Visualizing History: The Case for Chronography

by

Steven Zombek

Submitted to the Board of New Media
School of Film and Media
in partial fulfillment of the requirements
for the degree of Bachelor of Arts

Purchase College
State University of New York

May 2019

Sponsor: Paul Thayer

Second Reader: John-Christian Bailey

Part I

The human mind has many limitations, one of which is its inability to process huge swathes of information and consider it all at once. Though rarely an issue, this has many implications for the depth of human understanding. Consider the challenge behind maintaining humanity's collective, agreed-upon "memory": history, which is the "truth" of our past. If it is difficult enough for one to mentally organize their own life history, than it absolutely must be harder for one to comprehend collective history in a fully fleshed out way. History is a formidable stretch of information. For many learners, it is as frustrating to absorb as it is for teachers to teach. Like any broad subject, human understanding of it relies on imperfect pedagogical tricks to fit it through a limited scope. But history is especially slippery. On paper it is linear and orderly logically, yet in the mind it breaks down into an amorphous collection of abstract knowledge, structured only by the relative distance of one event to the next. Simply put, mentally picturing the past, and how it all fits together, is a precarious and imperfect practice.

For teaching history, two doctrines have emerged, and both have been employed with varying success. The first approach is *chronological*. As the name suggests it involves teaching history piece by piece, in order, as it occurred. Critics of this method have questioned its effectiveness, with one teacher noting in an article *The Current State of*

History Teaching: “History teachers have for too long been supplying the bricks of history, the ‘facts,’ to their students, but have failed in most cases to have them build any sort of structure with them” (Tew 5). In other words, this method does not engage the students in a way that connects them to history, instead making it merely bits of information for “regurgitating during exams”. On the other hand, a new approach, the *thematic* method, has recently emerged. This involves assignments that “select meaningful themes for students to explore in great detail” (Tew 3). This method stresses focusing on the fundamental ideas found in history, though it means the teacher must carefully pick and choose to teach certain information deemed significant over “less important content” (Tew 7). But while this method is able to bring history to life, it is imperfect as well, as it means bypassing large swathes of historical information that can be relevant, and relies on the judgement of the individual teaching. Educators must choose between disseminating as much information as possible in the fastest amount of time, or curating a particular regimen that reflects certain big ideas while ignoring facts and figures thought to be less notable. In either case, the “bigger picture” cannot be shown. As historian Marc Bloch notes, “The nature of our intelligence is such that it is stimulated far less by the will to know than by the will to understand” (Bloch 8). But can history be truly understood if it is not thought of as a whole?

Learning history through either approach feels problematic. Breaking up chronological information in disjointed palpable chunks, or leaving out information that may be relevant to understand the external circumstances or certain “big ideas” inevitably

leaves what can be referred to as epistemological “gaps”. In other words, in the way the mind fits this information together, even if taught linearly, it is very possible to lose a certain perspective. Imagine an understanding of history through this method as having two dimensions, but lacking, or sometimes having a distorted, third dimension, a metaphorical “depth”. This would naturally vary across individual minds, but the effect would be the same: it allows intellectual dishonesty, confusion, and ignorance to further distort our understanding of past events. If mankind is expected to learn from the past so as not to repeat it, the implications of this flaw are significant. 2

There are many examples of this flaw that can be given, but one in particular that partially inspired this project was Ben Jancewicz chronological infographic *How White Supremacy Attempts to Make Slavery and Segregation, ‘Soooo Long Ago’* (Jancewicz 2016). It aptly illustrated just how recent slavery and segregation in the United States was in a visual way, and brings attention to the fact that popular perspective on what is “ancient” vs what is “new” or “contemporary” can be distorted by things like the current status quo of politics or culture. This is not to say that current culture makes humans perceive, in a literal sense, an event like World War II happening later or earlier than it actually did. It can however influence people to consider something like slavery in the United States as long ago while also considering an event like 9/11 as painfully recent. The dates always remain the same, however “personal” distance from them can vary depending on many internal or external biases. It is helpful to picture human comprehension of history as a kind of slinky, with the coils compressing or expanding

depending on what is looked at. This problem is compounded further by the fact that not everyone learns history in the same fashion, order, or volume. More so, ideology and personal bias further informs how an individual processes chronological information. This means hindsight is often warped, even if only slightly, making objective judgement all the more difficult.

This brings up another concept, hence referred to as the *regime of the present*. It was inspired by Camiel van Winkel's *regime of visibility*, the idea that our culture's collective social and political sphere is influenced by visual media, which has a constant presence in our daily lives (Quaranta 25). Similarly, the *regime of the present* maintains that understanding of humanity, both as it existed in the past, and will exist in the future, is influenced by how people exist in the now. This means human foresight and hindsight are limited in scope, making it hard to picture how much humanity has changed or will change. This sounds axiomatic, but it is a concept not often acknowledged or explored. If political and social ideas are the result of individuals being born where they are, how can one gain any meaningful sense of humanity's trajectory? There is another term for this, known as the *specious present*, a concept popularized by pioneering psychologist William James. On this idea, James writes "the prototype of all conceived times is the 'specious present', the short duration of which we are immediately and incessantly sensible" (James 631). This idea and the questions that arise from it, are worth considering, and they form the core of what this project will be about.

If this gap issue is as problematic or relevant as it could be, it should also be noted that it would affect everyone differently. A dedicated student of history, with a well informed and solid grasp of the past, may avoid these “gaps” much better than a layman with limited education in the same field. Naturally, if this issue must be brought to the attention of any audience, it first should be that of the common citizen, who are the most susceptible to biases and misconceptions that the modern status quo can lead them to. The same can be said about the *regime of the present,* which is a question many people outside of historians or philosophers would never ponder. This is further muddled by the existence of factors like different teaching methods, neurodiversity, and learning disabilities, which makes sweeping generalizations of human epistemology untenable. But this does not make the idea behind this project, a tool for visually “putting history in perspective” any less useful, especially when it may make the difference for some people who might be helped by it. In the words of British polymath Joseph Priestley, “[time in itself is an abstraction that may not be] the object of any of our senses, and no image can properly be made of it, yet because it has a relation to quantity, and we can say a greater or less space of time, it admits of a natural and easy representation in our minds by the idea of a measurable space, and particularly that of a LINE.” (Rosenberg 2004).

