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# Diagrams of the past: How timelines can aid the growth of historical knowledge

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**Abstract:** Historians occasionally use timelines, but many seem to regard such signs merely as ways of visually summarizing results that are presumably better expressed in prose. Challenging this language-centered view, I suggest that timelines might assist the generation of novel historical insights. To show this, I begin by looking at studies confirming the cognitive benefits of diagrams like timelines. I then try to survey the remarkable diversity of timelines by analyzing actual examples. Finally, having conveyed this (mostly untapped) potential, I argue that neglecting timelines might mean neglecting significant aspects of reality that are revealed only by those signs. My overall message is that once we accept that relations are as important for the mind as what they relate, we have to pay closer attention to any semiotic device that enables or facilitates the discernment of new relations.

**Keywords:** timelines, diagrammatic reasoning, historiography, inference, abduction

## 1 Introduction

Many lay and professional articles, books, and websites about history use timelines. There are two ways of looking at this. One is to regard timelines as expository devices that come *after* historians have done their job. This is arguably the dominant view, perhaps because it rarely comes under any scrutiny. The other way of looking at timelines is to regard their use as an *integral part* of historical inquiry. I want to motivate the latter view, which says that timelines are, or at least should be, an integral part of how we come to know the past.

We do not fully understand how timelines work, exactly. Spatial depictions of historical time have been prominent in the West since at least the middle of the eighteenth century (see Rosenberg 2007), but in spite of the fact that “we use chronologies all the time, and could not do without them, we typically see them

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as only distillations of complex historical narratives and ideas” (Rosenberg and Grafton 2010: 10). I want to argue, though, that a full consideration of timelines challenges this view – or at least shows its limitations.

Promising investigations of timelines have been conducted (I will look at these), but so long as the use of these devices is considered lowbrow by professional historians and suspect by professional philosophers, our understanding and appreciation will progress at a slower pace than it could/should. So, in an effort to disabuse those professions of unhelpful apprehensions, I will look at studies confirming the cognitive benefits of diagrams like timelines. I will then survey the remarkable diversity of timelines by analyzing some actual examples taken from the wild (i. e., the internet). As we will see, one of the most basic functions of timelines is conjunction, at once visual and logical. Since historical facts mean very little in isolation, I will argue that neglecting the patterns revealed by such conjunctions might mean neglecting significant aspects of reality.

## 2 Timelines as instruments of diagrammatic reasoning

Like all images, timelines let viewers scan them at various places. Importantly, this back and forth of the gaze is not merely visual, but it also supports inferences. We can bring questions to bear on images and those questions can be affirmed, confirmed, or morphed into a new set of questions.

This inferential potential becomes more pronounced when parallel timelines split events into two or more groups, so as to make explicit both thematic unity (on a line) and disunity (on a different line). Such an organization compels interpreters to reassemble data from different domains, thereby revealing connections that might have otherwise gone unseen. Consider a recent study that used a “virtual environment” to divide historical events into three domains: art, psychology, and general history, as illustrated in Figure 1.

Subjects in the experiment were able to interact with the three timelines by shifting lanes, as it were, and also by moving backwards and forwards. Even though participants were not told the goal of the study, when they were tested two weeks later, they showed an increased ability to recall the information shown, as compared to a control group that had used booklets. Researchers explain that, “[a]ccording to the verbal reports of [virtual environment] participants, the most important factor that helped them achieve high scores [...] was their ability to connect events with each other – to see a structure and a point of



**Figure 1:** Virtual environment with multiple timelines (taken from Korallo et al. 2012: 858).

reference, being able to look across the three timelines, suggesting in turn that they were genuinely using a ‘survey’ form of cognitive representation” (Korallo et al. 2012: 860).

As one makes connections not previously made, novel features can come into view. The discovery of such a relation may be just as important as the discovery of a relatum. The Rosetta Stone, for example, reshaped a large region of our web of belief precisely because Egyptologists were able to relate it to pre-existing questions and concerns regarding the meaning of hieroglyphs. Now, if the activities of finding relata and finding relations are continuous manifestations of a common quest to understand the past, then scrutinizing timelines can potentially lead to further findings. This does not mean that we can dispense with frontline research. But, if one manipulates a stock of acquired findings, anything gleaned by those manipulations should only benefit the cause of historical inquiry.

### 3 Diagrammatic reasoning and the growth of knowledge

Juxtaposing timelines from different domains can facilitate memory, but there is more at stake here than increased recollection. At the height of logical positivism,

Otto Neurath wrote that “*Wenn der Zoologe Tiere, der Botaniker Pflanzen unterfucht, fo wird kein neues Gegenstandsgebiet erfchlossen, falls jemand die Beziehungen zwischen Tieren und Pflanzen unterfucht*” [If the zoologist investigates animals and the botanist investigates plants, no new object-region is opened up if somebody investigates the relation between animals and plants] (1935: 400). This view fails to explain why the activity of weaving relations is so cognitively taxing. It also fails to explain why the activity of weaving relations is so scientifically rewarding. Indeed, the case could be made that, over the last century, some of the most important scientific advances have been interdisciplinary in nature.

Echoing this, researchers using timelines in virtual environments suggested that, properly harnessed, timelines might allow subjects to “potentially understand more about what happens in different disciplines at the same time, and in turn build up relationships between events and help them to understand more about cause and effect phenomena” (Korallo et al. 2012: 861). Some studies have even shown that, by fine-tuning our awareness of “where” we have been and “where” we are going, timelines can reduce stress (Mazzetti and Blenkinsopp 2012) and even improve emotional coping (Curry 2009). Preliminary results like these suffice to prompt a closer examination of timelines.

Timelines seem able to make higher-level abstractions (like figuring out what unites zoology and botany) accessible to lower-level channels (like seeing that this is to the left of that). How all this occurs is not entirely clear. Yet, it is very likely that Williams James was right when he suggested that “the relations between things [...] are just as much matters of direct particular experience, neither more so nor less so, than the things themselves” (1977: 136). One way to handle complex historical knowledge, then, is to embody portions of the vast data in sign-vehicles that can be directly experienced.

James’ friend and fellow pragmatist, the American polymath Charles Sanders Peirce, believed that all knowledge is inferential and that all inferences are a form of diagrammatic reasoning. Peirce defined a diagram as a sign-vehicle whose relations resemble the relations of its object (1931–1958: v. 2, ¶ 277).

Timelines fit this description in several respects. First, the points on a line are not themselves past events, so only the relational skeleton between those *relata* is represented. Second, time is linear, and so are most timelines. This allows us to order items in “before” and “after” relations. Transitivity applies. Thus, if you were born after John F. Kennedy and John F. Kennedy was born after Beethoven, then you were born after Beethoven. Third, timelines can depict spans of time in a way that preserves their relative scale. Not all timelines strive for this extra degree of iconic motivation, but many do. Thus, if the duration of an event like the so-called “Hundred Years War” is one-tenth of a millennium, a timeline could preserve this 1:10 ratio regardless of the length it occupies on a page, thereby allowing

observational inferences. If, as a matter of fact, the “Hundred Years War” did not last a century, this information could also be stored and retrieved in the diagram. Hence, signs like timelines “may be criticized for showing only selected aspects of the territory” that they are about, but “*all* representations are bound to make such selections, without this in any way preventing them from potentially representing the aspects so selected in a truthful way” (Stjernfelt 2014a: 414).

Timelines can thus offer cognitive advantages that symbols like numbers and letters cannot match. One of these advantages is the ability to halt certain fallacious patterns of reasoning. Consider, for example, what is known as the “base rate fallacy” (Bar-Hillel 1980). Studies have shown that subjects routinely encounter an innate difficulty when compounding ratios. For example, suppose that there is a given quantity,  $x$ . If subjects are presented with a low subset of  $x$ , say 10 %, and then asked to extract a high percentage from that subset, say 90 %, a recurring bias will have them mistakenly foreground the higher fraction. Under its influence, subjects will tend to wrongly estimate 90 %-of-10 % as being higher than, say, 30 %-of-90 %.

Findings like these have increasingly led researchers to distinguish between “System 1” and “System 2” thinking (Kahneman 2011). System 1 thinking is quick and automatic, whereas System 2 thinking is slow and reflective. When subjects latch onto the larger percentage while forgetting the rate on which it was based, it is because their System 1 heuristics kick in. From an evolutionary standpoint, both systems have proven reliable, but they are obviously suited to different contexts. Theorists usually associate logical reasoning with System 2; in fact, this association is almost defined into the dual systems account. However, one of the most promising benefits of employing iconic signs like diagrams is that they carry some of the System 1 efficacy over to System 2 tasks.

