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Beyond the Artifact: Unfolding Medieval, Algorithmic, and Unruly Lives of Maps

Living in Maps and Living Maps: An Introduction

> *Most of us, I suppose, have a secret country, but for most of us it is only an imaginary country.*
> — C.S. Lewis, 1952[i]

The places we love and fear, the ones that we associate with past experiences, and those evoking hopes for the future, coalesce and engender affective human geographies. I remember noticing a row of colorful book spines that lined some shelves in my father's study. Scaling the desk and yanking one free, I spent the afternoon slouched on the floor browsing through maps and atlases. I gazed at continents, fractal coastlines, and vast oceans that seemed to defy gravity by clinging to a ball-shaped earth. Topographic maps of the terrestrial surface exposed a primordial biosphere ostensibly devoid of human civilization. Other illustrations showed a more comprehensible spatial order partitioned into colored shapes and neatly divided boundaries. Since this occurred in the 1980s, these boundaries included the Iron Curtain that divided both my native Germany and the western and eastern blocs. Admittedly, browsing through my old atlases and dog-eared stamp collection today makes me slightly embarrassed of my younger self's spatial illiteracy. While my efforts of sorting stamps by their issuing country appear commendable, they were undermined by critical gaps in knowledge that, however, did not prevent me from fabricating my own idiosyncratic view of the world.[ii] For instance, I apparently believed Berlin to be an independent nation. Flawed as it might have been, this palimpsestic Frankenstein geography stitched together from atlases and stamps had assumed a life of its own.

Maps, as this childhood episode intimates, have never existed within a scientific black box solely determined by data, expert knowledges, and mapmakers' intent—despite "'scientific' cartography's efforts to convert culture into nature, and to 'naturalize' social reality" (Harley 1989, 4-5; 11). Conversely, they "attain 'real' existence by virtue of networks and pathways, by virtue of bunches or clusters of relationships" (Lefebvre 2011, 86). Maps thus become systems of signification and visual assemblages of signs that connect with other (social, cultural, historical, political, economic, racial, etc.) signifiers to create "model[s] of knowledge and cognition" (Harley 1989, 4). Cartographers encode information and users decode it by aligning cognitive processes, environmental, and psychosocial vectors. Roland Barthes proposed that "the substance of the signifier is always material (sounds, objects, images)," hence making maps into signifiers of material culture (1983, 47). It is at the meeting points, overlaps,

fault lines, and sites of material and mental mappings where human geographies and a sense of place emerge.

While acknowledging the impact of material and mental maps on human lives, this paper aims to explore the social and biographical vectors of maps themselves. On the one hand, this implies an object-oriented decentering of mapping as a primarily anthropocentric exercise by retracing, as Tania Rossetto put it, "a piece of an object's autobiography in which a map tells its own story" (2019, 8). On the other hand, the following makes clear that "[b]iographies of inanimate things constantly intertwine with human biographies generating new meanings" (Dora 2009, 348). This approach is also indebted to J. Brian Harley's proposition that maps "can be regarded as agents of change in history" that prompt us to go beyond "a technical and practical history of the artifact [and] also [consider] the social significance of cartographic innovation and the way maps have impinged on the many other facets of human history they touch" (1987, 5).[iii] More than being material artifacts analytically caught between their creators' intent and recipients' perception, I suggest that maps regularly exceed the perimeters of temporally and spatially distant human experiences and themselves generate an "ever-changing outcome of complex sets of [social] relations" (Massey 1993, 67). Appreciating the social lives of maps then means undoing the "normative models of cartography" and breaking the "mimetic bondage" of objective representation (Harley 1989, 2; 4). Exemplifying these dynamics, the following (re)appraises a synchronous spectrum of historical and contemporary maps, among them medieval projections, hand-drawn maps of Manhattan, a soluble rendition of the Gaza Strip, and a map crafted from the wood of demolished Chinese temples. Unfolding the social lives of these maps, I propose, affords valuable insights into the often-neglected interplays of material culture and human placemaking.

Cartographic Lifelines: Portolan Charts, Medieval Big Data, and Butterflies

A new globe has been given us by the navigators of our time.
— Jean Fernel, 1530[iv]

During the early fourteenth century, commercial seafaring began to flourish in the Mediterranean. Medieval maps with their ornate embellishments, however, proved largely insufficient for these new endeavors at the onset of a new era of trade and exploration. Christian doctrine had mostly rejected Ptolemy's scientific worldview, which was preserved only in the Muslim world. Many medieval *mappa mundi* drew from the *Polyhistor*, authored by Gaius Julius Solinus. They mixed anecdotal knowledge with fantastical topographies, populating cartographic spaces with cryptozoological beasts and "monstrous races" (Mittman 2015, 38; see Wilford 2002, 40). These intellectually precarious and superstitious illustrations are the groundwork of today's GPS-based, mathematically precise cartographic techniques.