This idea of chronologically charting information is not new, though it is surprisingly young. The use of timelines, a way for chronological data to be visually organized, can only be reliably traced back to the Enlightenment era (Rosenberg 2004). This system of

linearly mapping events became popular in 1764 when the aforementioned Priestley published *A New Chart of History*. He developed this chart and others as pedagogical tools for his lessons, but they soon took on a life of their own, becoming popular for decades and earning Priestley a Doctor of Law degree at the University of Edinburgh (Schofield 118). They have since become a common enough tool that most people are familiar with. But timelines have their limits. Most are manually drawn out, meaning there is a limit to what can be practically displayed. Making an analog timeline that encompasses the entirety of human history would be a massive endeavor, not to mention too unwieldy to exist in real space. It would also be static, making the experience a fixed one. If one intends to put history into a visual perspective, it should be a modular system, one that allows viewers to steer their own experience in open ended ways.

Nowadays, with the advent of computers to help, this can absolutely be done. With the simple accessibility of a timeline graph, and the modularity and scalability of computing, both can be combined into a compelling system. Using computers to visually chart data is, again, nothing new. Information Visualization is a burgeoning field, as has been for years now. The trick is being able to plot information in a way that can clearly transmit meaningful patterns. Because of the unwieldy amount of information this project will include, it must involve careful categorization and organization of data. Certain information of specific types, such as historical periods, wars, and events will be

grouped with each other, to allow for a more calculated experience at the discretion of the spectator.

It is important to mention that both the ideas of the *regime of the present* and those of the epistemological “gaps” are not concrete and to be taken as universally true, but speculatory concepts backed up only by careful reasoning. Their role here is purely inspirational, and so it would not be disastrous if both turn out false. The point remains the same: a proper human grasp of the past can only be strengthened by visual aid.

While the aim of this project is ultimately putting all anthropocentric history in perspective, it also has a special focus. A section of this project will concern itself with mapping humanity’s technological development over the course of an as of now undecided window of time, including the early modern era and the Industrial Revolution to the present day. Technological milestones offer a very interesting way of visualizing human history, primarily because it allows a viewer to make observations on the trajectory of human development. Ultimately, all of this ties into another concept this project will explore: *technological determinism*.

Put very simply, technological determinism is the idea that a society’s cultural values and social structures reflect it’s technological achievements. It is a reductionist school of thought, and aims to find a causative link between the sociopolitical and the material. Marx, one of the first minds to ponder this idea, famously remarked “The hand-mill gives

you society with the feudal lord; the steam-mill gives you society with the industrial capitalist" (Heilbroner 54). It is not unreasonable to consider how technological conditions mold social structure, and many thinkers, including Jacques Ellul and Lewis Mumford, have written extensively about it. The theory is split into two categories: "hard" and "soft" determinists. Hard determinists like those of Ellul and Theodore Kaczynski hold the idea that "advancing technology has a steadily growing, well-nigh irresistible power to determine the course of events" (Smith xii). To the hard determinists, technology in itself is agency, that is the power to effect change, and it's progress is fatalistic. On the other end of the spectrum, soft determinists "begin by reminding us that the history of technology is a history of human actions" and "instead of treating 'technology' per se as the locus of historical agency, the soft determinists locate it in a far more various and complex social, economic, political and cultural matrix" (Smith xiii). To them, the human hand, guided by external circumstance, is the force that shapes history. Both sides' arguments have merit, but this project will not pick nor defend either. Instead, it aims to bring the viewer to an understanding that may lead them to appreciate either, or both. However, it must be mentioned that while the official stance this project takes on technological determinism is neutral, the primary motivation in pursuing a visualization of history through technology was inspired by the writings of hard determinist thinkers, particularly Kaczynski's and Ellul's.

If one wants an evidence of technology's influence on the development of human civilization, they need look no further than the introduction of the automobile. The

automobile's impact on modern society is damning, if one considers all the hidden consequences cars brought along with them. Car culture has shaped the very cities we live in thanks to its advocates, such as developer Robert Moses, the father of New York's urban and suburban sprawls. "The modern metropolis is now sprawling helplessly after the impact of the motorcar", wrote Marshall McLuhan, "As a response to the challenge of railway speeds the suburb and the garden city arrived too late, or just in time to become a motorcar disaster. For an arrangement of functions adjusted to one set of intensities becomes unbearable at another intensity" (McLuhan 14). The ability to drive has fundamentally altered economies by allowing entire communities to live and work in different places. Cars have brought along problems we've never even had before, namely gridlock and drunk-driving, and they have even led to an entirely new way of dying: auto accidents. To hard determinists like Kaczynski, these implications are dystopian. Car culture, while in theory solving some problems (e.g. mobility) has also created many more new ones. What's more, the automobile, conceived of as a practical tool, has become a necessity in the modern age. The infrastructure and social nature of our society, being shaped by the advent of the car, forces us to adapt to it, rather than vice versa. For most people, a car is now unofficially required to function in society, either for work or transportation. On this, Kaczynski writes in his manifesto, *Industrial Society and its Future*:

> Moreover, the use of motorized transport is no longer optional. Since the introduction of motorized transport the arrangement of our cities has changed in such a way that the majority of people no longer live within walking distance of their place of employment, shopping areas and recreational opportunities, so that they HAVE TO depend on the automobile for transportation. Or else they must use public transportation, in which case they have even less control over their own movement than

> when driving a car. Even the walker's freedom is now greatly restricted. In the city he continually has to stop to wait for traffic lights that are designed mainly to serve auto traffic. (Kaczynski 16)

Even further, cars became not only a tool but a right-of-passage for some, and a status symbol for others. To not have a driver's license may earns adults quizzical judgement by their peers. So the system reinforces itself. If these are only *some* of the impacts stemming out of the automobile's introduction, there are other, far more insidious ways technology has influenced civilization and its historical trajectory.

