The Open Map: A Granular Structure for Performative Readings

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As abstract systems that translate and reconstruct reality, maps have a long history of recording and interpreting space and time. Using different techniques across different periods and contexts, mapmakers have offered preeminent ways of collecting, organising, verifying, historicising, and on occasions even mystifying territorial knowledge. Mapping and its outcomes have been structured and restructured throughout history. Despite changes in society, technology, and design, maps' exploratory potential persists and enables them to successfully foster possible futures. Since the 1980s maps have been acknowledged, not as mere representations but as visual arguments that can be used to structure, extend and diversify our knowledge systems. Advances in technology and the everyday use of digital tools have increased 'resolution' in every aspect of our lives, altering our social, political, and economic structures.[1] Increased resolution through discrete data sets, simultaneous data inputs, and participatory network conditions have also altered the way we conceptualise maps. High-resolution participatory maps, for example, allow us to achieve ambient readings of both tangible and intangible aspects of reality. Without a fixed meaning, digital maps involve multiple data entries from numerous authors, which may constantly be arranged and connected to generate new collectives and networks. By altering the definition and conceptualisation of the map to embrace multiple data, authors and readings, digital practices of mapping become infrastructures in continuous transformation. This moment coincides with what Umberto Eco identified as open works, in which authors deliberately leave their work open to interpretation and completion by performers in order to maximise the number of possible readings.

Eco, Johns and Fuller

Openness, and more particularly open works of art were introduced as notions by Umberto Eco in the 1962 book *The Open Work*, where he links both notions to the multiplicity of meanings and audience participation.[2] According to Eco, an open work is contingent and can be interpreted at different levels and from different perspectives.[3] Open works of art are in continuous progress, rather than aiming for fixed conclusions or meanings.[4] Referring to scientific appraisals of reality, especially in relation to Einstein's work, Eco states that the indeterminacy and discontinuity of quantum physics' spatiotemporal conception of the universe have influenced artists' inclusion of emergence and multiple perspectives in their work.[5] A multiplicity of viewpoints is privileged over an absolute view, emergent interrelations are preferred to prescribed structures, and ambiguous conditions are deliberately included rather than excluded from art. To argue for the relevance of Eco's openness in contemporary mapping practices we can begin with a false start – in Jasper Johns's terms – and look at Johns's highly unconventional process of mapping (and remapping) on fragmented large-scale canvases.

The opening scene in Hans Namuth and Judith Wechsler's 1990 film *Jasper Johns: Take an Object* shows the artist repainting one of his largest