Figure 1
***Ebstorf Map* with T-O shape, showing East at the top, Jerusalem at the center, and Rome as a lion (c. 1230s; 360 x 360 cm stitched goatskin). Credit: Wikimedia Commons.**

The first professional mapmakers were called cosmographers and set up shop in the prospering Italian port towns of Venice, Pisa, and Genoa. Breaking with the clerical conventions of *mappa mundi* by changing orientation from East to North, their maps preserved some decorative elements of T-O maps by including depictions of monstrous creatures and foreign peoples (see figure 1). Contrary to the straightforward narrative of medieval cosmologies being replaced by a commerce-driven scientism, the origins of early modern cartography involve decidedly social dimensions. Instead of going into the field and taking measurements, most cosmographers remained landlocked and relied on social networks that connected them with captains and common mariners of incoming vessels with whom they exchanged observations about coastal geographies orally or through pilot books,[v] from whose Greek (*periplus*) and Italian (*portolano*) names stems the term portolan chart (Wilford 2002, 60). Unlike today, navigation with portolan charts did not work via numerical headings by degrees, but relied on so-called winds that corresponded to compass directions.[vi] As John Noble Wilford explains:

> The most distinctive feature of the charts was the network of rhumb [...] lines that crisscrossed all major bodies of water. These lines radiated from wind roses, placed at intervals over the map. Lines from the primary points, the half-winds, and the quarter-winds were usually drawn in distinguishing colors [...]. [...] A mariner would head his ship on one or several of those lines until he reached the next landfall. (2002, 64)

Although they often omitted inland topographies and toponymies, portolan charts made maritime pathfinding more reliable because they accurately illustrated shorelines and harbors, thus greatly reducing the risks involved in medieval seafaring. This new approach favored a view of the world that was less beholden to religious dogma and accessible to a wider social spectrum than clerics and few other medieval elites—while at the same time constructing the underpinnings of European colonialism overseas. Spain, Portugal, and the Balearics became a cartographic hotspot that fused cartographic traditions of Jewish, Western, and Arab scholars, resulting among others in the Catalan Atlas (see figure 2). With their six colorful maps of the world, Abraham and his son Jehuda Cresques in 1375 promoted a more data-driven cosmology that relied on falsifiable data and contained "almost no mythical creatures" (Wilford 2002, 65; Hessler 2015, 15). In the words of Alfred Crosby, this heralded

a transition "from thinking of the world in terms of qualities to thinking of the world in terms of quantities" (1996, 102). While cosmographers utilized innovative technologies—most importantly the magnetic compass—their charts proved beneficial chiefly for regional navigation within the Mediterranean, Black and Red Seas, Levant, and African Coast. Since portolan charts did not consider the curvature of the earth or show meridian lines, consistent transoceanic journeys during the age of discovery became feasible only after the emergence of Waldseemüller's *Universalis Cosmographia* (1507) and Mercator's revolutionary projection (1569).[vii]

Figure 2
***Catalan Atlas* with rhumb lines and the first-known depiction of a wind rose (1375; six vellum leaves at 64.5 x 50 cm). Credit: Wikimedia Commons.**

Unlike other medieval social traditions, many of which appear removed from contemporary experiences, the allure of portolan charts remains high. They are invaluable collector's items and are replicated *en masse*, adorning the walls of studies and virtual backgrounds of Zoom calls everywhere. Aesthetically, this allure may stem from their synthesis of artisanal hand-drawings superimposed with the mathematical strictness of rhumb lines. On the one hand, these lines materialize the mostly indiscernible, virtual connectivities that shape our own spatial experiences today. They reconnect us with literal and biographical networks of meaningfulness by historicizing the validity of 'our' ways of seeing the physical world. On the other hand, rhumb lines also bear witness to the Western histories of conquest, colonialism, slavery, and exploitation by empires and companies that navigated the globe with their help. But extending their social lives into the present day works not only in theory but also in praxis. For instance, should a ship suffer a breakdown of its modern navigational equipment, the captain could take a decorative portolano chart from the wall of her cabin and, together with a compass, use it to reach the nearest harbor as they are in fact "so accurate that ships today could navigate with it" (Rehmeyer 2018).

What is more, the diverse Christian, Jewish, and Islamic intellectual histories of portolanos extend beyond the scope of Europe. Rhumb lines that indicated viable routes to mariners draw analogies to the stick charts utilized by Micronesian seafarers to navigate the complex topography of the Marshall Island archipelago in the South Pacific in outrigger canoes.[viii] Connected by coconut fiber, on these material maps shells and coral pieces mark the position of islands while leaf-veins of palms indicate directions of ground swells, enabling navigators to find their way in an archipelagic water world of myriad islands (see figure 3). When the Marshall Islands fell under German rule in the late nineteenth century, colonial studies identified three different types of stick charts: *Meddo* and *rebbelib* served navigation and differed only in their degree of accuracy while *mattang* charts were coarser projections used for training and

instruction (Hessler 2015, 63). In contrast to their European counterparts, stick charts are neither fixed nor final but flexible, organically composed, and able to be re-arranged and adapted to new circumstances and discoveries. Still, like portolanos and in an intriguing case of transoceanic cartographic biographies, stick charts visualize maritime routes through complex linear patterns. This parallel emphasizes maps as universal visual texts whose symbolic vocabularies frequently exceed linguistic, cultural, social, and ethnic boundaries, as well as obstacles of literacy and age.[ix]