But the example above has negative implications. A more neutral way technology has influenced civilization is through the invention of the mechanical clock. The emergence of a reliable and constant method of timekeeping was a paradigm shift for the lives of many in medieval Europe. Lewis Mumford notes in *Technics and Civilization*:

> The bells of the clock tower almost defined urban existence. Time-keeping passed into time-serving and time-accounting and time-rationing. As this took place, eternity ceased gradually to serve as the measure and focus of human actions… The clock, not the steam-engine, is the key-machine of the modern industrial age. For every phase of its development the clock is both the outstanding fact and the typical symbol of the machine: even today no other machine is so ubiquitous. (Lewis 14)

As Mumford argues, this mechanical, rationalized system had profound implications for society. With it, he notes, humans had a system to adhere to, and a model to aspire to. Indeed, the mechanical clock as a model of functionality was so influential, it even inspired some Enlightenment thinkers, to perceive the universe as "clockwork". In fact, this model lead French mathematician and physicist Pierre Laplace to found the concept of scientific determinism as known today (Gleiser 2014). This misguided

perception of a cyclical and orderly existence persists even now no doubt because industrial civilization functions on the concept of time, and one cannot escape its grip living in contemporary society. From these examples it becomes clear that human perspectives, culture and systems are not within a vacuum, but under the constant influence of our surrounding technium. Certainly then, one must wonder what the world would look like if humanity was isolated from it's technological extensions.

If humanity at any given time is a product of material conditions, or vice versa, looking at how technology developed throughout history offers an intriguing perspective, though not because it offers a linear narrative. In fact, it's usually the opposite. The collective sum of humanity's research and innovation is all but linear; it can be thought of as more like an interconnected web of ideas interacting with one another, separating sometimes by centuries in between. A similar issue exists in the subject of scientific history, which has less tangible evidence to work with. Thomas Kuhn, in his book *The Structure of Scientific Revolutions*, where he coined the term "paradigm shift", notes that because of our flawed understanding, representation, and teaching of scientific history:

> The result is a persistent tendency to make the history of science look linear or cumulative, a tendency that even affects scientists looking back at their own research. For example, all three of Dalton's incompatible accounts of the development of his chemical atomism make it appear that he was interested from an early date in just those chemical problems of combining proportions that he was later famous for having solved. Actually those problems seem only to have occurred to him with their solutions, and then not until his own creative work was very nearly complete.1 What all of Dalton's accounts omit are the revolutionary effects of applying to chemistry a set of questions and concepts previously restricted to physics and meteorology." (Kuhn 138)

The same problem is absolutely applicable to technological progress, which is heavily interwoven with the sciences. While this makes it difficult to isolate and identify the development of individual inventions and ideas, as well as making it all but impossible to organize the progression of technology in a logically structured and visually accessible way, we are still able to observe and estimate the emergence and impact of tangible technological artifacts as they appear in history. In other words, it is easier to visually display the year the car was invented than it is to chart the millennia of collective knowledge that led to the car in the first place. While not addressing the latter, a timeline system visually plotting the years inventions emerged still puts our trajectory into perspective, and allows for viewers to draw their own conclusions. So, at the expense of thoroughness, this project aims for expediency and clarity.

To that end, this project will go by the year a prototype was invented and/or patented as the "official" year that the artifact emerged. But this still can cause confusion. What about prototypes of inventions that pre-dated their practical implementation or patent status? The first practical automobile was officially invented in 1886, but it did not reach ubiquity until decades later (Challoner 446). Care must be taken when plotting the emergence of certain artifacts so as not to mislead. Pointing out the first functioning prototype of an incandescent light bulb was achieved in 1835 might lead some to assume that light bulbs could be found during the Civil War era, well before the time of Thomas Edison (Challoner 305). This would be a regrettable mistake on the project's behalf. The problem is compounded by instances where multiple different inventors

concurrently achieved the same discovery or goal. To remedy this, distinctions will be made where necessary, and only years and examples of technological achievements supported by academic sources will be consulted when plotting this timeline.

Within this focus, there is another goal, which is almost a separate project in its own right. For all intents and purposes, it is this project's secondary objective. As earlier mentioned, mapping out the lineage of technology is incredibly difficult. For one thing it is tedious, and it also cannot be guaranteed to be completely accurate. Doing so would require consulting the selective memory of recorded history, which is not always true to life, and does not contain all the answers. For the issues in studying the history of the closely related field of science, Kuhn writes:

> Because they aim quickly to acquaint the student with what the contemporary scientific community thinks it knows, textbooks treat the various experiments, concepts, laws, and theories of the current normal science as separately and as nearly seriatim as possible. As pedagogy this technique of presentation is unexceptionable. But when combined with the generally unhistorical air of science writing and with the occasional systematic misconstructions discussed above, one strong impression is overwhelmingly likely to follow: science has reached its present state by a series of individual discoveries and inventions that, when gathered together, constitute the modern body of technical knowledge. From the beginning of the scienti c enterprise, a textbook presentation implies, scientists have striven for the particular objectives that are embodied in today's paradigms. (Kuhn 141)

A similar problem exists in the field of technology. Nevertheless, if we acknowledge this caveat and heed it cautiously, and take the words of historical records with some scrutiny, it is possible to illustrate a narrative of technological evolution with an acceptable degree of accuracy. This is very possible, and has been done before, an

example of which can be found in Kevin Kelly's book *What Technology Wants,* which features a "genealogical tree" of the evolution of combat helmets over the last millenium, researched and illustrated by zoologist and armor expert Bashford Dean (Kelly 52). Dean's sketch demonstrates that, assuming research is adequate, technology can be chronologically mapped in a visually accessible and logical way. So, a special web/timeline system, constructed specifically to helpfully organize the plait of ideas and achievements leading to a particular invention, will be included in a separate section of the project. Even if this objective fails to illustrate the picture in its entirety, it will still provide some idea that hopefully will provoke thought on the part of the audience. It's purpose is simple: to deconstruct the misconception that inventions are the achievement of an individual, instead of the collective effort of centuries of knowledge.