Consider again the ingrained biases with compounded ratios. What happens when the same problems are posed in a diagrammatic idiom instead of a numerical one? Here, an iconic rendering seems to make the base rate fallacy less likely. Indeed, if one depicts the comparison as a collection of parallel lines instead of numerical symbols, as shown in Figure 2, it is literally apparent which option is larger.

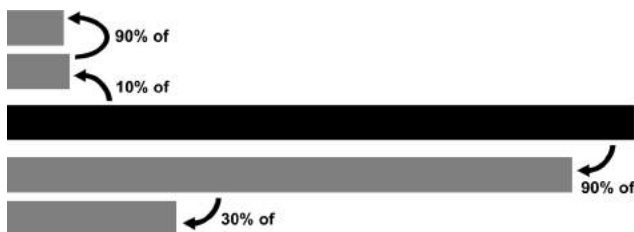
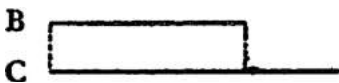


Figure 2: Parallel lines halting the base rate fallacy.

When the situation is rendered as a diagram, the fact that 90 % is larger than 30 % no longer obscures the final assessment: the image above clearly shows that the top-most line is shorter than the bottom-most line. Perceptual discrimination notwithstanding, there is no need to draw another image comparing the top and bottom line, since that comparison is already included. Draw the question well, and in the process you draw the answer. That is what led Peirce to say that “a great distinguishing property of the icon is that by the direct observation of it other truths concerning its object can be discovered than those which suffice to determine its construction” (1931–1958: v. 2, ¶ 279).

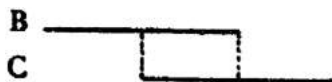
In Figure 2, one can make this difference in length even more vivid by dragging the outer lines closer to each other (for more on such diagrammatic interventions; see Stjernfelt 2014b: 263–292). Either way, because the appeal to vision is more powerful than the appeal to the intellect (*pace* the dual-system account), the base-rate fallacy loses its grip. Comparing quantities using visual magnitudes thus seems to be more cognitively natural than comparing quantities using symbols (Moyer and Landauer 1967). The same power that generates optical illusions can generate optical insights.

Just as parallel lines are well-suited to express relative amounts, they are also well-suited to express relative durations. Quite simply, given a fixed legend, a longer line takes more time than a shorter one. Interestingly, Leonhard Euler (1835) considered spatial inclusion as the natural counterpart of logical inclusion. Friedrich Lange (1877) went even further, surmising spatial inclusion grounds all logical inclusion. Exploiting this, Gottfried Leibniz, co-inventor of the calculus, thought that a proposition like “All Bs are Cs” (e. g., “All humans are animals”) could be shown with the lines of Figure 3.



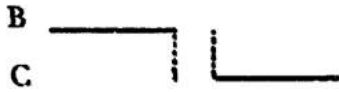
**Figure 3:** Parallel lines showing “All Bs are Cs” (taken from Leibniz 1903: 292).

In the same vein, a proposition like “Some Bs are Cs” (e. g., “Some humans are wise”) would be the one shown in Figure 4.



**Figure 4:** Parallel lines showing “Some Bs are Cs” (taken from Leibniz 1903: 293).

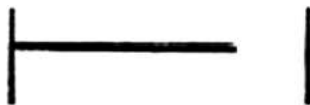
A proposition like “No B is a C” (e. g., “No human is a stone”) could be rendered diagrammatically as in Figure 5.



**Figure 5:** Parallel lines showing “No B is a C” (taken from Leibniz 1903: 293).

Although stipulations must come into play in order for these diagrammatic signs to make sense, there is something intuitive about their proposed interpretations. Indeed, one recent study showed that subjects are better at estimating the duration of events when they venture their estimates with lines instead of with numerical values (Carelli 2011). Of course, in actual sign-use, conflicting psychological factors come into play. For instance, research by Zerubavel (2003) suggests that subjects tend to shorten intervals between events when those events are perceived as similar, whereas they tend to lengthen intervals when the events are perceived as dissimilar. A tenable cognitive semiotic account of timelines would have to acknowledge all these messy details. Still, using diagrams may be a way for historians and history teachers to harness the power of System 1 in order to overcome the slow defects of System 2.

Professionals charged with coordinating long-term construction projects (like digging a subway or building a hydroelectric dam) often use what is called a “Gantt chart.” No human mind can fathom a plan on so vast a scale. Gantt charts break the activity into manageable steps, so that planners can see whether the collective endeavour is on time or falling behind schedule. Thus, in Figure 6, the horizontal line shows an estimated completion time, while the total horizontal space between the two vertical lines represents the time actually taken to complete the task.



**Figure 6:** Line showing and anticipated and completed task (taken from Clark 1923: 36).

In this case, work has been inefficiently carried out. Segments like these are combined to form longer series of lines that run parallel to each other, thus mapping the entire project, as shown in Figure 7.

The goal of such a map is to track how fact and forecast match or mismatch over time. Here is how one engineer described such timelines: “Unlike statistical diagrams, curve records, and similar *static* forms of presenting facts of the past (Gantt) charts [...] are *kinetic*, moving, and project through time the integral



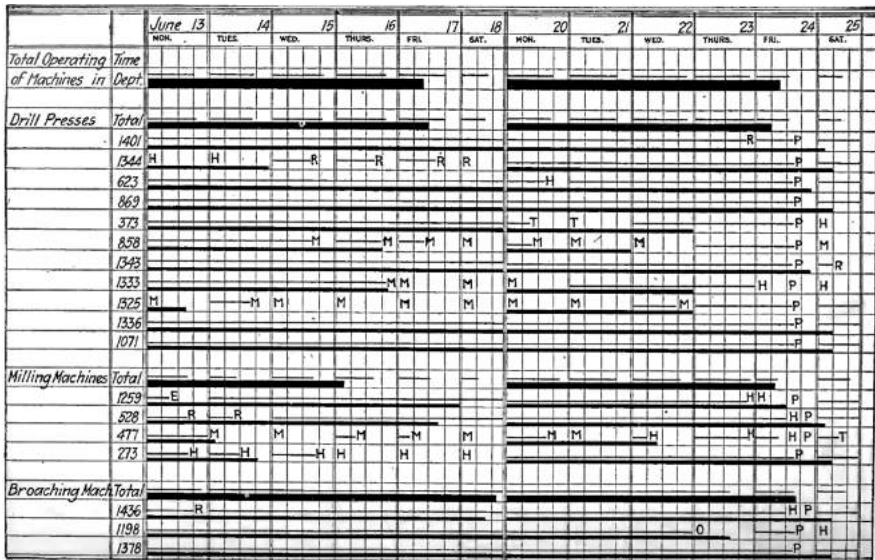


Figure 7: Timeline of project completion (taken from Clark 1923: 24).

elements of service rendered in the past toward the goal in the future” (Clark 1923: 21; compare this remark with Pietarinen 2006: 103–108).

Large-scale collective undertakings would be literally un-thinkable without the synoptic vantage afforded by these visual tools. If this applies to looking forward in time, then surely it applies to looking backward too, since understanding an historical event as complex as, say, the Quiet Revolution in Québec, is arguably as challenging as understanding a complex construction project.

## 4 No time to study timelines?

If there is such a thing as “external cognition” (Scaife and Rogers 1996), then it stands to reason that there may also be “cognitive artifacts” (Norman 1991) that aid our minds in the manner that tools aid our hands. Recent years have witnessed a growing appreciation of how diagrammatic representations in particular can assist human reasoning.

With different emphases, linguists (Simone 1995; Van Langendonck 2007), logicians (Shin 1995; Hammer 1995; Allein and Barwise 1996; Pietarinen 2011), historians of mathematics (Mancosu et al. 2005; Giaquinto 2007), semioticians



(Stjernfelt 2007; Bordron 2011; Dondero and Fontanille 2012; Pombo and Gerner 2010), and cognitive scientists (Glasgow et al. 1995; Hoffmann 2011; Magnani 2011; Nakatsu 2010) have all recognized that a better understanding of reasoning by diagrams is crucial to understanding problem-solving, inference-drawing, and hypothesis-making.