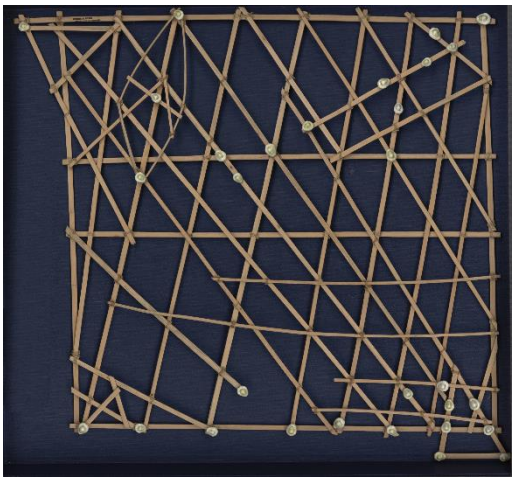

Figure 3
Stick chart of the *rebbelib* type from the Marshall Islands (c. 1920s; 67 x 72 cm bamboo and shells). Credit: Library of Congress.

After the Marshall Islands gained their independence in 1986, stick charts were immortalized, together with a pictogram of a traditional sailing-vessel, in the nation's seal. This decision further underlines the significance of maps as utterly social entities. First, as agents of historical and social cohesion among the diverse cultures of Oceania, connected through mnemonic artifacts and traditions such as stick charts. Second, in relation to individuals and their particular place in the world as "individual charts [were] constructed by a navigator to suit his own particular requirements. Indeed, an entirely competent navigator cannot, under any circumstances, interpret a chart which he himself has not made" (Resture 2012). Like Lukasa remembrance boards in Congolese society, stick charts are not only memory banks that hold personal geographical knowledges but also mnemonics of significant historical events in societies without printing culture (see Hessler 2015, 113). They bridge the *terra nullius* between individual human geographies and the overarching social functions of cartography and illustrate that maps can be at once personal and universal. Putting them in relation to European portolan charts brings into question the "mimetic bondage" of representation and terrain that "look[s] down on the maps of the past (with a dismissive scientific chauvinism) [and] regard[s] the maps of other non-Western or early cultures [...] as inferior" (Hessler 2015, 113). Contrary to technocratic views of maps as "an impersonal type of knowledge [that] tend to 'desocialize' the territory they represent [and] foster the notion of a socially empty space," Micronesian mapping traditions unveil the socially adhesive function of maps (Harley 2002a, 81). Maps, it becomes clear, are material and organic spaces of knowledge that encompass mnemonic social landscapes and thus create a "totemic geography linking together place and people [...] not [as] something 'natural' and opposed to people, but totally socialized" (Tilley 1997, 38).[x]

Present-day cartographers, geographers, and computer scientists—and increas-

ingly the blend of quantitative and qualitative research in the digital humanities—rely on geographic information systems (GIS), machine learning (ML), and computational algorithms that process spatial data to produce "deep," "thick," and "forensic" maps (see Morris and Voyce 2015). Mapmaking today thus is no longer only concerned with questions of scale, distance, and pathfinding but increasingly turns into an interdisciplinary play-lab where scholars and artists experiment with creative ways of visualizing physical and social spaces. Examples are endless and range from brain atlases[xi] to literary geographies[xii] and maps of virtual play-spaces.[xiii] Despite the seemingly insurmountable distance to this interactive mapmaking, tracing the social lives of portolan charts bring to the fore unexpected vectors of agency that reach well into the present. For instance, almost three quarters of a millennium before the rise of Silicon Valley tech companies, late medieval cosmographers accumulated and processed their own version of big data. As critical geographer Sam Hind observed, portolanos "served the same general, navigational purpose as any location-enabled map 'app' does in the 21st Century" (2020, 133). This *longue durée* of the portolanos' biographical lives then asks for a prosopographical perspective that provides insights into the patterns, techniques, and relationships through which these old maps continue to transform present knowledges.

Some of the most fascinating recent probes into these dynamics was not performed by a geographer or historian. In 2000, a burned-out chemical engineer named John Hessler left the US to take a contract job in the French Alps. There, the passionate amateur climber could pursue his interest in lepidopterology—the study of moths and butterflies. Navigating the mountainous terrain, Hessler studied the distribution and genealogy of butterfly species that were isolated on remote mountains by the last ice age. Analyzing the shapes and patterns on the insects' wings to test for possible genetic kinship across the scattered populations, he faced the problem that their distinctive "features take a variety of forms from lines and polygons through more complex curved concave and convex shapes" (Hessler 2010). Much like a cartographer, Hessler had to find a way to project a three-dimensional object onto a two-dimensional surface without warping its actual form beyond recognition. Unlike the medieval cosmographers, however, he employed mathematical algorithms for morphometric analyses of shapes and sizes. A specialized software morphed the patterns and calculated how much energy was needed to transfigure one shape into another; the less energy and computing power it took, the closer the genetic kinship between the species.

Following his alpine stint, Hessler worked as a curator of the archaeological and historical collections at the Library of Congress. Digging through, he eventually came across some of the first-known portolan charts drawn on rolled vellum (calfskin) and was taken aback by their mathematical accuracy. "Where and how did medieval mapmakers, apparently armed with no more than a compass, an hourglass and sets of sailing directions," he pondered, "develop stunningly accurate maps of southern Europe, the Black Sea and North African coastlines, as if they were looking down from a satellite, when no one had been higher than a treetop?" (Tucker 2010). What also amazed him were the portolanos' radical improve-

ments compared to their imprecise precursors as well as their variation from subsequent Mercator projections that project grids of latitudinal and longitudinal lines. In contrast to both, the multidirectional network of rhumb lines of portolanos that radiate from wind roses appears entirely random.