One question the audience may have for this project is why it specifically focuses on technology. Technology development gives a more unique picture on humanity's progress through tangible artifacts. While inseparable from ourselves, technology has its own history, and has its own story. For example, a wheel can be thought of as a product of its time, an amalgamation of the ideas, needs and technological and material capabilities of it's inventors and users. Alternatively, a wheel can be a benchmark of commonality that links the technium of today with the past. To observe these links, patterns and shifts provides us a catalyst for thought. We become forced to consider questions that we have never pondered before. What was life like before the steam

engine? How come the paperclip was invented as late as it was? How was the first fax machine built in 1842 (Challoner 321)? The list of possibilities for self reflection is endless. Even something as mundane as a sharpened stone can illustrate the material parameters of a certain era, as well as tell us something about the human that made it.

It is exactly because technology exists in tangible form that conclusions about the past can be made with more concrete certainty than a scientific concept, which on the other hand offers no satisfying anchorage. Making a point on the unreliable chronological nature of scientific knowledge, Kuhn similarly states in *The Structure of Scientific Revolutions:*

> In recent years, however, a few historians of science have been finding it more and more difficult to full the functions that the concept of development-by-accumulation assigns to them. As chroniclers of an incremental process, they discover that additional research makes it harder, not easier, to answer questions like: When was oxygen discovered? Who first conceived of energy conservation? Increasingly, a few of them suspect that these are simply the wrong sorts of questions to ask. Perhaps science does not develop by the accumulation of individual discoveries and inventions. Simultaneously, these same historians confront growing difficulties in distinguishing the “scientific” component of past observation and belief from what their predecessors had readily labeled “error” and “superstition.” (Kuhn 2)

And so, because we cannot parse the minds of dead historical figures, the most empirical way we can judge the scientific capability and agency of past civilizations must then lay in the material they left behind. While not perfect, this offers the strongest benchmark for gauging the knowledge of mankind at a given time.

All in all, the goal of this project is simple. The planned end product is a computer program that should allow for viewers to be able to see the “big picture” of human history, through a visual, chronological display, carefully designed to be user friendly and accessible to any audience. The data it displays will be straightforward: years specific events occurred and periods of time. It will be modular, to allow for users to juxtapose any historical events or periods they want, and it should be collaborative, to allow users to submit any historical event or period they believe belongs with the rest. This means the timeline will allow audiences to make their own observations and conclusions absent of any pre-calculated experience. This project further explores a focus on technological-determinism, and to that end, will have an entire section dedicated to mapping out various technological milestones that, hopefully, will illustrate how far humanity has progressed and how long certain innovations and ideas have been around.

As a final caveat, it should be mentioned that this project is only as objective as the chronological data it displays. While it is useful as a visual tool, it is not intended to prove any agenda or lead one to any singular conclusion. It unfortunately cannot represent all of history, despite that idea of doing so being a central pillar behind the idea of this project. It is meant as a proof of concept, one that hopefully will demonstrate graphing distances between events is a helpful way to visualize the abstract concept of how long several centuries really are, and add the 3rd dimension that brings history to life in our minds. It also does not seek to prove the idea of the *regime of the present*, or

that of epistemological “gaps” beyond doubt, as these are less provable hypotheses than open thought experiments meant to provoke self reflection and consideration. For the purpose of this project, both ideas are assumed to have some justification, only so far as to inspire the idea behind it. Should they be discredited, the value of such a visual tool will remain unchanged.

Part II

The process for turning *Visualizing History* into a reality was not straightforward; there were many considerations that needed to be taken, both technical and personal, and ultimately I ended up pivoting from an ambitious goal to a more manageable one. Over the course of the semester various developments and factors came to influence this decision. In the end, the final product differed only in execution from the original idea, as instead of being an interactive program, it was constructed as an animated demonstration with a supplementary infographic series. However these changes came relatively late in the project's course, and the core idea of the project remained unchanged regardless.

Gathering my chronological data, that is the inventions and the years they were invented, was not terribly difficult. For this I consulted Jack Challoner's book *1001 Inventions That Changed The World*, which actually had more information than I could use. Certainly if I included all of the inventions mentioned the design would become too cluttered and the message unclear. My first step in narrowing down my data set was to focus on the past 300 years of the so called "modern era" from 1700 to 2018. I also 'reduced' the complicated list into manageable, color coded categories, namely: media, manufacturing, militaria, health and safety, and transportation. Even narrowed down this far there were still hundreds of examples to use with no clear message behind displaying them together.

I became faced with a dilemma in narrowing my data set: the more limited a data set is, the harder it is to clearly observe a pattern, however the more data included meant the more unwieldy the interface would become. This was also true for the timeframe, as my original thesis was based on the assumption that human history should be visualized as a whole in order to gain a useful perspective on it, and this would mean the timeline would need to stretch thousands of years back to, at the very least, the invention of agriculture. A timeframe that long was clearly not a practical goal for me, so I opted to start smaller with the past three centuries as a prototype for building off of. Because my original plan called for building a modular, open access timeline tool with pre-included data for people to use, I decided I would place the burden of responsibility for finding meaning in my included data on the user themselves, by making them choose what they wanted to display. Ultimately this was a cop-out, though it never came to fruition.