Strangely, despite the “spatial turn” in the humanities (see Jerram 2013), this recent wave of research on diagrams has not yet reached the shores of history. No one objects to using timelines as pedagogical aids (Denial 2013; Hoodless 1996; Masterman and Rogers 2002). But, outside the classroom, we find resistance to the idea that manipulating diagrams might yield genuine historical insight. Timelines, it seems, are meant for history teachers, not historians.

There is “a prevalent prejudice that visual images are in some intrinsic way arbitrary, vague, and ambiguous,” which in turn “encourages the view that images are less precise than words, and especially the written word” (Birdsell and Groarke 1996: 1–2). It is apt to call this a prejudice, since only some signs (typically icons) receive such complaints, whereas others (typically symbols) get a free pass. “Of course, pictures may be misleading. But, so may sentences” (Moktefi and Shin 2013: v). For the most part, semiotic inquiry has gotten past such “glottocentrist” prejudices (see Deely et al. 1986). However, for a host of reasons, large segments of historical scholarship remain mired in language-centred assumptions. This may explain why iconic devices like timelines remain so poorly understood, with hardly anyone noticing or deploring the lacuna. Yet, if it is true that “the past is chaos to pupils – until sequenced” (Wood 1995: 11), then I see no reason why it should cease to be true when it comes to adult cognition.

While I do not want to downplay the power of words as conveyors of meaning, I do want to call attention to the blind spots that ensue when one forgets that linguistic symbols – the sort that can be strung together according to a code – are only one kind of sign among many.

## 5 The forced choice between narrative and evidence

One way to diagnose the neglect of timelines is to see it as a failure to do justice to the full range of meaning conveyance. Things can be significantly related to other things in three ways: by convention (which is what links the marks “milk” to the nutritious white liquid), by causality (which is what links dilating mercury to the ambient temperature), and by similarity (which is what links an upright pencil to a straight bodily posture). These are symbolic, indexical, and iconic

relations, respectively. All signs acquire their meaning by blending these connections, but we can nevertheless conceptually tease apart what is responsible for what in a given instance.

Within this threefold taxonomy, the unique contribution of iconic signs (like diagrams) has, on the whole, been eclipsed by a recurring belief that language can only be tethered to the world by *causal* means. The analytic philosopher Bertrand Russell (1910–1911) had this in mind when he coined the distinction between “knowledge by description,” which uses symbols, and “knowledge by acquaintance,” which uses indices (like “Look at this here now”). So, in the analytic tradition inspired by Russell it is held that, without regular policing by direct empirical acquaintance, the descriptions of language will fail to have real referents.

These worries are particularly acute in historiography. History, we are often told (notably by Windelband 1900/1998), is an “idiographic” endeavour to catalogue discrete facts that, unlike the “nomothetic” sciences, cannot induce generalizations from those facts. If one accepts this, then historians have a thankless job, since the moment they write about their results in prose, they introduce hermeneutic distortions that they must then strive to minimize. The addition of linguistic symbols is tolerated as a necessary evil, but museums and archives are tasked with housing the original indices that prevent scholarship from lapsing into purely fictional discourse (see Derrida 1996). Arthur Danto (2007: 122–130) therefore brought Russell’s acquaintance/description distinction to philosophy of history by distinguishing between “conceptual” and “documentary” evidence. Evidence of the latter sort can be used by those who fear that “the revival of narrative may lead to a return to pure antiquarianism, to story-telling for its own sake” (Stone 1979: 22–23).

Many semioticians consider language to be an outgrowth of more basic forms of semiosis (Sebeok 1991). But, if one considers language to be a sign-system inherently closed-in on itself, then language has to float away from the world, since it has been detached from the get-go. Thus, “in the course of one hundred years of philosophy of language, a whole galaxy of epistemological and ontological concerns has developed around the paradigm of the true sentence, exercising an enormous quasi-gravitational pull on all discussion of the notions of meaning, truth, and reference” (Ankersmit 2013: 173).

Timelines do not fit well into this narrative about the pitfalls of narratives. Iconic signs submit various qualities to observation, but they do not impose those qualities on interpreters with the same forceful actuality as indices. One can robustly demonstrate the Pythagorean Theorem (see Danesi and Bockarova 2014: 10–13), but the relational insights housed in such diagrams do not slap viewers in the face. Because of their intrinsic character, these signs tell us, in

effect: “This *could* hold.” It is important to bear in mind this modal strength, since icons do not “assert” anything. This suspension of truth or falsity may explain why timelines have been invisible to the “paradigm of the true sentence” (Ankersmit 2013: 173). Thus, in the controversy between fixation on language and fixation on hard evidence (Roth 2007), the unique contribution of quality-based signs has been, for the most part, overlooked.

This general neglect of iconic signification is now being rectified (since at least Eco 2000). In keeping with this welcome trend, I want to look at salient examples of temporal diagrams in order to show how historical claims can sometimes be prompted by – and answerable to – an iconic dimension. Educators can use timelines to teach, but the service is reciprocal, since timelines can teach us as well.

## 6 The remarkable diversity of timelines

As images, timelines are not completely self-explanatory. Given that the codes needed to interpret timelines often remain unstated, I want to walk slowly through a few actual cases in order to unpack some of the pictorial strategies employed. Some of these strategies include: the relation between sequentiality and proportion, left-to-right convention in representing sequentiality, number of domains and parameter simultaneously depicted, strategies to reduce information clutter, strategies to represent uncertain periods of time, semantic associations implied by spatial relations, and interaction between chronological and non-chronological representations. A desideratum of a fully developed theory of timelines would be to identify what, if anything, all these meaning-generating strategies have in common (for a partial attempt, see Yakura 2002), but my modest goal in this section is to comment on notable specimens in a way that can eventually contribute to such a theory.

In contrast with the diversity of approaches that we find in the discipline of history (the *Annales* School, deconstruction, cliometrics, etc.), it seems to be assumed, quite uncritically, that timelines come only in one or two basic formats. The example of Figure 8, which traces the history of technological advances, is quite standard. The intervals are not proportional to time, so the sequence seems to matter more.

Interestingly, many of the timelines used in scientific journals have to do with the idea of progress; the journal *Nature Reviews*, for instance, regularly features timelines showing that things are steadily moving forward (particular uses of this format can have political connotations; as brought out by Ihde 2000). The timeline

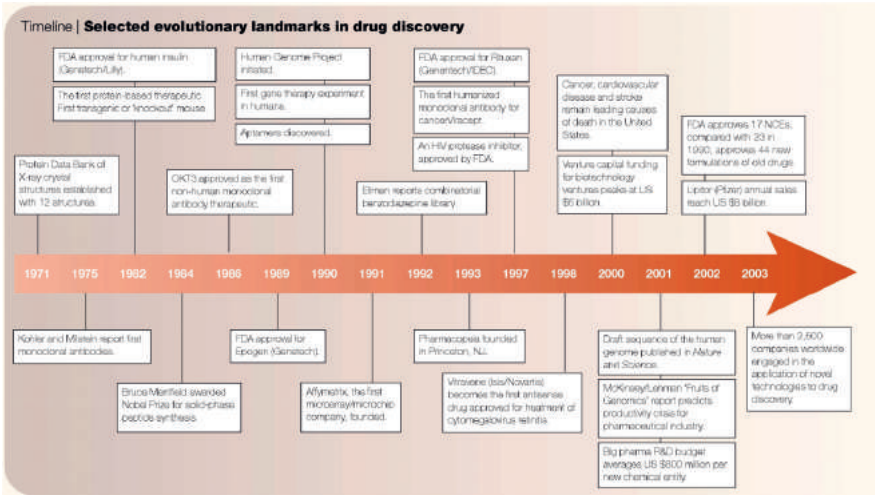


Figure 8: Timeline of drug discoveries (taken from Gershell and Atkins 2003: 322).

of Figure 9 also shows a linear progression. However, perhaps recognizing that advances in hair removal are not as momentous as pharmaceutical innovations, it puts arrowheads on both ends of its line, which makes it seem less triumphant.