Remembering his time in the French Alps, Hessler wondered if morphometric methods could help decipher the secrets of the rhumb lines' placement. After experimenting with this approach, Hessler realized that "[m]odeling the shape change on a modern and ancient map is not all that different from the butterfly wing problem" (Hessler 2010). In fact, the algorithmic approximation of Mercator projections and portolano charts showed a somewhat consistent 8.5-degree counterclockwise rotation of the latter. This deviation is known as magnetic declination and reflects the disparity between true North and magnetic North, which changes across time and place based on the movements of liquid iron in the Earth's core. Hessler speculated that the cosmographers did not consider these deviations and instead took surprisingly accurate averages from the observations of sailors and pilot books. For Hessler, the significance of interdisciplinary research lies not just in solving historical puzzles with modern technology but also in recovering the social position and importance of maps. This endeavor becomes pivotal for the current coordinate system of society since "[u]nderstanding how the technology was developed gives us insight into how we got here, and perhaps into where we're going" (in Rehmeyer 2018). Present and future mapmaking, the following section shows, is fraught with issues that appear even harder to untangle than the social strands of portolan charts.

Discipline and Visualize: Algocracy, Ego Maps, and Maps of Protest

I am marked like a road map from head to toe with my repressions.
— Philip Roth, 1969[xiv]

Nation-states and powerful corporations have always acted as patrons and gatekeepers of cartographic knowledge used for navigation, diplomacy, warfare, exploration, exploitation, censorship, empire and nation-building. In terms of social and racial hierarchies, their maps project constellations of power or lack thereof, for instance via the segregation of living quarters alongside railroad lines or lacking public transportation infrastructure. Maps are epistemic instruments of authority that make possible control over the mobility of people and goods. They may reveal seeming hotspots of criminality and justify no-go zones or the oppressive policing in areas labeled as deviating from the patterns of a statistical map of 'normal' (i.e., desirable) society. Cartographic power is not only projected through political action but also through social conventions at the core of the cartographic vocabulary, for example technical and aesthetic decisions such as size, scale, typography, color coding, or what to include and omit.

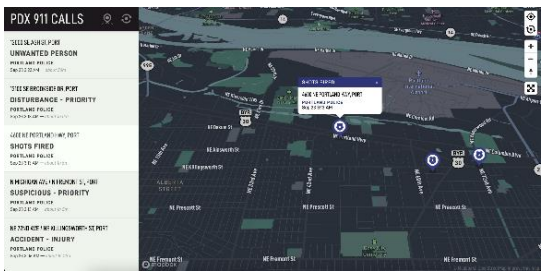

Figure 4

Live map showing 911 calls and police responses in the Portland, Oregon area (2021). Credit: PDX 911, http://pdx911.wtf/

What Ben Williamson called "algorithmic governance" works through the mathematization of social orders as each palpable information is measured, weighted, and mapped (2013, 1). This so-called algocracy permeates almost all aspects of social life, visible in online maps that show 911 calls and the responses of authorities in real time (see figure 4). Unlike portolan charts that held immense material value for their users, many twenty-first century maps are freely available on the internet. Cartographic value thus no longer stems merely from the (immaterial) object of the map itself but from its constituting data and access to its sources, as well as algorithmic methods of collection and visualization. Instead of aggregates used for specific purposes such as navigation and exploration, contemporary maps express ever-growing data pools collected and processed by state agencies and private corporations. In *Social Physics*, Alex Pentland described the resulting cybernetically processed social data as "socioscopes" that "give a view of life in all its complexity—and are the future of social science. Just as the microscope and telescope revolutionized the study of biology and astronomy, socioscopes [...] will revolutionize the study of human behavior" (Pentland 2015, 23). Together, artificial intelligence (AI) routines, and algorithmic mapping reduce the complexities of social issues to the binary logics of computational space. Here, the individual is placed either inside or outside the 'normal' parameters of civil society.[xv]

The resulting map of 'normalcy,' however, hinges less and less on social discourse and interpretation among individuals or groups. Instead, it claims to map facts that are seemingly legitimized by scientifically neutral data sets, for example socioscopes of criminal hotspots or social credit scores in Chinese cities. Harley recognized these issues already in the 1980s. "Much of the power of the map, as a representation of social geography," he noted, "is that it operates behind a mask of a seemingly neutral science. It hides and denies its social dimensions at the same time as it legitimates" (Harley 1989, 7). In a historical reversal of cartographic logic, maps are no longer carefully crafted from a (at least temporally) stable set of numerical values such as distances, wind directions, or elevations. Conversely, the data collectively produced by members of a given social group *becomes* the map. Italian media philosopher Matteo Pasquinelli afforded some profound theoretical insight into these dynamics:

> Data are not numbers but diagrams of surfaces, new landscapes of knowledge that inaugurated a vertiginous perspective over the world and society as a whole: the eye of the algorithm, or algorithmic vision. [...] The accumulation of numbers by the Information Society has reached the point at which numbers themselves turn into space and create a new topology. The digital matrix is eventually morphing into a world of curves and waves rather than bits and quantities: vectors of tendencies, clusters of social patterns, dorsals of anomalies and spikes, concretions of in-