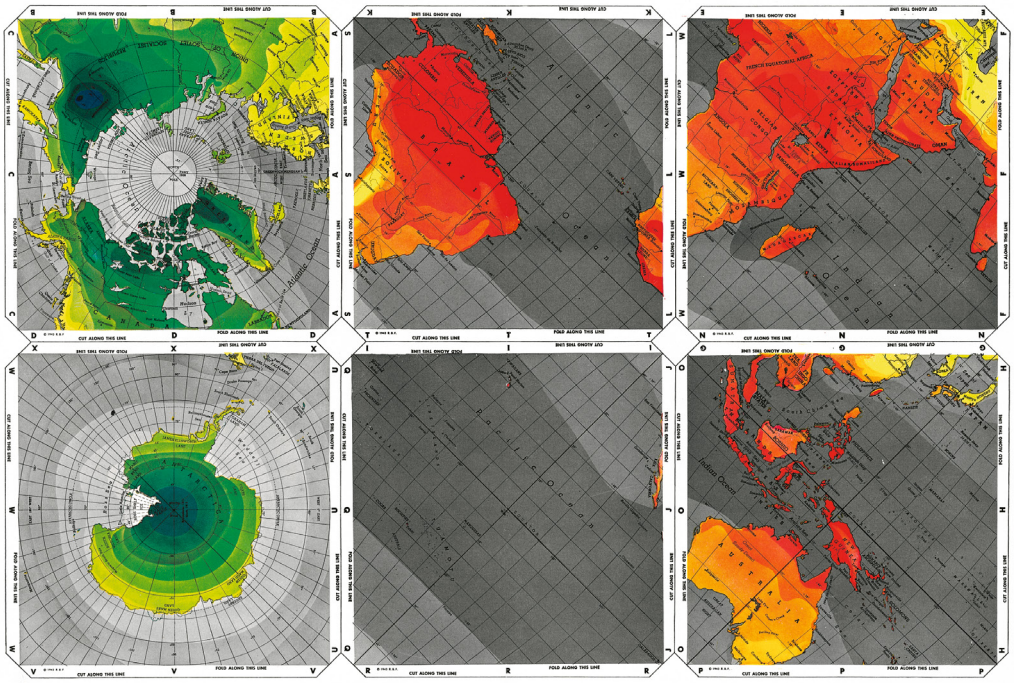
paintings, entitled *Map (Based on Buckminster Fuller's Dymaxion AirOcean World),* in his New York Houston Street studio.[6] [Fig 1] The painting was created in 1966 for the *American Painting Now* exhibition at the United States Pavilion at the 1967 Montreal International Exposition, under the theme 'Man and His World' (inspired by Antoine de Saint-Exupéry's book).[7] Johns was invited by the curator Alan Solomon to participate among many other leading American artists of the post-war era. The exhibition was famously housed in Buckminster Fuller's 62-metre high geodesic dome. The vast space was filled with four enormous staggered platforms joined by lengthy escalators, each filled with enormous display objects: American satellites and their parachutes, including an Apollo space capsule, large-scale paintings, and huge photographs.[8] Attempting to reflect upon the size and the problem of scale inside the gigantic dome, along with his well-established interest in maps and map paintings, Johns borrowed Fuller's *Dymaxion Airocean World Map* and transferred it onto twenty-two separate triangular panels. In the abovementioned film scene, Johns explains how he painted each panel separately based only on a copy provided by Fuller to indicate what the painting should resemble when the panels fit together.[9] A 1965 photograph from his studio shows a number of panels of different sizes on the wall and four panels leaning against the wall at an angle; a printed copy of the *Dymaxion Map* is discernible on the floor.[10] When Johns saw his own *Map* fully assembled and exhibited vertically for the first time (despite its intended horizontal layout), he decided to re-do the whole thing. A year after the exhibition, Johns moved to a bigger studio with a wooden support structure to install the panels so that he could have his whole 'globe' in view while working on individual panels. In five years, he edited the painting in three significant ways,

> adding a layer of collaged media and encaustic to the surface of each panel; redrawing geographic elements in a fragmented manner so that the overall projection appears less coherent and more distorted; and abandoning the vertical orientation for a horizontal one.[11]

The considerable autonomy given to the artist to create this work of art mirrors the original compositional arrangement of the *Dymaxion Map*. Published in sections (with instructions for assembly) in *Life* magazine in 1943, Fuller's patented map presented the earth as a cluster of essentially uninterrupted landmasses. [Fig. 2] Its several editions (for example, a cuboctahedron edition and an icosahedron edition) enabled the *Dymaxion Map* to unfold the projected image of the globe on the surface of a polyhedron with minimum distortion, as well as to distribute negligible distortions evenly on each piece. Compared to other examples of world maps that aim to project the globe on a flat surface with much larger distortions, Fuller reproduced the shapes of the earth's landmasses with a minimum of distortion as he breaks down the globe into triangular parts. By defining an alternative structure for the representation of the world, the *Dymaxion Map* can be rearranged to provide alternative readings according to the reader's interpretation. Unlike many other maps it does not propose a privileged orientation, as it does not indicate the north as a dominant pivot point. According to Fuller, the expansion of global mobility in the twentieth century demanded a flexible map accounting for many different readings and relations.[12] His near-precise projection of the globe was achieved through a mathematical structure in which the different facets of the icosahedron can be reassembled without any distortion to expose well-known, but also new or unexpected relationships.[13] To exemplify the near-infinite amount of possibilities offered by his map, Fuller provided six templates, noting that 'by means of these elective arrangements, our thinking may be realistically insinuated within the special geographical environment of the people of any one world area as predicated upon their own set of conditions.'[14] [Fig. 3]

Fig. 1: Jasper Johns working in his New York Houston Street studio. Still from the short documentary *Jasper Johns: Take an Object*, directed by Hans Namuth and Judith Wechsler, 1990.