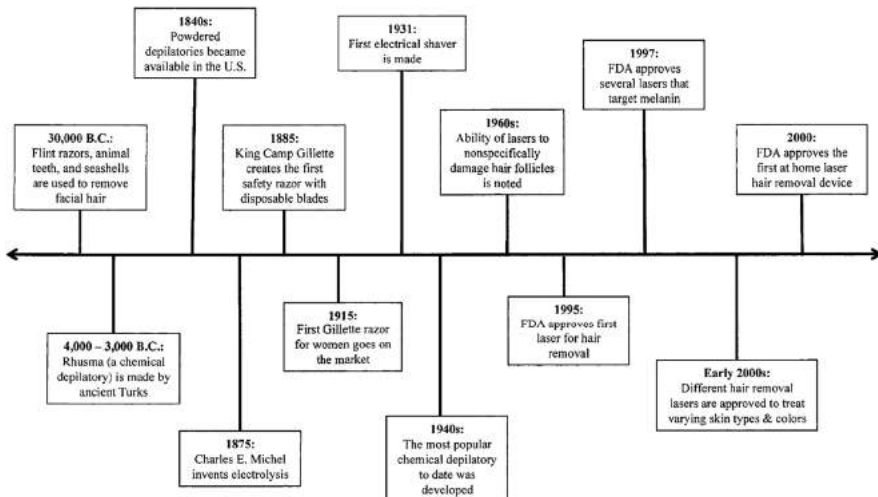
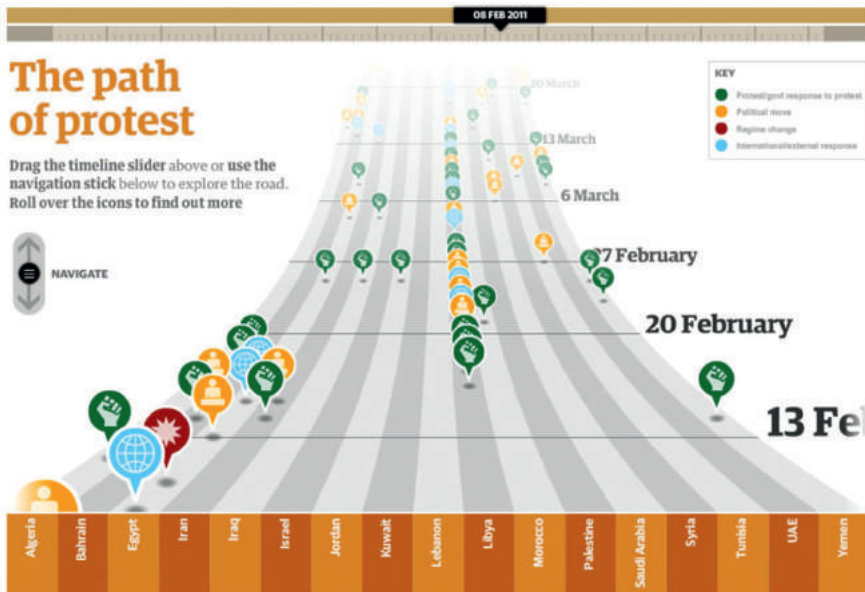


Figure 9: Timeline of hair removal methods (taken from Fernandez et al. 2013: 157).

Most of the timelines found in journal articles proceed from left to right. However, time certainly does not “move,” much less from left to right. Conventions in our use of symbols therefore colour how we view the passage of time. Indeed, experimental evidence suggests that most people are disposed to process temporal information in a left-to-right manner (see Ouellet et al. 2010). Even so, there is no reason for timelines to have this specific diagrammatic format, so abiding uncritically by a blanket convention may blind us to certain possible relations.

Some of most innovative timelines come from web pages unconstrained by the burden of academic conventions. The specimen of Figure 10 shows events using a first-person perspective.



**Figure 10:** Timeline of social protests (taken from <http://www.theguardian.com/world/interactive/2011/mar/22/middle-east-protest-interactive-timeline>).

As was the case with the virtual environments of Figure 1, the lines follow laws of perspective, converging onto a horizon. The fact that this timeline is interactive positions the interpreter, making her a participant in the event; a fellow-traveller, if you will. To advance in time, one must move forward, not sideways (as is usually the case). Clearly, this “forward” movement can elicit positive connotations. In ordinary language, we often say that “events here are moving forward” to express progress. Also, the parallel lines, which divide information according to country, have a

noticeable “upward” path, perhaps implying that the outcome sought is desirable. These are connotations only, so none of the associations are immune from counter-examples. Because culture conditions how we conceive the direction of time (Boyd Davis 2012), a forward movement does not *have to* stand for progress. Still, universal or not, timelines do seem to tap into spatial metaphors rooted in our embodiment (see Lakoff and Johnson 1980).

To the extent that retreating or falling down is a bad thing, one would expect the depiction of events that culminate in an undesirable outcome, to have a downward path. Figure 11 seems to do just that.

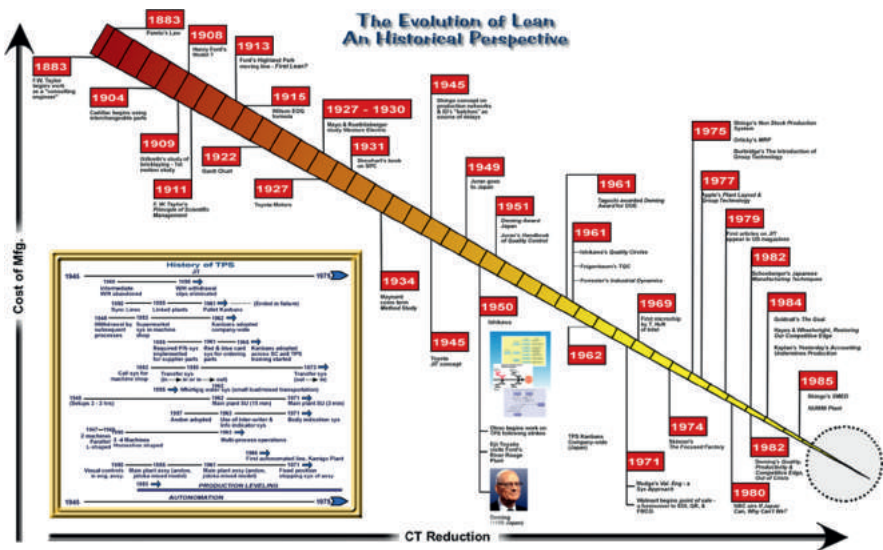


Figure 11: Timeline of financial developments (taken from <http://rickladd.com/2010/10/18/the-evolution-of-lean-a-timeline/>).

These two parameters (“Cost” and “CT”) converge with time, leading to a clear linear narrative with a climax, marked by a dotted circle. Given the use of many abbreviations, the addressee of this image presumably knows the tale conveyed. The goal here does not seem to be to make new connections, but to confirm the inevitability of a pre-existing set of conclusions. Still, one does not have to know the content of the tale to ascertain that a tale is being told.

Because these assertions are packaged up in the graphics in an implicit way rather than making an overt argument, there is no argument, just diagrammatic implication. Yet, if the dual-system account is correct, the effects of non-argumentative modes of persuasion can be quite formidable. Logically speaking, the

data placed on the x- and y-axes could be inverted without affecting the truth-values that they convey. Semiotically speaking, though, an upward slope would likely invite very different interpretations (in fact, we could almost define icons as the difference that separates symbols or symbol systems which can be substituted *salva veritate*).

Spatial layout is therefore not a trivial matter. Whereas Figure 11 sloped heavily in one direction, this timeline of Figure 12 is flat.