> telligence. A new collective geography opens to colonization. (2016, 250)

The most persistent perils of algorithmic mapping lie in the indiscriminate collection of data and ability to discipline social spheres in the service of governance, regularly under the pretext of crime and terrorism prevention. In Foucault's terms, "[t]he map [is an] instrument of power/knowledge" on various social scales (1980, 74). Its creation and interpretation depend on state or corporate interests, and it illustrates ostensibly incontestable truths that discipline individual and social bodies alike as:

> [t]he map becomes a means of inquiry, of examination and control—electoral maps, maps of ethnic groups, taxation maps, etc. Discipline can only be effective through the control and structuring of space; and hence it is not surprising that prisons resemble hospitals, which resemble schools, and factories, which resemble prisons. (Tilley 1997, 21)

But the disciplining function of big-data mapping also exhibits a penchant for collapse. If every day experiences and cartographic representations can no longer be reconciled into a meaningful relationship, maps turn into hollow simulacra of social power and forfeit authority and discursive weight. Claims of unbiased and objective mapping run the risk of culminating in what Baudrillard described as the "mad project of an ideal coextensivity between the map and the territory" (1988, 166).[xvi] On May 1, 2000, a new law in the United States laid the groundwork for these developments by removing restrictions from the civilian use of GPS navigation devices. While the technology was long-since open to private use, the government had thus far inserted random inaccuracies "in an effort to deny accurate positioning service to U.S. military adversaries" (United States Department of Transportation 2020, 1).

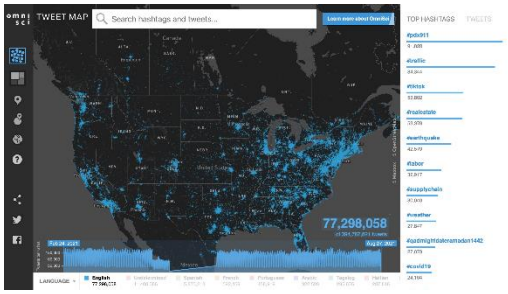

Figure 5
***Tweet Map* picturing global Twitter activity and trending hashtags (2021). Credit: OmniSci, https://www.omnisci.com/demos/tweetmap**

The law removed the artificial deviations which increased the accuracy of GPS by a factor of twenty (or from a hundred to five meters) and therefore paved the way for 'smart' mapping technology driven by AI, ML, and big data. Two decades later, as we commute, walk, or cycle from one place to another, GPS-enabled devices and apps construct maps around us by processing a plethora of information. Some is purely functional and used to avoid traffic jams or road hazards. Other information is used to recommend restaurants or places of interest along the way or allow the sharing of real-time locations with family and friends. Sam Hind described this as the "Russian Doll" effect in which "[r]oad names, retail locations, 3D building models, and other such features present themselves at varying levels; dependent on their perceived relevance to the map reader" (2020, 134).

Interactive maps, it appears, have evolved into distinctly social entities that never cease to cater to our every need and desire. Tireless personal assistants with subservient voices locate the coordinates of our existence within virtual frameworks that range from country roads to urban grids and intercontinental flights. At the same time, the vanishing of standardized physical maps, such as road, undermines the role of maps as social glue that "creat[ed] a common territorial and topographic basis for nationhood" (Schulten 2001, 19).[xvii] Navigating virtual cartographies suggests that instead of the (imagined) community of the nation the individual squarely occupies the semantic center of an 'I-map' that is brought into existence unconsciously via social activities on Twitter, Facebook, or Google Maps (see figure 5).

The subsequent and constant hailing of the 'you are here' paradigm sets in motion the processes of ego-mapping. If everyone perpetually creates their own map, a sense of cartographic narcissism breeds a spatial self that always arrogates a position of centrality. Paradoxically, this kind of mapping is both social and antisocial; it depicts a zoomed-in sector of the world that scrolls with the movements of the user, stripping away as invisible and thus irrelevant social contexts that exist beyond the egocentric map.[xviii] In an interview with *The Verge*, Snapchat CEO Evan Spiegel—perhaps unwittingly—condensed this notion into a statement about a newly introduced "Snap Map" feature, which he described as a way of "personalizing the map, and making it reflect the world the way that you see it" (Newton 2020). Procedurally generated by social media feeds, the world shaped by ego maps is at once intimately personal and facelessly corporate. Anticipating and reinforcing the physical and mental motion of their users, the psychogeography of these maps exemplifies glaring present-day social phenomena that juxtapose feelings of limitless extraversion and cosmopolitanism with the myopic, self-referential parochialism of social echo chambers.

In view of this algocracy, it seems easy to agree with the idea that "the discipline of geography often presents us with an emotionally barren terrain, a world devoid of passion, spaces ordered solely by rational principles and demarcated according to political, economic or technical logics" (Davidson, Bondi, and Smith 2007, 1). Still, few would deny that our surroundings also engage closely in entanglements with our social and emotional sensitivities.