In order to save time, I carefully selected from the inventions that Challoner had curated in his book, and reasoned that he already had done the work of justifying why these specific examples were significant, and all I had to do was narrow down from his list. But there were also inventions that he did not include that I added myself, mostly in the field of militaria and weaponology that I felt was severely limited. Many of those milestones I added in that category, such as the surface-to-air-missile, speak for themselves in terms of significance, as the impacts of military technology are often easier to perceive. By this I mean it is far more compelling to consider the killing

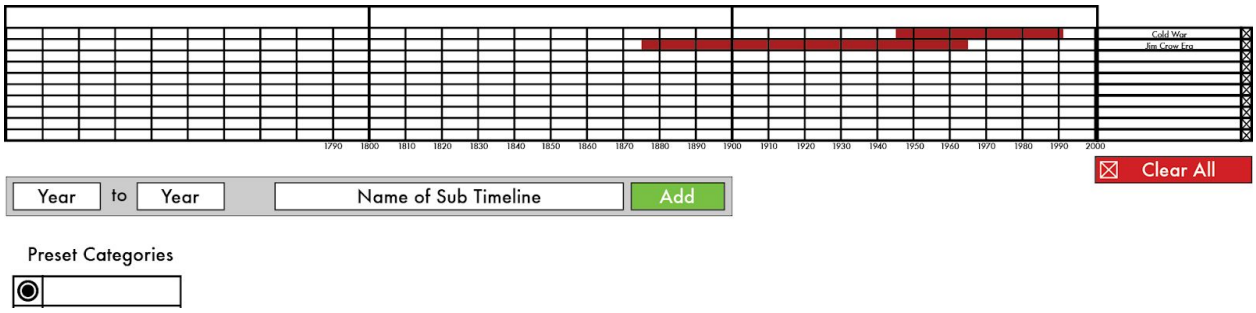
capability of a hydrogen bomb than the more subtle influence of acrylic paint on human creativity. Even the less obvious example of a combat helmet has self evident significance as a milestone of warfare.

Another problematic aspect of gathering this chronological data, especially as it relates to technological milestones, was that these technological milestones were not always reliably dated, even those of the modern era. Of course history as we know it is not an exact science, being that it relies on the theoretical agreement of multiple accounts. But for dating technological breakthroughs and inventions, more considerations had to be taken. The first was that inventions may be independently invented by more than one individual at more than one time and place, a good example of this being the incandescent light bulb, which has a disputed history. Sources might also disagree on the exact year a breakthrough was achieved, even if by a single inventor. There is also an important but often ignored distinction between when a crude prototype of an invention was made, versus when a practical application is developed, and the span of time in between these could be decades to centuries. Finally, there is another distinction in that a device or breakthrough may be invented one year, but only officially patented a few years later. For instance, Leo Szilard patented the idea for a nuclear weapon in 1934, but the first working application of this idea was only realized eleven years later. Considerations like these were important, and throughout my research I had to independently verify that certain years listed as the date for a milestone were accurate.

For some cases I specifically labeled certain milestones as being the first practical application of an idea to avoid confusion.

But data was only one side of the story. There was also a question of building the timeline interface on which to graph it. Using Adobe Illustrator I made nearly a dozen different iterations of the same basic core design template. Some were laid out on a horizontal scrolling axis, and others vertically. Different systems of labelling years, decades and centuries were tested. Most of the differences between variations were simple aesthetic tweaks to ensure a coherent, visibly effective design, such as modifying the size and thickness of the boxes representing years. All of them were based on the same guiding principles of minimal visual clutter and a logical, color coded and grid based structure organized for the eye to easily follow. It would be simple to build as it would be to use. The design, to be coded for modularity and interactivity, involved building a dynamic series of *sub-timelines* that would fit within the main *super-timeline*. Organized like strings on a guitar, each sub-timeline would be pre-labelled and pertain to a certain period or invention and could be added or deleted at the user's discretion. The idea behind this building block styled system is that the user, by placing certain sub-timelines above and below each other, would be able to observe the coincidences and trends of events and periods in history however they wanted. These observations, if any were to be made, would be up to the user's actions themselves, meaning I would have no interference in their interpretations. Even if it

turned out crude, the finished product was intended to be the small scale prototype for a more ambitious future goal.



Pictured above was the base layout for the super-timeline concept

From the start I had challenged myself with this idea to leave my comfort zone and gain experience in coding, particularly with HTML and JavaScript. I originally believed that this goal would motivate me enough to do both. But instead of it encouraging me to do either, I found the daunting task of building it discouraging and uncomfortable instead. With my limited skill set in that field, not knowing where to begin and time running out, I made the strategic choice to pivot my goal towards a medium more in my element: graphic design. Because I had enjoyed building the prototype timelines, it was suggested to me that I should continue my goal of visualizing chronological information, but in more visually interesting and creative ways. Hence I modified my project goal twofold. First, I would create a series of posters that displayed chronological information through new visual models. These would be supplementary to the main piece: an animated video intended to demonstrate the workability of the interactive timeline system.