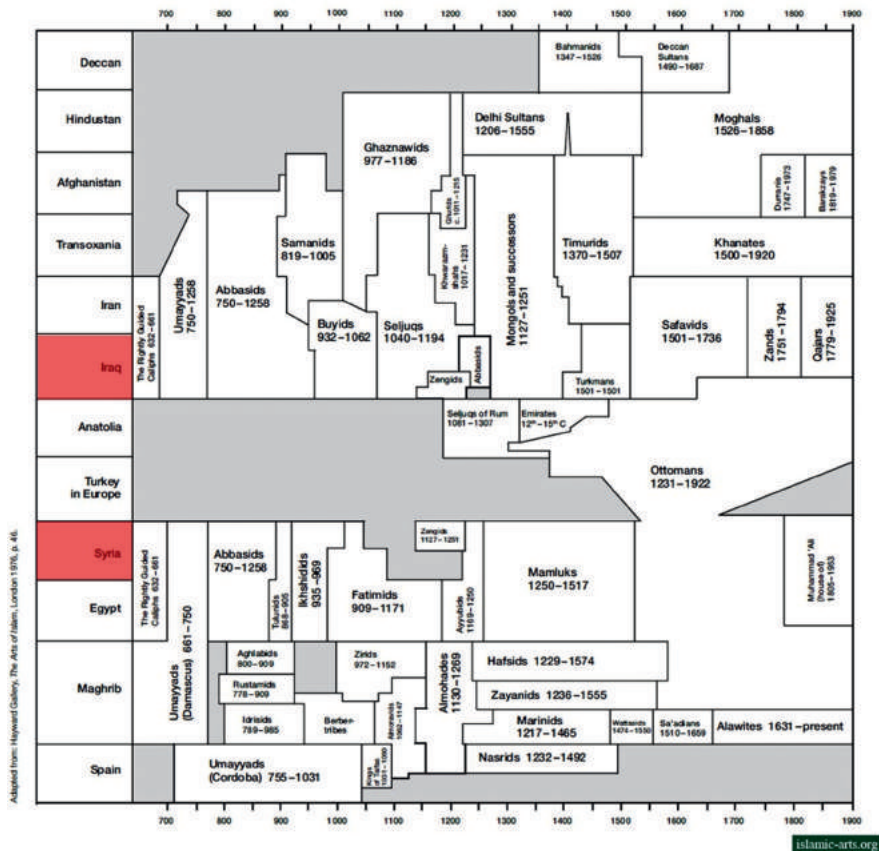


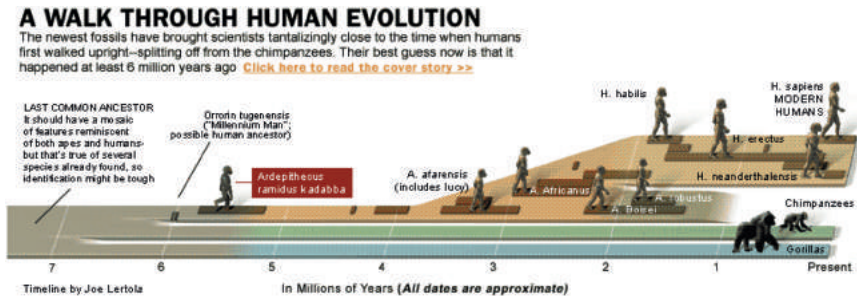
Figure 12: Timeline of Islamic architecture (taken from <http://islamicarchitecture2.blogspot.fi/2012/10/syria-iraq-timeline.html>).

Three parameters are combined: geographic (the countries), temporal (the dates), and political (the regimes). This is still a timeline, but the desire to express many domains at once results in an image that looks like an architectural blueprint with



many rooms and closet spaces. A person moving in to this dwelling might well discover a new “room” (think, for instance, of the empty spaces shaded in grey). It is unlikely that all the outlines were anticipated in the original design. Even so, discerning those gaps might well prove pivotal to inquiry.

It is more common for timelines to divide information from two or more domains by using parallel lines. Letting the lines touch each other can carry additional information, as is the case in Figure 13.



**Figure 13:** Timeline of human biological evolution (taken from <http://www.internetttime.com/itimegroup/timelines.htm>).

The point where the lines diverge has no event on it, but the divergence is what is worthy of note. Despite advances in radiometric dating techniques, we have to contend with much uncertainty. As such, the time of occurrence in this timeline is often fuzzy, which is an iconic way of saying that the split of species was either gradual or unclear. Archeological specimens identified by name are on their own well-delineated but finite lines, presumably because there is hard evidence plus a lack of consensus about exact dating.

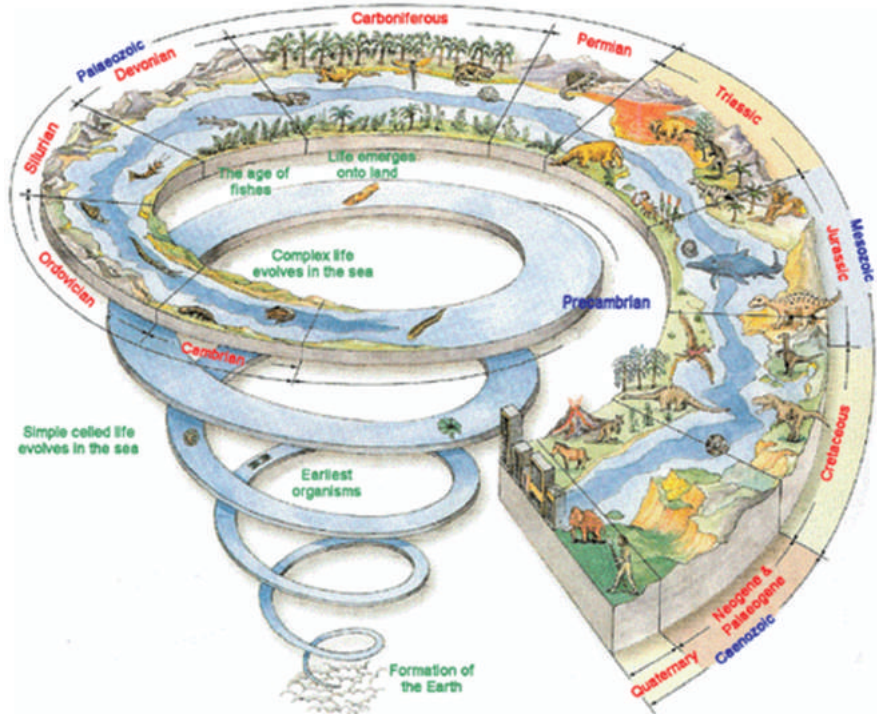
Sometimes, though, an important bifurcation can be given a precise date, as in Figure 14. By splitting how we see the split of the Roman Empire (which took place at a city called Split), the timeline lets us gain some insights and lose others. Notice how, once we have passed the fork in the road, some persons are connected to both political entities by means of a vertical line. Intention may shape the sign-vehicle, but it certainly does not control all subsequent interpretations. Hence, nothing prevents a timeline intended for use in communication from also being used in investigation.

The timeline in Figure 15 is not horizontal but circular. We have a discrete event, namely the first television transmission in 1927, with symmetrical series of dates radiating outward from the centre. By spreading out the events over a greater surface area, this diagrammatic configuration reduces clutter. Moreover, the spatial dispersal is itself an icon of radio waves. The horizontal line is



actually just a legend, since the dotted concentric rings are what mark the time spans.

Unlike the split of the Roman Empire and the first television transmission, this diagram in Figure 16 captures well the idea of fuzzy beginnings.



**Figure 16:** Timeline of life on Earth (taken from <http://www.dinosaurisle.com/timeline.aspx>).

Notice how the skyscrapers near the present are shown in cross-section, to suggest that more developments are coming. Farther back in time, a great deal of space is devoted to mapping periods where nothing much happens. Overall readability is maintained by coiling these boring stretches of time into a receding spiral.

Another way to bring a very large time span into a single field of vision is to keep the lines straight, but to start again a new line when space runs out. Figure 17 does this. The strategy of starting again on a new line is a common one. Twyman (1979) classified options like pure linear, linear interrupted, list, linear branching, matrix, non-linear directed, and non-linear open. In Figure 17, we are ostensibly dealing with a linear interrupted format. The ratio of time to length changes



Figure 17: Timeline of the universe (taken from <http://www.atgc.org/TimeliNe/>).

regularly with each line. The left-most line marks a full year, the one beside it tracks 100 years, then 10,000 years, then a million years, and so on, until we reach the formation of our Milky Way galaxy in the lower right corner. No major topical change should be read into the change of lines other than time scale.

Not every line in a timeline has to track the passage of time. Diagrams can make a hybrid use of their lines, as is the case in Figure 18.

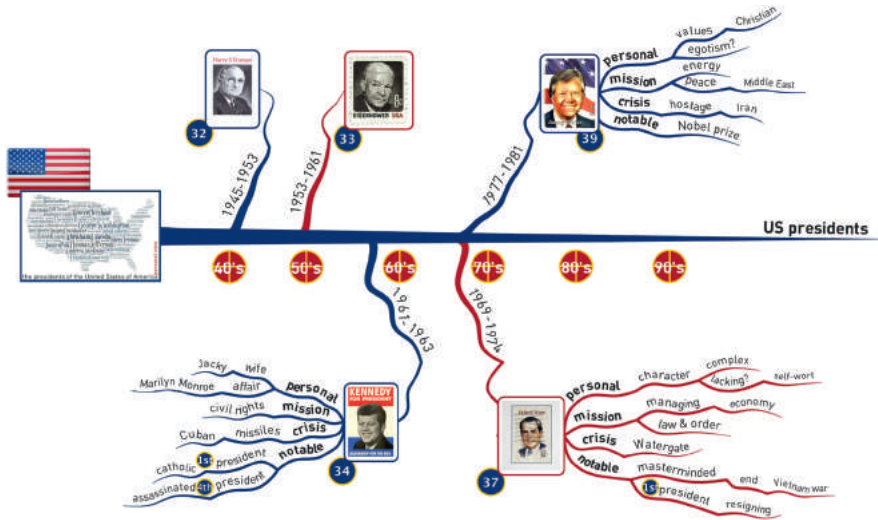


Figure 18: Timeline of some American presidents (taken from <https://mastermindmaps.wordpress.com/2012/11/08/a-terrific-free-timeline-template/>).