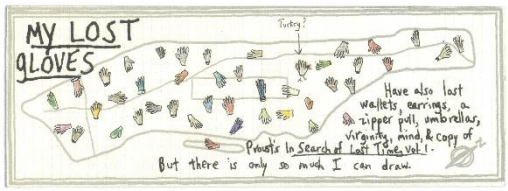

Figure 6
Map of Manhattan showing locations of gloves lost by American humorist Patricia Marx (2013; 8.8 x 24.4 cm crayon). Credit: Cooper, Becky. 2013. *Mapping Manhattan: A Love (and Sometimes Hate) Story in Maps by 75 New Yorkers*. New York: Abrams Image, p. 19.

Brooklyn Bridge, for example, "could be a place for romantic meetings but also the ideal location for suicide: a consummation of the individual's new-found freedom, or of the city's potential for alienation" (Dennis 2008, 7-8; see Wöll 2017). Despite all algorithmic insinuations, cognitive interactions with space via mental

mappings remains a crucial mechanism of placemaking. In what Frederic Jameson called "cognitive mapping," socio-spatial structures connect "the individual subject to that vaster and properly unrepresentable totality which is the ensemble of society's structures as a whole" (1991, 51-54).[xix] As an enduring part of the human condition, the most powerful social maps remain those on which we envision home. Iconic models of how distinct this sense of home can be in terms of scale and perspective are Saul Steinberg's autogeographies *View of the World from 9th Avenue* (1976) and *Zip Code Map* (1994). Both maps externalize skewed distances and warped scales while simultaneously offering a subversive commentary on the myopic worldview of New Yorkers and Americans who see their hometown or nation as the center of the universe. Eccentric Steinbergian geographies are not so much technical instruments as visual ways of thinking about the world that invite comment, evaluation, and pastiche. They reveal that in what Katherine Harmon called "the age of the citizen mapper," cartography is no longer a specialized profession but a part of everyday life, particularly for those living in New York City where one:

> can find maps of [the] most common dog breeds and dog names, by neighborhood, and a map of neighborhoods with the most dog poop. [...] There are New York woodcut maps, knitted maps, embroidered maps framed by doilies, gilded maps, and a map of the boroughs made of honeycomb. [...] There are maps of what New Yorkers complain about (mostly garbage, vermin, noise, graffiti, and blown-out streetlights, the order depending on the neighborhood) and maps of happiness, too. (Harmon 2017, 26-28)

The city's hyper-productive nexus of human geographies forms a tapestry for cognitive maps drawn by belonging and alienation as the metropolis "blends the gift of privacy with the excitement of participation" (White 2011, 23).[xx] For her collection *Mapping Manhattan* (2013), Becky Cooper asked both random people on the streets, but also celebrities like Yoko Ono and Neil deGrasse Tyson, to fill in blank maps of Manhattan. The result is a convolute of personal, emotional, experimental, and experiential maps (see figure 6). Some merely contain typewritten dates while others portray ornate fantasy worlds. The maps are at once a litmus test of the sensitivities of American society and, as Cooper noted, "passports into strangers' worlds" (2013, 10). These worlds are assemblages of somber data, lost objects, and subjective abstractions of the 'real' world whose imaginative topographies defy attempts of 'factual' mapping, instead conveying memories, emotions, and the materialized agency of socio-cartographic lives.

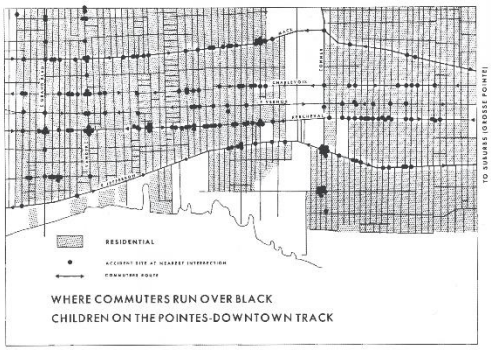

Figure 7
Where Commuters Run Over Black Children on the Pointes-Downtown

***Track* by radical geographer William Bunge (1971; 21.4 x 25.4 cm print). Credit: Hessler, John. 2015. *Map*. Hamburg: Edel, p. 210. [originally published in Bunge, *Field Notes: Discussion Paper No. 3*, 1971]**

While mirroring ideologies, hierarchies, race, class, gender, and other vectors of spatial orders, maps can become powerful instruments of social critique. In the 1970s, radical geographer William Bunge mapped the fatal state of American and Canadian inner cities under such blunt titles as *Where Commuters Run Over Black Children on the Pointes-Downtown Track* (1971; see figure 7) and *Region of Rat-Bitten Babies* (1975).[xxi] At the surface, they offer seemingly neutral figures about traffic flows, accidents, and distribution of diseases in urban environments. Once this information is interpreted, however, the maps reveal the spatial consequences of social and racial discrimination. They make graspable the cartographic marginalization of subaltern people and that "[t]he peasantry, the landless laborers, or the urban poor had no place in the social hierarchy and, equally, as a cartographically disenfranchised group, they had no right no representation on the map" (Harley 2002b, 101). Dennis Wood wrote about *Commuters*:

> Any Detroiter would have known that these commuters were white and on the way between their work downtown and their homes in the exclusive Pointes suburbs to the east. [T]his is a map of [...] white people as they rush to and from work run over black children. [...] It's a map of racist infanticide, a racial child murder map. (2010, 115)

Bunge's map discloses the uneven power relations between infrastructural planning, political governance, and social realities of disadvantaged people by visualizing the fatal privileging of automobile mobility over that of black children who play in the streets due to the lack of municipal playgrounds (see Morris and Voyce 2015). This example of activist mapping expresses a caustic social critique that hits hard because it clads itself in the somber guise of scientific facts and the authoritative visual language of cartography. In doing so, civic mapping demonstrates that social disadvantages and injustices resulting from the methods that undergird capitalist spatial policies can be exposed with the very tools with which they are justified and enforced. In Bunge's own words, in order "to cut all these poisons it is necessary that I passionately dismiss passion" (1979, 172). It also shows that maps are no innocent reflections of reality but assume agency through a social responsibility to disclose injustices and abuse.