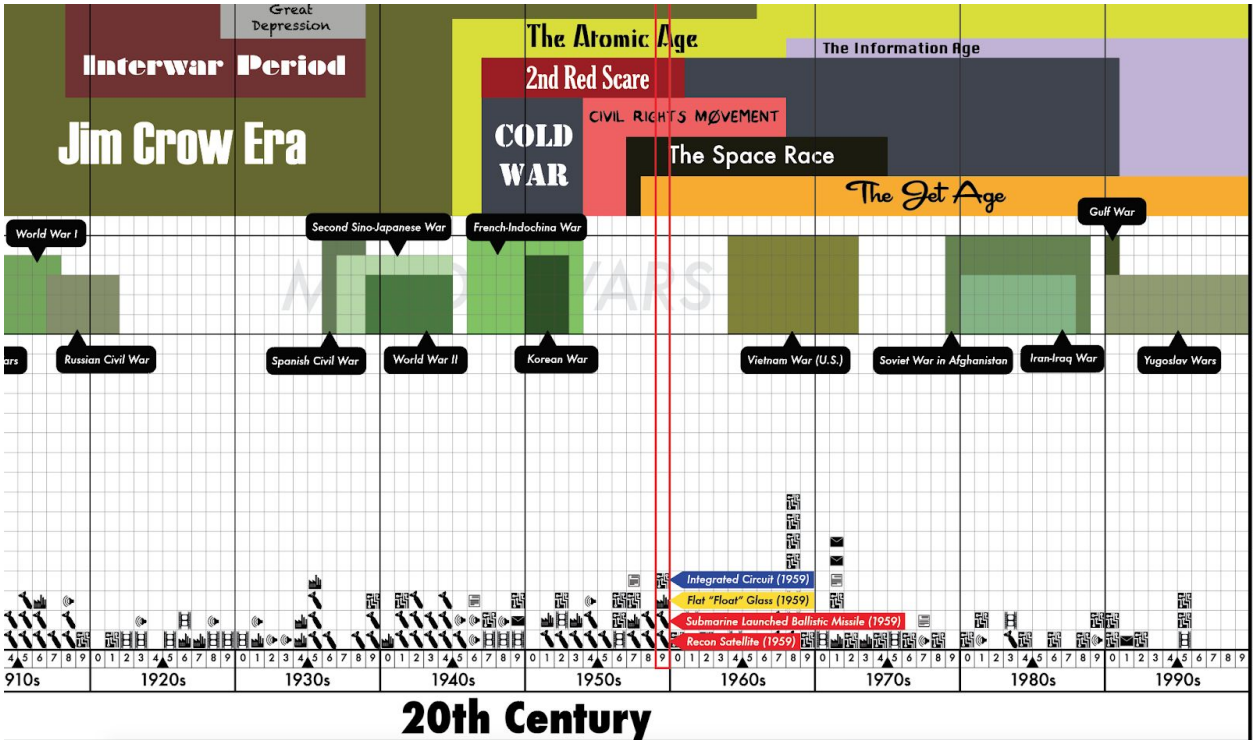
Around this time I also found a suitable *theme* behind what technological milestones I considered significant and would map. My opinion was that the technological forces that shape and guide modern industrialized civilization can be reduced to three major categories. The first category is *manufacturing*, because processes and tools for for mass production are integral to how our society is able to run on material goods. The second is *firepower/force* because the threat of institutionalized violence and multiplication of force is what is needed to keep inhabitants of civilization in line. The third and final category I consider highly significant to the modern era is *media*, namely any form of tool that allows for communication and the speedy and/or reliable transfer of information. This final category ranges from printing, film and motion picture, to radio, audio and computing and personal communication devices like the telephone. I believe the significance of all three categories are self evident, because how civilization consumes, enforces itself, and disseminates information are three elements whose implications are difficult to deny or ignore. This is especially true for the last two centuries, the history of which was impacted by all three like never before.

Around this time another uncertainty began to haunt me: who really was the audience? It made me consider the value of my concept and the purpose of creating it. While I had always intended the final product to be an open tool for the benefit of others, I found it difficult to consider how others would respond to it. Would they understand the point? Would they be interested in, or appreciative of it? It dawned on me that the biggest force behind building this system was my own interest. I was the primary audience, and it was

my own neurological disposition of needing a visual guide to digest abstract information that gave me the desire to see it through. I realized that I never thought about others not being neurologically wired the same way I was, and that I had just assumed my difficulty in learning things without visual aid was a universally shared experience. But my perception was unique to me, so I had to be true to myself in that regard. Thus I've accepted the fact that this project was primarily conceived and made for my own interests, and should it help other people, that would be a bonus.

With the meat-and-potatoes of my senior project now planned as a video, I began constructing a large color coded timeline in Illustrator to be animated in After Effects. At the advice of a few professors, I shortened the timeframe of the video to the past two centuries instead of three, and decided not to include the past two decades of the 21st century. Feeling that the color coded milestone blocks were not visually helpful or eye-catching, I decided to replace them with a series of pictograms representative of their technological category. An aerial bomb would represent firepower, a factory for manufacturing, and to organize all the various forms of media more conveniently, a film strip, speaker, circuit board, printed page and envelope were used to represent each sub category. Also included in the video were a series of color-coded and labelled blocks that denoted specific historical eras, such as the Romantic Era and The Great Depression. Blocks representing major wars were also provided. These additional elements would add more visible historical context to the technological milestones, and it would show just how these breakthroughs, conflicts and periods coincided with one

