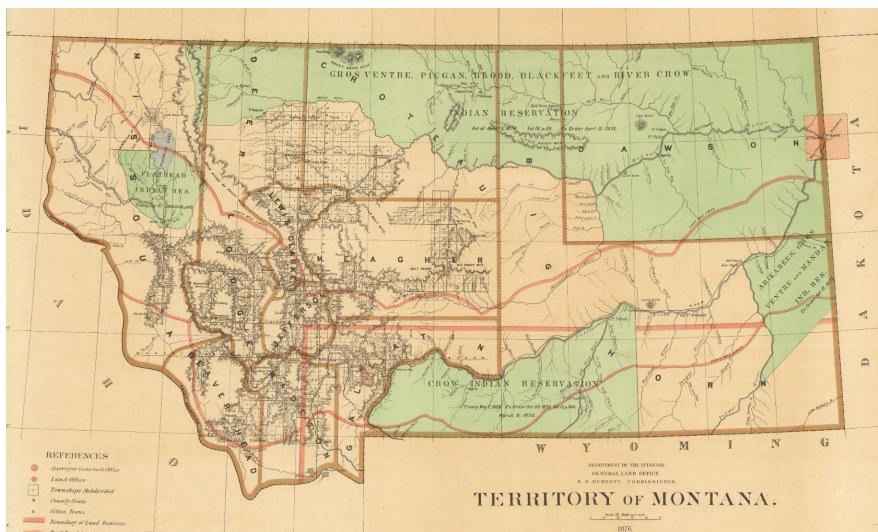




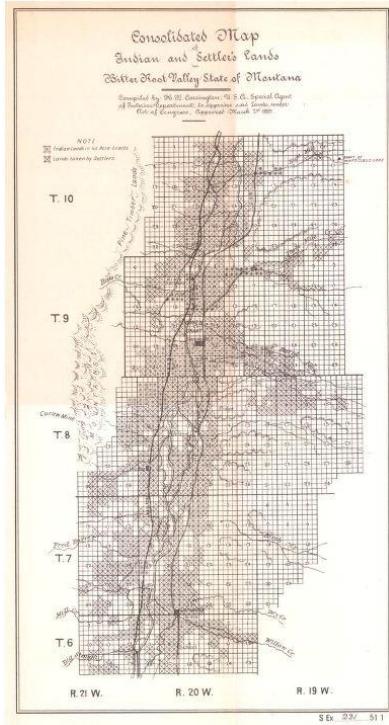
going west. He wintered in the valley during the winter of 1853 and 1854 with a group of around 15 men and set out to survey the region (Howard 1934). The maps that came out of his survey work, both under his own authorship (Mullan 1865) and his detailed descriptions (States. et al. 1855), show a new era of Cartographic style, using hachuring to represent steep terrain (**Figure 8 Left**).

This style was popularized by the military topographer Johann Georg Lehmen and was widely used from the 19th through the mid 20th centuries (Mulcahy 2005). These maps did two things for the Bitterroot Valley. They showed the area in detail and listed Fort Owen and other trade routes to navigate the mountainous terrain for the first time. Secondly, the narrative provided with them encouraged settlement and agriculture in the Bitterroot Valley. And it was one of the first times white emigrants saw the Bitterroot as an excellent place to homestead (Richey 1999).

The following map highlighted in this Cartographic journey was produced by the General Land Office of the Department of the Interior. It was published one year after Marcus Daly founded Hamilton in 1875. Hamilton does not yet appear on this map, but the Indian reservation delegated in the Hellgate Treaty of 1855; The Flathead Reservation does.



**Figure 9: Department of the Interior, General Land Office. S.S. Burdett, Commissioner Territory of Montana. 1876. Compiled from the official records of the General Land Office and other sources by C. Roeser, Principal Draughtsman G.L.O. Photolith. & Print by Julius Bien 16 & 18 Park Place, N.Y**



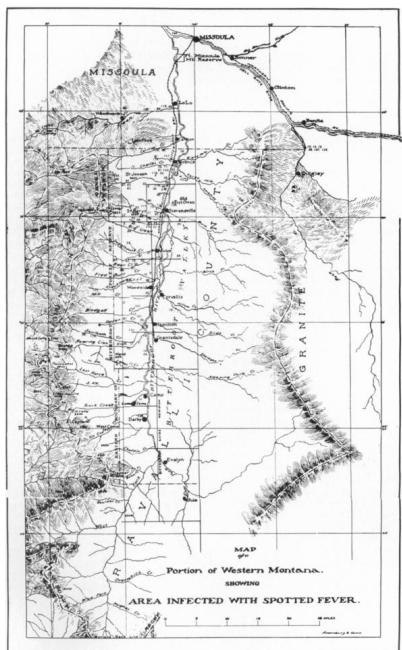
Just two years before the Salish were forcibly removed from their lands to the Flathead Indian Reservation (Richey 1999), detailing the “Indian Lands in 40 Acre-tracts” and “Lands taken by Settlers” This map represents a period in our history where Cartography was used to justify the inhumane land-grabs that took place concerning indigenous peoples. **Figure 10 Left:** *Consolidated Map of Indian Settler's Lands in Bitter Root Valley, State of Montana*

The final map that will be examined here with respect to early Hamilton history and Cartography is a map published originally in 1904 in the Journal of infectious diseases. It depicts the geographic nature of the early 1900s outbreak of Rocky Mountain Spotted Fever on the west side of the Bitterroot River (**Figure 11 Left**). This map was produced not long after the very first disease map was published of a cholera outbreak in London by John Snow (Snow 1856). This idea that specific diseases could be tied to geography and the power of Cartography could help unlock our understanding of their spread was a relatively new concept. The identification of the Bitterroot as a hotspot for this newer disease ended up leading to the geographically concentrated effort to contain them and study them at Rocky Mountain Laboratories in Hamilton (Wilson and Chowning 1904). And today, RML continues to be an economic driving force for the town of Hamilton and the surrounding area.

### Conclusion:

The field of Cartography, which is often perceived as obsolete by the outside world, is blossoming. New GIS technology, techniques, data availability, and scientific/artistic knowledge allow cartographers to improve their skillsets and expand their understanding of what a map can be. The long history of cartography has shaped the field as we see it today, and often, historical techniques can be incorporated into modern maps and GIS data. In addition to being a fantastic field of study that relates to almost every other scientific field on the planet,

Cartography is an excellent tool through which we can look at historical moments and data. The Hamilton example shows that both cartographic and human history are preserved through maps, intricate and beautiful representations of how humans see the world.



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