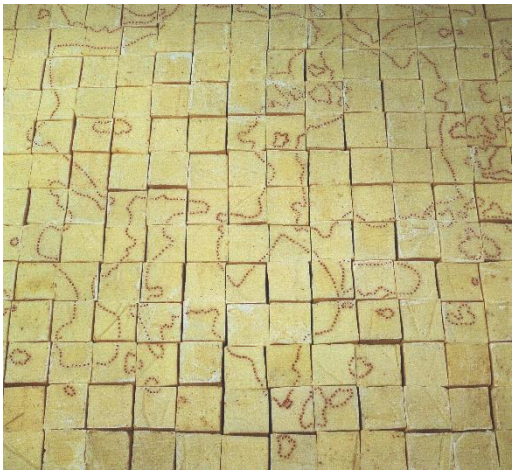

Figure 8
Close-up view of Palestinian artist Mona Hatoum's *Present Tense* (1996; 5.5 × 232.5 × 289 cm soap and glass beads). Credit: Hessler, John.

2015. *Map*. Hamburg: Edel, p. 143. [originally on display at Tate, London]

As a result of his civic activism, Bunge was branded a radical Marxist by the Un-American Activities Committee and banned from teaching at campuses. He subsequently moved to Canada, drove a cab in Toronto, and worked with underground publishers. Many critical maps of today are indebted to Bunge's groundbreaking research. Of course, they largely use digital tools to establish counter-discourses, resulting in a map of Black Lives Matter protests,[xxii] a Global Protest Tracker,[xxiii] and a city map of Hamburg that shows the hotspots of violence between protestors and police during the G20 meeting in 2017.[xxiv]

Artistic approaches to mapping provide additional venues that allow for nuance and creativity in protest. Palestinian artist Mona Hatoum's installation *Present Tense* (1996; see figure 8) is a floor sculpture made from 2,400 pieces of olive-oil Nablus soap. The soap blocks were locally sourced and form a map of Palestinian territories in Israel with red beads indicating lands that were supposed to be returned according to the Oslo Accords. In the installation, objects "to be found at home and in communal spaces, objects used in the rituals of everyday life" reify the political aloofness of territorial strife (Dimitrakaki 1998, 95). The result is a fragmented social landscape that speaks through the minimalist language of a strict grid broken up by meandering red lines that visualize the polysemous connections among Palestinians and Israelis and transcend the breakages of the region's complicated socio-political history. Finally, the artwork's materiality reminds us that political boundaries are always artificial and borders highly soluble.

Figure 9
***Map of China* sculpture sculpted by dissident Ai Weiwei (2004; 43 x 56 x 400 cm ironwood). Credit: Kunsthalle Bern, https://kunsthalle-bern.ch/en/exhibitions/2004/ai-wei-wei/**

Chinese dissident Ai Weiwei crafted *Map of China* (2004; see figure 9) manually from tieli (ironwood) salvaged from dismantled Qing Dynasty (1644-1911) temples. Four meters long and weighing 635 kilograms, its scale prompts viewers to orbit the sculpture, study it from multiple angles. At first glance, the wooden map seems to be a solid object carved from one single tree. A closer inspection reveals its assemblage from many separate elements, suggesting a twofold awareness. First, that the country's vastness and complexity run counter to the self-promotion of Chinese sovereignty and territorial integrity by its ruling political cadres. From the perspective of Western viewers who may kindle a one-dimensional image of China and the monolithic plasticity of all things 'Made in China,' it

signals the multidimensionality of Chinese history and culture.

Second, the map's structured and imperfect surface made from one of the oldest building materials also counterpoints the sterility of disembodied binary abstractions of computer-generated maps and their lacking sensuous dimensions regarding shape, size, texture, and smell. Finally, the map's fragmented monolithity speaks to "China's cultural and ethnic diversity, a sensitive topic that has resulted in violence and civil estrangement in recent years" (Cheung 2015). *Map of China's* skin-deep uniformity and concurrent jigsaw structure embody the contradictions between the nation's specious external power and its internal struggles with ethnic diversity[xxv] and individual rights. Compiled from the remnants of Chinese cultural traditions, Ai Weiwei's map reconstructs social connections with the memories and traumas of its loss that were erased from public memory by the Maoist regime.