The blue line at the centre is chronological, but the root-like offshoots are not. Rather, they capture thematic highlights, which are the same for each president: personal, mission, crisis, notable. Spatially, the Nixon-related words “crisis” and “Watergate” align with the 90s, but it is assumed that the interpreter will know to not attribute that date to those events.

The timeline in Figure 19 resembles Figure 18, but it drops the thematic sub-divisions.

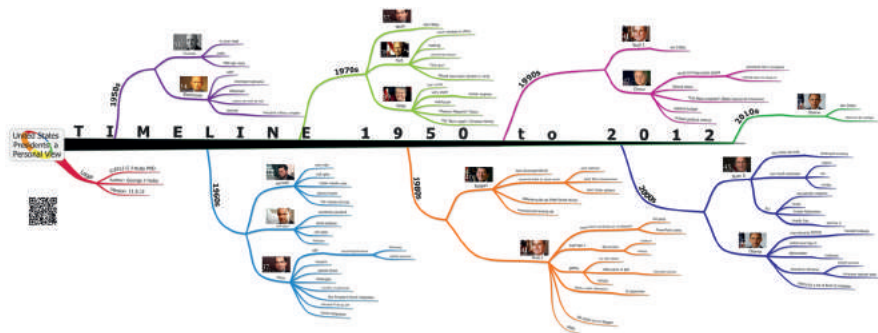


Figure 19: Timeline of many American presidents (taken from <http://galleryhip.com/creative-timelines.html>).



In Figure 19, we find keywords associated with each person. Each decade is given a distinct colour. When a given term of office does not map neatly onto this division into decades, we are referred back to the appropriate branch. Thus, “Bush 1” appears atop the purple 1990s, but the diagram instructs us to see the 1980s.

As Figures 18 and 19 show, one’s life can be severely reduced to essentials. The timeline of Figure 20 takes this even further, since it is concerned only with the quantitative lifespan of biblical figures.

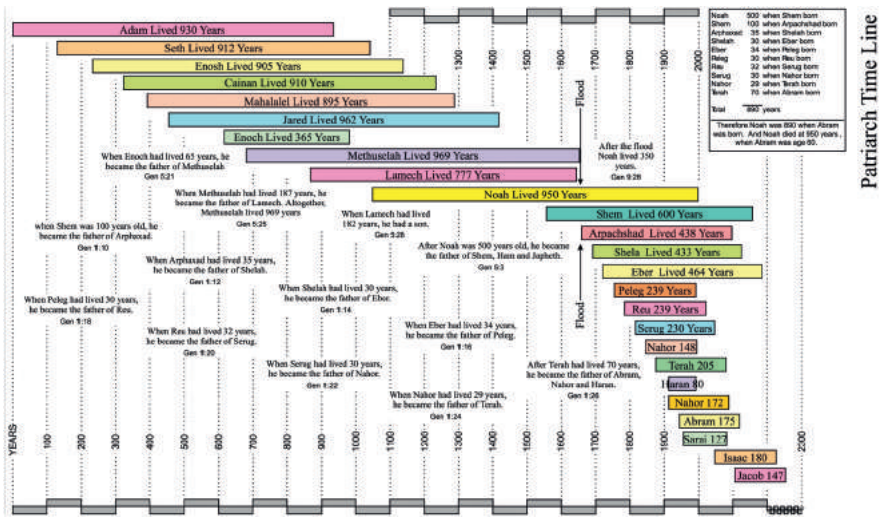


Figure 20: Timeline of Old Testament figures (taken from <http://www.thegloriousgospel.ca/patriarchal-timeline/>).

The main inferences one can draw from these juxtapositions are who could have met whom. In keeping with the idea that, modally, icons only say “This *could* be the case,” inferences can be drawn even when the information at hand is false or fictional. In the same vein, logicians will say that an argument can be valid even though its premises are false. A similar distinction seems applicable to diagrammatic reasoning. Thus, in the Old Testament timeline, one can conclude that Lamech never met Serug, even though their respective lifespans of 777 and 230 years are unlikely. Even so, because the quantities are visually juxtaposed, we can compare them.

## 7 Bringing it together

We have seen how visually comparing linear magnitudes can halt fallacious patterns of reasoning. We have also seen how much easier lifespans can be compared

when they are rendered on timelines. Actual juxtaposition of lines is needed for these cognitive benefits to occur. Now, one of the most interesting features of the diagrammatic logics recently developed in the wake of Peirce is that they do not assign conjunction a sign of its own, but rather let conjunction be marked by the mere juxtaposition of its conjuncts (Ketner 1981: 59). Being side by side is enough to convey a proposition like “This and that,” without having to explicitly add a symbol for “and.” Timelines essentially do the same.

Some semioticians (e. g., Stjernfelt 2015) have recently begun to realize that this co-localization must be reckoned as a primitive condition of semiosis. To say that being nearby is a primitive is to say that it enables sign-action (and as such cannot be explained by sign-action). The Rosetta Stone once again gives us an exemplary lesson of this. The three sets of inscriptions that it displays were already available elsewhere in the world. But, it was precisely their conjunction in one location that spawned a new line of interpretations. To put the same point negatively, scattering apart the linguistic sign-vehicles of the Rosetta Stone so that they never meet would have been a sure-fire way to foreclose all the novel inferences made on their basis.

Likewise, one of the main services rendered by timelines is to bring together varied historical facts within a unified field of awareness. It is the *Umwelt* space that counts here, not any disenchanting geometric space, since “nearness” only makes sense in the former (Pietarinen 2014: 301). Various historical facts are thus “synthesized because they are aspects of the same topological section of the cognitive process; to put it psychologically, they may be perceived in one glance” (Stjernfelt 2015: 159).

The visual-*cum*-logical conjunctions of timelines nevertheless have to contend with well-known limitations. Indeed, when subjects are confronted with more than seven or so items, this goes beyond subjects’ ability to discriminate the items at a glance (see Miller 1956). Consider, for example, the long sequence of gibberish shown in Figure 21.

**C I A F B I I R S**

Figure 21: String of letters.

Americans can discern, in this seemingly random arrangement of letters, their familiar governmental agencies, resulting in Figure 22.

**C I A F B I I R S**

Figure 22: String of letters chunked into governmental abbreviations.



Treating multiple items as compound figures is sometimes called “chunking.” Chunking allows for informational compression. It is a bit like working with an abacus: once ten balls have been pushed to the side, attention can be allocated solely to the next bar. Yet, unlike the governmental acronyms, chunking can also latch onto spatial affordances that have no apparent semantic value. For instance, considering the image below in rows is closer to handling three items than it is to handling a dozen items, as shown in Figure 23.

From 12 items...

...to 3 items



**Figure 23:** Assortment of letters chunked into rows.

The diagrammatic organization into rows, when properly exploited, can increase subjects’ ability to quickly recollect what they have seen (Sperling 1960). Chunking the left-hand grid into columns instead of rows would have still brought the image within a manageable range showing these benefits. But, perhaps inevitability, viewing subjects will tend to apply a “preferred layout model” (Knauff 2013) to particular situations.

Such prearranged shortcuts are useful, but their unthinking rapidity can sometimes occlude important interpretive options. We have seen how, in history, many academics eschew alternative timeline formats in favour of an uncritical fixed template. To appreciate how this might result in missed opportunities, consider how a museum displays its documents and artefacts. All museums bring together artefacts and documents, but good museums realize how much visitors stand to benefit when those artefacts and documents are brought together in just the right way. Thematic arrangements, chronological sequences, closed passageways and open rooms, colours, textures, and lighting levels – all can be mixed with an eye to fostering a transformative experience that stacks of books will never match. This potential for discovery partly comes from the freedom of movement allowed. For instance, a visitor could walk down the corridor once, from one end to the other, but she could then decide to go back and forth. Strolling a room with one’s feet and scanning an image with one’s eyes are both inferential strategies, trying to make sense of what often seems, at first blush, like haphazard evidence of a foreign era.