Fig. 1



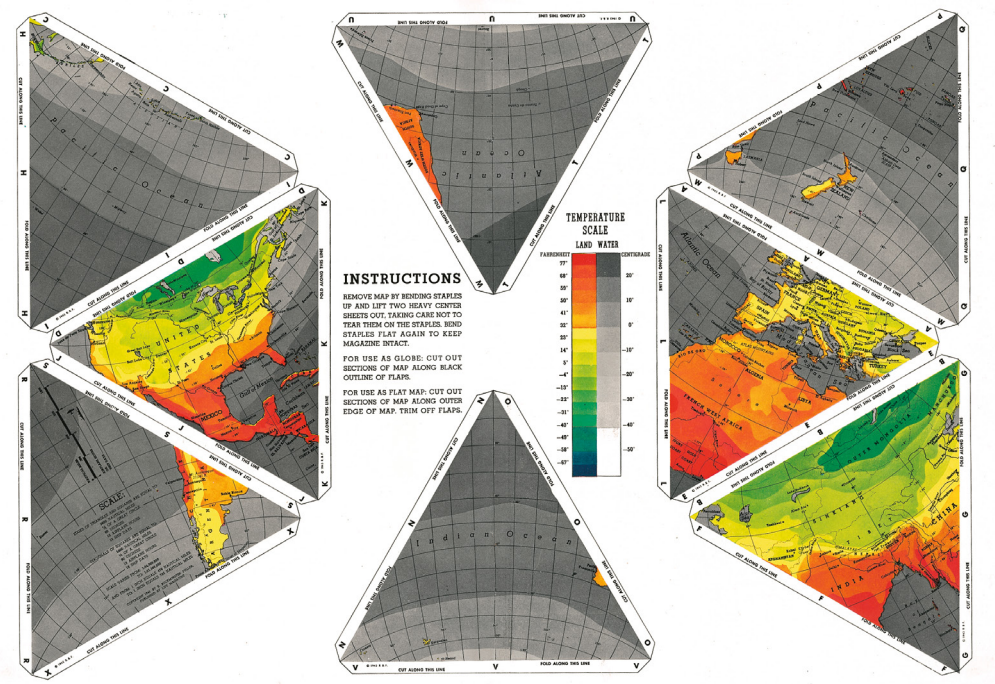


Fig. 2: The original two-page pull-out pattern insert of B. Fuller's Dymaxion Map published in *Life Magazine*, March 1943. Source: The Estate of R. Buckminster Fuller.

DYMAXION WORLD (continued)

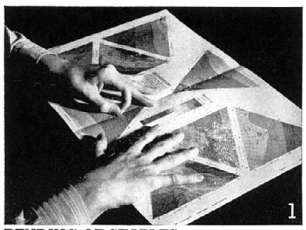
HOW TO ASSEMBLE THE GLOBE

Here demonstrated is the simple procedure by which the segments of the Dymaxion World map are assembled into a visual approximation of a round globe. The opposite page is the reverse side of the second of the two heavy center sheets on which the map is printed.

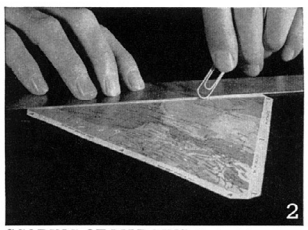
First step, removal of center sheets from magazine, must be taken with care to avoid tearing map on staples. Segments cut out are best fastened together by paste or mucilage. Because they warp the paper, pins should not be used. For neatest product, sequence of assembly here illustrated should be followed. Marginal letters of triangles match marginal letters of squares.