Conclusion: Folding and Unfolding Cartographic Biographies

Finally, exploring the social dynamics that surround maps and mapmaking asks us to go beyond the artifact and appreciate its connections with human and material structures of knowledge, meaning, affect, and time. Marcel Duchamp's *Network of Stoppages* (1914) shows that map-like artifacts attach spatiotemporal experiences not only because they "[look] like a 'map"' but also because their social layers of meaning form "part of a 'map' of *time*" (Gell 1998, 249; emphasis in original). By insisting on the interchangeability of human and non-human forms of expression, such meta-cartographic epistemes destabilize anthropocentric worldviews and establish common ground with object-oriented ontology and the rejection of "claims that human experience rests at the center of philosophy, and that things can be understood by how they appear to us" (Bogost 2009). Two obstacles, however, impede the move towards a more socially inclusive conception of maps. First, the strictures linked to scientific literalism and cartographic objectivism. As Graham Harman explained, "no one can tell us the literal meaning of *Hamlet* [...] just as no one can translate the curved three-dimensional Russia into a perfect two-dimensional map of that country. Literalism holds that a thing can be exhausted by a hypothetical perfect description of that thing, whether in prose or in mathematical formalization" (2017, 90). The second obstacle concerns the swift rise of algorithmic methodologies that uphold and enforce the disciplinary functions of maps. A focus on creative resistance against both issues should thus be part of future attempts at tracing and unfolding the social lives of maps.

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[i] In *The Voyage of the Dawn Treader*, p. 5.

[ii] Some specimens, for instance, appear under the country label "Island" (the German term for Iceland), probably because the stamp on them contains the word "island." To resolve the 'mystery' here, the actual writing on the stamps identify their origin as "The Island of Cyprus."

[iii] See also Harley's melancholy reflections in his 1987 article "The Map as Biography: Thoughts on Ordnance Survey Map, Six-Inch Sheet Devonshire CIX, SE, Newton Abbot" in *Map Collector* no. 41, 18-20.

[iv] Qtd. in Lach 2010, 415-16.

[v] Dating back as far as the fourth century BCE, pilot books are still used as supplements to digital navigational aids such as Global Positioning System (GPS) and radar. For a history of early modern navigation see Nordenskiöld's *Periplus:*

An Essay on the Early History of Charts and Sailing-Directions (1897).

[vi] The oldest preserved specimen of portolanos and simultaneously the first known nautical chart is the *Carta Pisana*, carbon-dated to around 1290-1350.

[vii] Fritz Connor Kessler explains that "[t]he Mercator projection was designed to permit rhumb lines drawn on the projection to be straight lines. This characteristic was particularly useful to navigators in that they could lay out a rhumb line on the map and then follow its compass direction from the origin to destination" (2020, 51).

[viii] The widespread use of stick charts in Micronesia declined after the arrival of American forces during World War II.

[ix] Carl Sauer observed that "the map speaks across the barriers of language" (1956, 289). For children's perception of space and maps see Piaget and Inhelder 2005.

[x] American essayist Adam Gopnik encapsulated this notion poetically by musing that "[m]aps [...] are the places where memories go *not* to die, or be pinned, but to live forever" (2013, 4).

[xi] See https://portal.brain-map.org/.

[xii] See http://www.literaturatlas.eu/.

[xiii] See https://www.minecraftmaps.com/.

[xiv] In *Portnoy's Complaint*, 124.

[xv] The most prominent and controverse example for the confluence of algorithmic mapping and the regulation of social behavior is China's Social Credit System (社会信用体系) introduced in 2011.

[xvi] Ironically, reality in this instance overtakes poststructuralist critique as there indeed exist cartographic traditions in which territory and map are equivalent, see Hanson 1983. Viewed from this angle, maps exemplify the collision between the modernistic passion for the real and the postmodern emphasis on representations. As Slavoj Žižek cautioned, the advancing replacement of social realties with representational models (such as maps) eventually "culminates in its apparent opposite, in a theatrical spectacle [and] passion for the semblance" (2002, 5-6).

[xvii] This social function of maps regularly acted as a tool of oppression, for instance serving to confirm white supremacy as part of "a metageography where continents correlate to race and physiography" (Schulten 2001, 35).

[xviii] Or, as Becky Cooper put it in *Mapping Manhattan*, "a GPS can't map the cure to all kinds of lostness" (2013, 12).

[xix] Edward C. Tolman coined the term "cognitive map" in the 1948 *Psychological Review* article "Cognitive Maps in Rats and Men."

[xx] In an essay titled "Feeling New York," I have some years ago discussed the emotional geographies in Horatio Alger's *Ragged Dick* and that "authors have regularly likened the metropolis to a living organism that was, starting at the middle of the nineteenth century, increasingly seen as being infected with the disease of poverty caused by the exploitation of the growing ranks of the working classes" (Wöll 2017, 2).

[xxi] In his *Nuclear War Atlas* (1988), Bunge refers to the same map as *Children's Automobile "Accidents" in Detroit*.

[xxii] See https://www.creosotemaps.com/blm2020/?fbclid=IwAR28N-iX_CZZ06JZrR7fd64xp5lfPIYBvLiHb_sB7g1Kb1-z70rCDBnX4qs.

[xxiii] See https://carnegieendowment.org/publications/interactive/protest-tracker.

[xxiv] See https://g20.protestinstitut.eu/.

[xxv] For instance, regarding the sensitive subject of oppressed Uyghur Muslim minorities in some of China's northwestern regions.