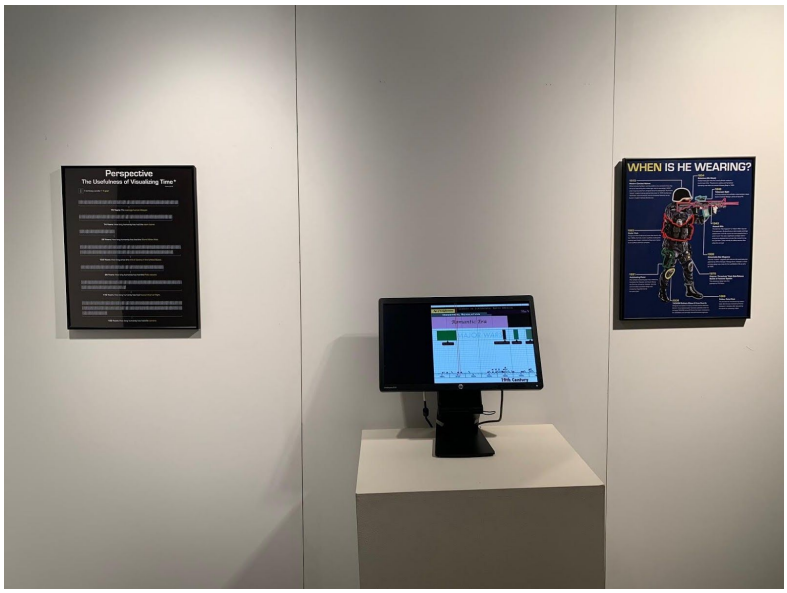
another in a clear way. As the video scrolls from right to left, a fixed red “slider” box positioned down the middle of the screen would align with the column of a specific year. If the column of that year contained a pictogram marking a technological milestone, a label denoting what it is would briefly appear next to it. This design would simulate a new concept for the interactive timeline: technological milestones, instead of being labelled along the Y axis where they would accumulate space, would simply have a label that appears when hovered over. This new idea emerged relatively late in the development process, coinciding with the decision to use pictograms instead of colored boxes.



The final design for the animated video layout

Creating the poster portion of this project was much less simple than the animated demonstration. These investigative standalone infographics had to have an interesting twist, and so it became a question of displaying chronological information in a non-linear way. Conceiving of new ways to do this was not simple. There still remain many unrealized possibilities for doing so, but in the end I only had time to construct two examples. The first was a twist on the iconic Hollywood question “who are you wearing?”. The headline for this poster was instead “*When Is He* Wearing” and it labelled the gear and accessories of a SWAT officer by the year each piece of technology could be reliably traced back to, as well as including some historical information surrounding that breakthrough. I consider this first poster to be highly successful. It’s vaguely politically charged subject matter (which suggests the militarization of police), and strikingly visible design make it grab the viewer’s attention while avoiding an overt message. The second poster investigated the idea of visually years gone by not as an abstract numerical value but as a visual element, in this case a birthday candle representing a single year. The age of certain breakthroughs and historical periods, for instance the invention of the atomic bomb and the end of slavery in the United States, were illustrated by the amount of candles representing the years that had since passed. Though this design was less visually interesting than the former, it was successful in that it helped demonstrate the main point behind my project as a whole: the idea that illustrating a value like age can be more compelling than using numbers. In my opinion, it’s inclusion in my project’s exhibit worked very well in

providing an introductory context that otherwise might have been lost to the viewer, though this effect was not intentional.



The project as it appeared after installation

Though my final timeline animation proved to be an effective proof of concept for my idea, I believe it's execution could have been improved. One of the main outcomes I intended for in creating this project was to be able for it to communicate meaning through data represented. This would have been ideal for an interactive graphic system. The limitations of video, however, weakened this effect. It became apparent that in order to lead viewers to find draw more compelling narratives from these technological milestones,, the video would need to display a greater amount of chronological data. More visual clutter would not be a problem, if not for the constant motion of the video as seen in it's installed form. At some points, the video was already in fact pushing the limit

on what could reasonably be read by a viewer while it progressed. If viewed by itself without these compelling and visible patterns, the bigger picture would be much less apparent to an observer, and it could give the impression that it is about dating the individual inventions rather than the entire trajectory they aim to illustrate. Fortunately with my investigative posters at each side, as well as an explanatory message I created at the beginning of the video, there was enough context provided for my project's intent to be understood. Aside from this, the video as it existed installed suffered a minor cosmetic setback. The "background" of the animated video, which for convenience sake was a flat image, did not render in a resolution intended for the final video. Even after a second attempt to fix this problem, it remained pixelated but still legible. Another consideration was the videos speed, in particular how briefly the milestone's labels flashed on the screen, though this was only a concern when multiple labels would need to be read for one year. In any case, the running time of the video, roughly three minutes, was short enough that it looped in convenient intervals for viewers to catch what they might miss, making this factor less of an issue.

As mentioned before, this project exists as a proof of concept, a role it serves adequately. Of course, this means that it has the potential to be developed much further, with a much larger and ambitious undertaking that would require a great deal more research, labor and time than I had available for this project. Static and close-ended implementations do not do the core idea behind my project the service it requires, and for that reason the original motive I began this project with remains

unsatisfied. To allow the bigger picture to be seen, and the viewer to be able to make their own judgements without restriction, means building a software program that allows for their participation through open access customization. But even so, while not in its ideal form, the value of this project has been crudely demonstrated as reasonably functional and technically attainable. It is proof that a modular program, laid out in a similar way and with similar visual elements, can be a practical tool that anyone can use or gain information from. The logic has been proven sound, and now my goal has become turning this ambitious idea into a reality.

Aside from learning lessons in collecting data and building an effective timeline design, I've also gained an appreciation for the new possibilities in visualizing history non-linearly. Besides the posters which were included in my final exhibition, there were other less successful experiments I abandoned, and they taught me valuable lessons for the practical communication of data. For example, I've learned to consider that designs for doing so not only must be legible and logical, but that any shape it takes effects the pattern it intends to show. Sometimes a pattern you intend to show may be vague or even non existent. Beyond this, I've come to find that graphically mapped data is not the only way to communicate my idea for this project, as the poster for "When Is He Wearing" demonstrates. And so I also aim to further explore this with future standalone infographics using new visual methods.