The map, thus assembled into a 14-faced solid, has many of the advantages of a globe. Like a globe it can be viewed from any perspective to bring geographical relationships into new relief—to show that the Southern is the water hemisphere, that Chicago and Sverdlovsk are fairly close together over the top of the world, that Dutch Harbor lies closer to the shortest San Francisco-Tokyo route than Pearl Harbor.

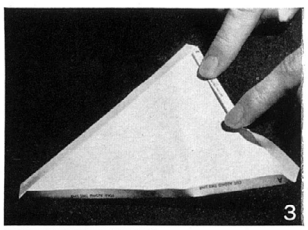
Before they are hidden inside globe, statistics on reverse of each segment are worth inspection. For example, the North Pole square's 8.9% of world population contrasts dramatically with the South Pole's .0004%.



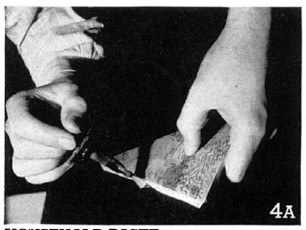
BENDING OF STAPLES is first step in removing map from copy of LIFE. Bent back, staples hold copy intact.



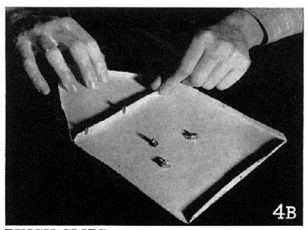
SCORING OF MARGINS of colored face of segment with clip or dull knife facilitates folding of flaps (*right*).



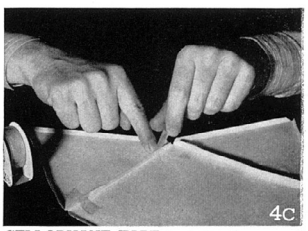
FOLDING OF FLAPS should follow margin of map precisely. Flaps of segments to be joined are keyed by letters.



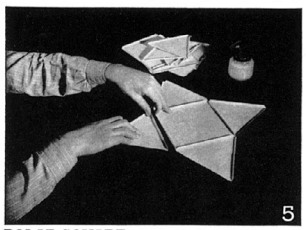
HOUSEHOLD PASTE or mucilage is best means for fastening flaps. It should be spread thinly to avoid warping.



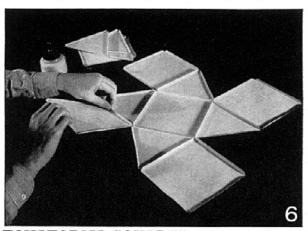
PINCH CLIPS, easy to apply, permit disassembly of globe. If clips are used last segment must be taped or glued in.



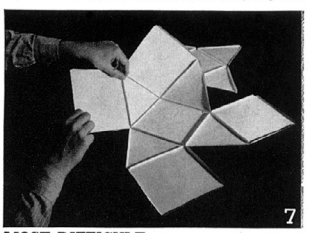
CELLOPHANE TAPE is substitute for paste and clips. It must be applied inside and out to keep edges together.



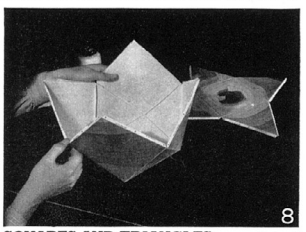
POLAR SQUARE and triangles should first be assembled into unit. Care should be taken to keep edges in register.



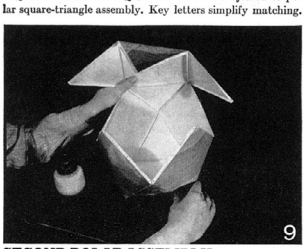
EQUATORIAL SQUARES are then joined to polar square-triangle assembly. Key letters simplify matching.