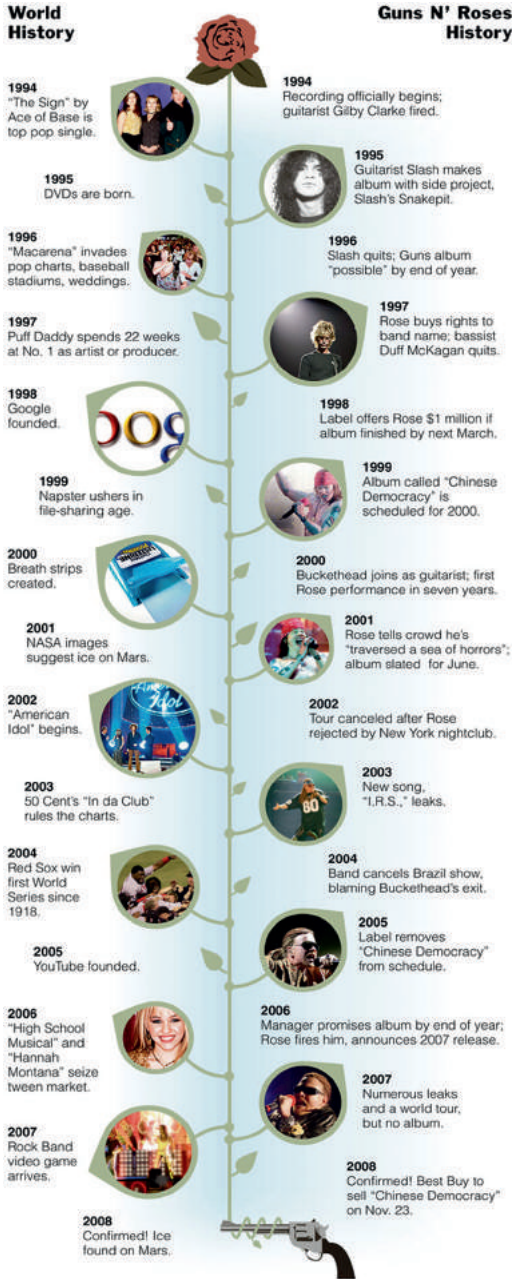
Critics debate the merits and demerits of such exhibits with a high degree of seriousness. None regard spatial organization as somehow below linguistic prose. The appraisals are instead premised on the idea that history museums are simply the next step in historical inquiry. By parity, the same level of planning and scrutiny should be brought to bear on semiotic devices like timelines.

## 8 Making sense of the past by discerning relations

Unless it simply wants to list things, historiography must work from the meta-physical assumption that the world houses patterns (Dennett 1991) and the epistemological assumption that we can know some of those patterns. Using timelines may aid us to see such patterns, but this important cognitive service is constrained by what materials are visually available in the first place. So, in keeping with the idea that diagrammatic conjunction suffices to express logical conjunction, consider Figure 24, which juxtaposes two domains.

On the right side, one is shown various events in popular culture (announced, perhaps tongue-in-cheek, as “World History”). On the left side, one is shown highlights in the career of the rock band *Guns and Roses*. In keeping with the name of the band, the line has a rose at the top and a gun at the bottom. The branches suggest vegetation, but whereas a plant grows upward and culminates with a flower, here the chronological direction goes downward. The events on either side of the line bear no obvious relation to each other, so juxtaposing them would seem to make no sense. This arrangement might be the most pregnant, because it makes no sense. Let me explain.

Psychologists using Rorschach tests have long known that subjects presented with random collections of data cannot help but see patterns. When directed at timelines, this propensity for interpretation can, I think, be harnessed to increase our understanding of the past. Yet, to get the most out of timelines, one should observe them in a playful manner that is not entirely predictable (see Sebeok 1981). Korallo et al. made provisions for this in their experimental design, since apart from a general instruction to remember as much as possible, subjects were allowed to scrutinize timelines “at their leisure” (2012: 858), without any other goal(s) or task objective(s). “Note that participants were not specifically told to cross-refer between time lines” (Korallo et al. 2012: 858). Hence, whatever cross-reference did take place was freely initiated by the interpreters themselves. With that in mind, consider the following cross-domain relations:



**Figure 24:** Joint timeline of rock band and other events (taken from <https://kellene23.wordpress.com/2008/11/20/world-history-vs-guns-roses/>).

- Israel attacked by Iraqi missiles during First Gulf War (1991) AND Digital image morphing is first used to fuse different races in Michael Jackson’s music video “Black and White” (1992).
- United States income tax is declared unconstitutional (1895) AND Friedrich Engels, co-author of *The Communist Manifesto*, dies (1895).
- William S. Burroughs publishes his (homo)erotic novel *Naked Lunch* (1959) AND Elvis Presley is filmed only from the waist up on *The Ed Sullivan Show* (1957).
- The Bauhaus movement wanes (1933) AND The B.B.C. television network starts broadcasting (1936).
- Contraception pills are approved in the United States (1960) AND Bank of America issues the first credit card (1958) AND Radio stations refuse to play the Rolling Stones’ song “I Can’t Get No Satisfaction” (1965).

Doubtless, many of the conjunctions listed above lack any causal connection. But, inquiry grows by means of hypotheses, so the relations each venture a surmise, namely that a past causal link *might* be established. Peirce, for instance, believed that while “it is the idea of putting together what we had never before dreamed of putting together which flashes the new suggestion before our contemplation” (1931–58: v. 5, ¶ 181).

If diagrammatic experimentation – adding or removing items, moving them around, and so on – can engender surprises, then timelines can be the site of discoveries. Classroom teachers already know this, but it is merely contingent circumstance that divides “personal discoveries” from discoveries. Indeed, it could be argued that all historical knowledge requires that one see a story or picture emerge in a mosaic of facts. Arthur Danto acknowledges something similar when he writes:

[T]he relationship between a narrative and the materials which initially support it is, in a sense familiar to students of Peirce, *abductive*. And in an important sense, we cannot really make historical sense of whatever bits and pieces we may possess of “history-as-record” until we are able to find a narrative for them to support. Indeed, until we find a narrative for them to support, it is something of a misnomer to regard them as evidence. (Danto 2007: 122)

Even if we keep fixed the number of nodes in a network, adding new arcs between the nodes increases what one knows. For example, knowing that all the people in a room are family is one thing, but surely one’s knowledge is increased by knowing who is a brother, a sister, a father, a cousin, an aunt, and so on. Some might say that knowing the people is *Erlebnis* whereas knowing the various relations between the people is *Erfahrung*. However, a plausible concept of knowledge should be able to cover both *relata* and *relations*.

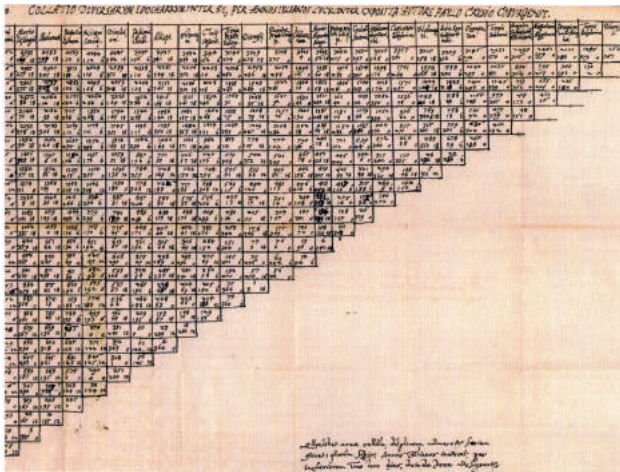
## 9 Mapping patterns

Recently, there has been some interesting work done on the role of diagrammatic reasoning in geography (Afã et al. 2014; Stjernfelt 2014b: 288–290). When a geographer wants to depict spatial relations, she crafts a motivated sign-vehicle that can enjoy a one-to-one match with its object. Things are more tricky for the historian wishing to map the passage of time since, strictly speaking, events do not “line” up; they merely appear then vanish. We may look upon a cross-section of an old tree and pin flags that mark important historical moments in its inner rings, but those rings are nevertheless present here now, not in the past. Leon Goldstein is therefore right to warn about treating “the historical past on the model of the experienced present” (1976: 38). Still, representing time in spatial terms seems indispensable (see Bundgaard and Stjernfelt 2010).