As it stands, I consider the results of this project a success. The final video represents the points this project set out to make from the beginning. While only displaying a chunk of human history, it makes an effort to display periods and eras not in the fragments we are often taught in, but through interconnected pieces of a much larger puzzle. It shows just how recent or distant several key technological developments have occured, and how they coincide with historical periods and conflicts, to paint a “bigger picture”. The accompanying infographics communicate my idea that chronological information is much more compelling when given a visual twist. The video, even with the limitations of it as a medium, was nevertheless able to demonstrate the feasibility and functionality of a dynamic timeline system. All of this, and all the considerations and lessons I’ve experienced in building this project, have given me a valuable understanding in undertaking a large creative endeavor, and will undoubtedly serve to guide my future as I pursue the potential behind this idea further, as well as continuing to fulfill a number of other artistic enterprises.

Bibliography

"The History of Data Visualization." *Dashboard Insight*, 13 September 2013. http://www.dashboardinsight.com/news/news-articles/the-history-of-data-visualization.aspx

A brief overview of the development of information visualization from its roots in the Early Modern Era. This is useful for illustrating how the technology of data visualization has evolved, shaping the way we perceive large concepts.

Bloch, Marc. *The Historian's Craft*. Manchester: University of Manchester Press, 1967. Print.

A book that deals with what constitutes history and how it should be written, from multiple angles. This is a useful resource for allowing one to understand the mindset of a historian and the ethical and practical considerations they must make in their work.

Challoner, James. *1001 Inventions that Changed the World*. Hauppauge: Barron's Educational Series Inc., 2009. Print.

This book is a rich resource for finding the approximate years of human technological breakthroughs.

Gleiser, Marcelo. "The Problem With The Clockwork Universe." *NPR*, 22 January 2014, https://www.npr.org/sections/13.7/2014/01/22/264504218/the-problem-with-a-clockwork-universe. Accessed 11 December 2018.

This article explains the Enlightenment concept of a "Clockwork Universe" and deterministic worldviews.

Heilbroner, Robert. "Do Machines Make History?" *Does Technology Drive History?*, edited by Leo Marx and Merritt Roe Smith.

This essay is significant because it ties into the Marxist origins behind technological determinism.

James, William. *The Principles of Psychology*. University of Michigan. 1985. Print.

Helpful to understand and supportive of the concept behind the "regime of the present".

Jancewicz, Ben. "How White Supremacy Attempts to Make Slavery and Segregation, 'Soooo Long Ago.'" *Zerflin.com*, 2016,

https://zerflin.com/2016/04/06/client-highlight-how-white-supremacy-attempts-to-make-slavery-and-segregation-soooo-long-ago/

This infographic and it's mission of demonstrating the relative recency of historical events that are widely considered "long ago" is partially what inspired my own project.

Kaczynski, Theodore. *Technological Slavery: The Collected Writings of Theodore J Kaczynski AKA The Unabomber*. Port Townsend. Feral House Publishing, 2010. Print.

This collection of Kaczynski's writings is useful for understanding hard technological determinist stance.

Kelly, Kevin. *What Technology Wants*. New York: Viking Press, 2010. Print.

A technological theorist and critic who founded Wired.com, Kevin Kelly recounts the history of our civilization's relationship with technology and its implications, as well as citing the ideas of thinkers on the subject from previous decades and eras.

Kuhn, Thomas. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press, 1962. Print.

In this text Kuhn coins the term "paradigm shift" and gives strong explanations on the difficulties of chronologically mapping scientific progress.

Marx, Leo and Merritt Roe Smith. *Does Technology Drive History? The Dilemma of Technological Determinism*. Cambridge: MIT Press, 1994. Print.

This text features essays on technological determinism by several thinkers, outlining the history and major points it entails, and criticisms of it as a theory. It is helpful to provide a background for the research of this paper and provide historical and theoretical context.

Mumford, Lewis. *Technics and Civilization*. New York: Harcourt, Brace and Co., 1934. Print

Lewis Mumford is one of the first 20th century critics of technoculture as well as one of the first authors to publish works on the topic. He is cited by many other scholars and had a profound influence on technological determinism as a whole.

Priestley, Joseph. "A New Chart of History." *The New Atlantis*, Alan Jacobs, 2010, https://www.thenewatlantis.com/imgLib/20110127_TNA29JacobsPriestleylg.jpg

This image is one of the earliest ever recorded chronological timelines, and is a primary example of the idea that history can be visually represented. Furthermore, being relatively recent in terms of history, it demonstrates how new the idea of the "timeline" and data visualization is.

Quaranta, Domenico and Antonio Caronia. “Einmal Ist Keinmal: Observations on Re-enactment” *RE:Akt! Reconstruction, Re-enactment, Re-reporting*. Lulu.com. 2013. Print.

This text has an excellent explanation of Camiel van Winkel’s concept of the “regime of visibility”.

Rosenberg, Daniel. “The Trouble With Timelines.” *Cabinet Magazine*. 2004. http://www.cabinetmagazine.org/issues/13/timelineIntro.php Accessed 10 December 2018.

This article by Daniel Rosenberg is helpful for understanding the history behind timelines and the pioneer Joseph Priestley, who popularized the concept, as well as their limitations.

Schofield, Robert. *The Enlightened Joseph Priestley: A Study of His Life and Work from 1773 to 1804*. University Park. Penn State University Press. 1997. Print.

This is a biography of Joseph Priestley who is an important figure to mention as he developed one of the first methods for the “chronography” of time.

Priestley, Joseph. *The Theological & Miscellaneous Works of Joseph Priestley*. London. G Smallfield. 1817.

This book contains the thoughts of Joseph Priestley in his own words, who pioneered the concept of chronography and was responsible for one of the first attempts at a comprehensive timeline for all of human history as an educational resource.

Tew, Daniel J. “Pedagogy of Teaching History: Comparing the Chronologic and Thematic Approaches” (2014). *Honors Senior Theses/Projects*. 14.

Tew’s thesis gives an important background on understanding the pedagogical practices of history education.