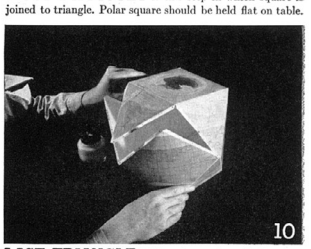
MOST DIFFICULT is this step in which square is joined to triangle. Polar square should be held flat on table.



SQUARES AND TRIANGLES are now fastened and structure is self-supporting. Paper has surprising rigidity.



SECOND POLAR ASSEMBLY is mounted. Paste should be allowed to dry a little before the flaps are joined.



LAST TRIANGLE is left unfastened until other flaps are secured. It can then be set by pressure from the outside.

—OR YOU CAN USE SEGMENTS FOR A FLAT, MOVABLE MAP (SEE PAGE 53)

Fig. 3: The original page from the Life Magazine article published in March 1943. Source: The Estate of R. Buckminster Fuller.

Fuller's map allows its readers to assemble or open all facets of the icosahedron in different ways. Thus, it allows them to achieve partial readings and alternative interpretations of the world, as well as to produce visions of other possible worlds. A map is always an incomplete and insufficient description, 'a surface on which is laid out an assemblage of the world', according to Svetlana Alpers.[15] By deploying triangles that could be fitted together to form a globe, Fuller offers a new descriptive map that directly challenges mapping on two fronts. First, it expands the relationship between a two-dimensional map and the three-dimensional world it signifies; and second, it unfolds the user-generated dynamic relationship between the map's parts and whole. Challenging the conceptualisation of the map as a representational tool that depicts reality, the *Dymaxion map* is endowed with agency; as a productive, proactive, and provocative medium that – by shuffling relations without a fixed depiction – extends the boundaries of representation and enables mapping to function as an interpretative medium with an incomplete and ever-changing organisation of visible and invisible relations. [16]

Considering the highly politicised landscape of the post-war era, the particular context of the Montreal Expo, and Fuller's uniquely utopian perspective, we could see both the *Dymaxion Map* and Jasper Johns's mural version of it as significant examples of openness that shift the observer's attention from object to performance. Each of Johns's murals (objects) must also be understood as an act or process of mapping a 2D map. In that sense they not only represent, but also physically rework, interpret, and interact with the 3D content (the globe) that is common to all. The fact that the paintings don't obviously look like conventional maps reveals that mapping is always an 'ongoing process of picturing, narrating, symbolizing, contesting, re-picturing, re-narrating, re-symbolizing, erasing, and re-inscribing a set of relations.'[17]

Part-to-whole relations

A work of art's openness – or 'suggestiveness' in Eco's terms – largely depends on whole-to-part relationships.[18] For centuries historical maps have provided their readers with multiple, real and fictive layers of information. For instance, Boundelmonti's fifteenth-century Constantinopolitan views or Jacopo de Barbari's map of Venice mediate between real and possible urban configurations. As a generative instrument, cartographic practice makes and remakes the urban conditions over and over, and thus offers alternative readings where 'fact' (factum, something made) and 'fiction' (fictio, the act of making) delimit a continuum rather than an opposition. According to James Corner, the act of mapping neither reproduces nor forces knowledge.[19] Instead, every reception of a map is an interpretation of the complete original work whose parts are countlessly reconfigured by a mental and aesthetic contribution by the observer – as Eco emphasises. Even an unquestionably definitive map, such as the fourteenth-century Jericho map from the Farhi Bible, 'opens up' in similar ways in the eyes of the beholder. [Fig. 4]