Because stepping back from the minutia of accumulated facts can allow one to discern patterns, some in the German tradition have been led to posit a “*Zeitgeist*” crawling its way through time while leaving a discernible trail. The art historian Erwin Panofsky (1955: 26–54) thus called for the elaboration of a field of study named “iconology,” which would view cultural artefacts as distillations imprinted with the distinctive mark of an era. To induce this iconological level, one must first have ample practical experience, then a solid knowledge of the relevant sources, and finally a “synthetic intuition” that gives one “insight into the manner in which, under varying historical conditions, *essential tendencies of the human mind* were expressed by specific *themes and concepts*” (Panofsky 1939/1972: 15; emphasis in original). If Panofsky is right, then academics who stop at the level of directly observable items undercut the potential explanations and elucidations. On this view, the point of extensive scholarship and first-hand connoisseurship is to allow one to stand back and see patterns that would otherwise remain invisible.

Clearly, something was gained when historians looking at the past discerned the pattern called “humanism,” a high-level abstraction for which we have no single piece of evidence. Hence, some have argued that “[t]he narrow focus of modern historical scholarship hides the large patterns” (Christian 2010: 20). Iconic signs like timelines may be what permit the study of “iconology” as Panofsky conceived it.

The attempt to study such large-scale and long-term patterns may have fallen out of fashion, but it was precisely a synoptic search that established history as a discipline. Timelines were regarded as a way to detect historical “invariants” (Leuridan and Froeyman 2012). The renaissance astronomer Paulus Crusius, for instance, looked to geometrical correlation between time intervals and important events for his clue. His diagrammatic historical inquiry is laid out in Figure 25.



**Figure 25:** Timeline trying to find a pattern between notable events (taken from Rosenberg and Grafton 2010: 65).

This timeline brings to history Galileo’s suggestion that reality is fundamentally encoded in mathematical regularity. Metaphysically, the assumption is that the world is meaningful, being filled with signs (Westerhoff 2001). In trying to interpret these signs, the timeline exemplifies the search, originating in biblical exegesis, for what were called “great conjunctions” (see Smoller 1994).

There are undoubtedly conjunctions; the only question is whether any of them are “great.” Despite working as a cryptographer deciphering hidden patterns, Max H. A. Newman once objected that it would be “absurd” to think that “importance” figures “among the prime unanalysable qualities of the constituents of the world” (1928: 147). I do not think this is absurd. In a way, some conjunctions *have to* be more important; otherwise our understanding of the world would come to a halt, being overwhelmed with information. Indeed, “[i]t is by means of regularities that we understand what little we do understand of the world, and thus there is a sort of mental perspective which brings regular phenomena to the foreground” (Peirce 1931–58: v. 1, ¶ 406).

When a conjunction of events jumps to our attentive foreground, we may surmise that a causal link between the conjuncts might be established (the better the historical training, the likelier the link). Yet, I want to close by suggesting that we need not always be concerned with whether the events in question are causally related. Similarity relations, for instance, are real but not causal. Biologists and biosemioticians recognize this when they distinguish between “homology” and “homoplasy.” A homology is when two species resemble each other in virtue of having a common



ancestry. A homoplasy, by contrast, is a relation of resemblance that is real without being causally underwritten. An undue preoccupation with (efficient) causation may blind some scientists to such qualitative relations, but any insect that has avoided the attack of a predator by looking like a leaf will attest to the reality of homoplasies (Maran 2007). Needless to say, insects and leaves do not share a common ancestor (except in the trivial sense that all living things do). In the same manner, there is a respectable way to look at the past without obsessing over what caused what.

When Diana the Princess of Wales died in a car accident, this event got absorbed in our ever-growing body of historical knowledge. Yet, imagine if three princesses had died on that day. Even if each death had been due to independent causes, we still would have been justified in chunking these events together as, say, “The day of royal deaths.” If non-causal relations like these crisscross the past in the same way that homoplastic relations crisscross the zoological and botanical world, then to miss a cluster of similar events “is surely to miss relations that truly exist in the world” (Champagne 2013: 136).

Timelines can render some of these patterns visible. Consider Figure 26, which places scientific and technological advances on a timeline, paying special attention to the discovery of chemical elements.

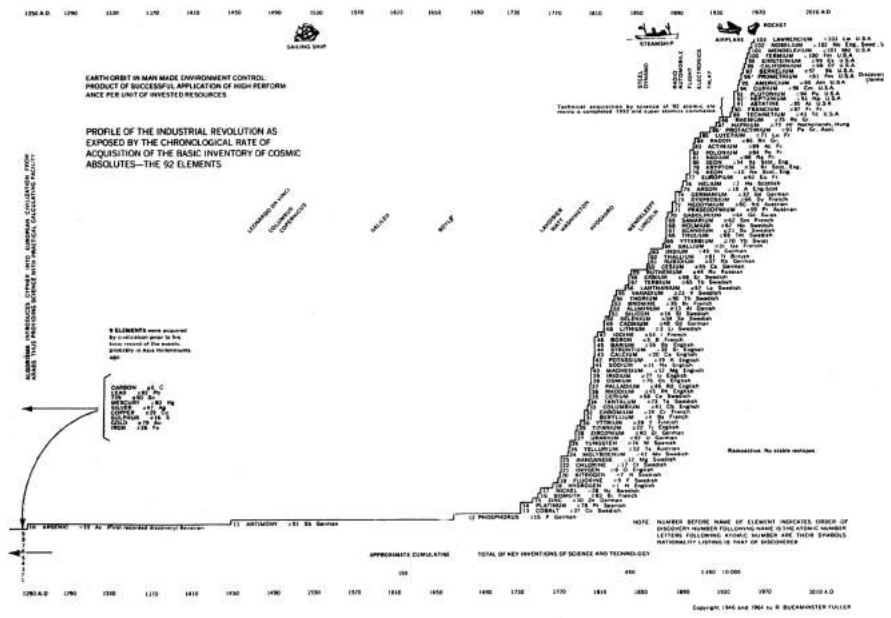


Figure 26: Buckminster Fuller’s timeline of scientific discoveries (taken from <http://www.datadeluge.com/2015/02/profile-of-industrial-revolution.html>).



Most of the scientists and engineers responsible for this progress(ion) par-took in shared methods, used similar laboratory instruments, had overlapping educational backgrounds, adhered to the same notational conventions, read the same scientific literature, reproduced their peers' results, and so on. It is hardly surprising, then, to see a relatively sudden spike in the knowledge of chemistry. An explanation by causal links would seem to suffice. However, I have issued an invitation to go one step further: having *collected* the evidential dots, we can also *connect* those dots.

Ingrained metaphysical and epistemological assumptions nevertheless instruct not to do this. As we saw earlier, it is often believed that “the strength of the study of nature lies on the side of abstraction and that of history on the side of concreteness” (Windelband [1900] 1998: 16). Yet, consider the irony of refusing to accept that the timeline conveys a real pattern: concerted efforts by chemists to fill the gaps in the periodic table of elements were guided precisely by a (prior) conviction that the world exhibits some sort of patterned regularity. For all we know, timelines may be a way to discern – and perhaps even naturalize – the “spirit” of an age.

## 10 Conclusion

There has been a growing interest among semioticians in the idea that when we reason, we essentially manipulate diagrams in order to glean what ensues. This account obviously fits well with formal sciences like logic and mathematics (Pietarinen 2006), but it is sometimes hard to see how diagrammatic reasoning might occur in other fields, like the humanities. In an effort to show that diagrams can aid minds in a generalized manner, I have explored the role that timelines can play in historical inquiry.

It is too early for a full-blown theory of timelines. Still, I think that, amid the many cognitive functions of timelines, one that stands out is logical conjunction by visual juxtaposition. We can pick any two known items and mentally contemplate them side-by-side, but to the extent that the deliberate comparison is known in advance, it will not really lead us to acquire new information. Timelines, however, are more likely to surprise us, by showing us past events that we would have never otherwise considered chunking. Hence, in addition to historical scholarship expressed in regular prose, consulting diagrammatic signs can foster the discovery of patterns essential to a fuller understanding of the past.

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## Bionote

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