The map depicts the biblical city mentioned in several Old Testament episodes. The circular pattern represents 'the need to circumambulate the city seven times to enter it because of its seven walls.'[20] Jericho is illustrated as a circular maze; a continuous blue trail lined with a fortification wall that constitutes the meandering walkway defended by many watchtowers. The walkway begins at the closed city gate and ends at the centre. In that sense it is complete. However, as explained by Reed Dobb, labyrinths 'simultaneously incorporate order and disorder, clarity and confusion, unity and multiplicity, artistry and chaos.'[21] Thus, even though the Jericho map might look like a perfect finite work (a straight path created by a set of specific repetitions applied on predefined structural coordinates) this relatively static view becomes dynamic from a walker's perspective. The round pattern, its impenetrability (and the disorientation it causes), and a sense of

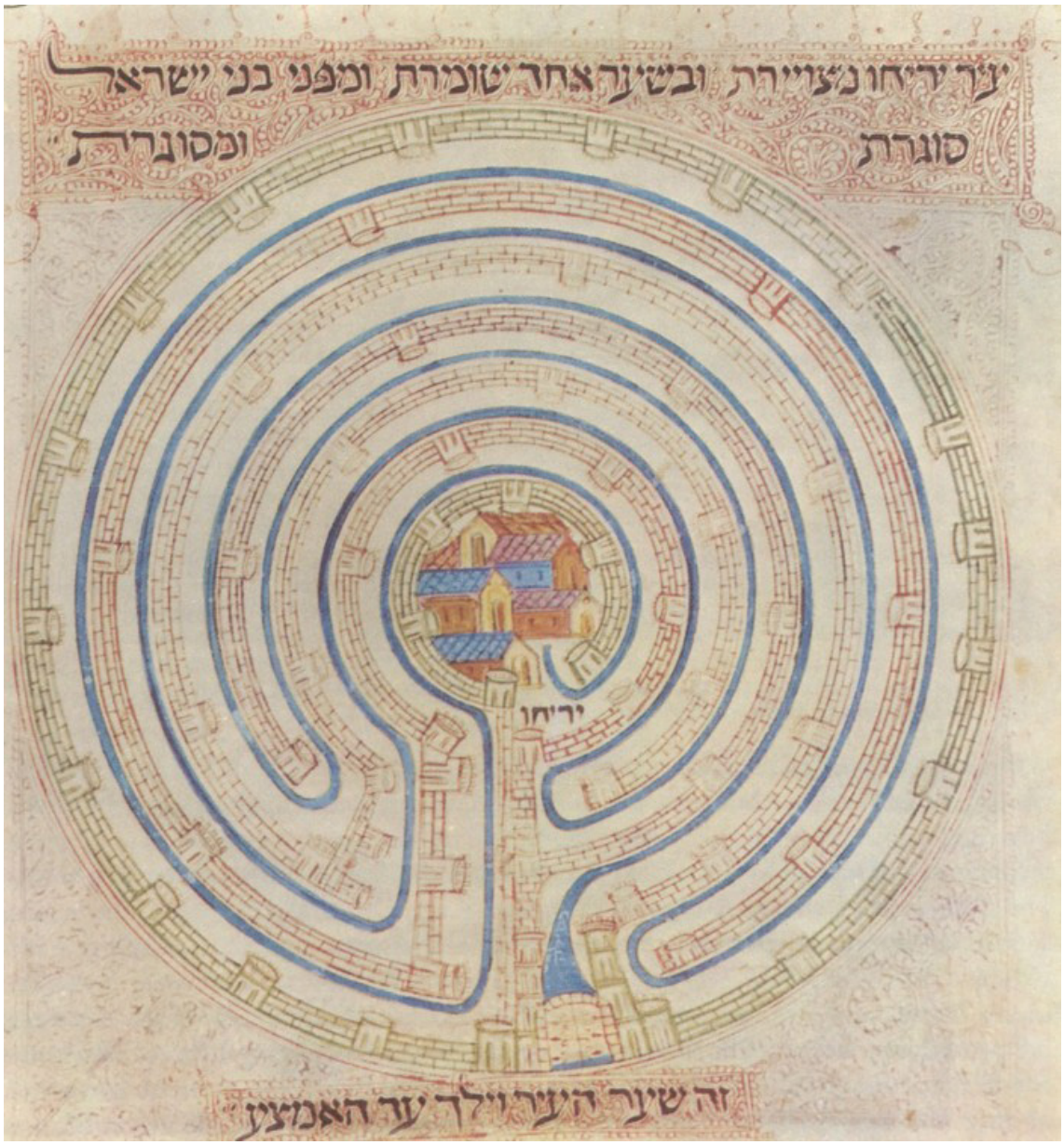


Fig. 4: Maze map of the Palestinian city of Jericho, by Elisha ben Avraham Crescas, in the Farhi Bible, fourteenth century. Source: Wikipedia.

enforced circuitousness, demand that one decides between two paths at any given movement, just like Eco's 'works in motion'.[22] The maze's embedded 'perceptual ambiguities' allow the observer to conceive the world as a new potentiality before habit and familiarity kick in.[23] Just as the 'blank space surrounding a word, typographical adjustments, and spatial composition in the page setting of the poetic texts' create 'a halo of indefiniteness and to make the text pregnant with infinite suggestive possibilities,' in Eco's words, the embedded 'perceptive ambiguities' of the maze are 'a deliberate move to "open" the work to the free response of the addressee.'[24] As such, part-to-whole and part-to-part relations range from static to dynamic, from multi-scalar to multi-dimensional, and from ambiguous to interactive. Reading the Jericho map offers us an opportunity to ponder part-to-whole relations in the digital age.

In light of technological developments such as the printing press, aerial photography, global positioning systems (GPS) and geographic information systems (GIS), mapping has been redefined as an act of accessing, deciphering, visualising, and producing tangible or intangible data, which is always in continuous transformation.[25] More specifically, digital maps enable extensibility and polyvocality.[26] The large scale of data input, polyvalent authorship, unfinished and indefinite readings, and stratified realities do not define a giant map made of bytes, but rather an unfinished model open to new constellations and interrogations. Loaded with data from different sources and authored by different participants, digital maps are intrinsically incomplete and unstable. They achieve a sense of depth by 'recording and representing the grain and patina of place through juxtapositions and interpenetrations of the historical and the contemporary, the political and the poetic, the discursive and the sensual' and embrace ambiguity, uncertainty, contingency, and incompleteness in order 'to provide a platform for a spatially-embedded argument.'[27]

A map's stratification and grain come together in order to create meaningful readings or emerging existences that do not necessarily merge in a single reading. The discretisation and the part-whole relations implicit in mereological thinking define a theoretical framework for digital mapping practices.[28] Mereology is the study of relationships between parts and wholes. By focusing on the connections and collections that explain wholes, it facilitates the consideration of increased resolution and its subsequently produced realities.[29] Mereological thinking allows us to understand how different parts define and structure the whole they are part of, but also function as discrete entities at different scales. According to Edmund Husserl, part-whole relationships take place at different scales.[30] Interdependency, discreteness, distinctiveness, and individuality define the specific conditions that articulate parts and whole. In the case of the above-mentioned Jericho map, for example, the whole is defined by the absence of identifiable parts.

Such dissolution of interrelations between parts is what Manuel DeLanda calls a 'flat condition,' in which the emergent wholes are liberated from the drive to become unified and the interaction between parts – circumstantial and/or evanescent – is emphasised.[31] Within emergent wholes, parts 'retain a relative autonomy so that they can be detached from one whole and plugged into another, entering into new interactions.'[32] Thus, flatness dissolves the distinction (and dependencies) between parts and wholes; connections intensify and focus on the conditions that define emergence as well as on the coincidental occurrences of parts and wholes. This departure from conventional definitions of part-to-whole relationships offers us a better framework to gather, store, and process information on maps composed of different layers and multiple interactions.

The contemporary city and the open map

Computers have enabled us to acquire, interpret and use complex data. With continuous data input from various sources, increased intensity and saturated processes disturb and redefine conventional

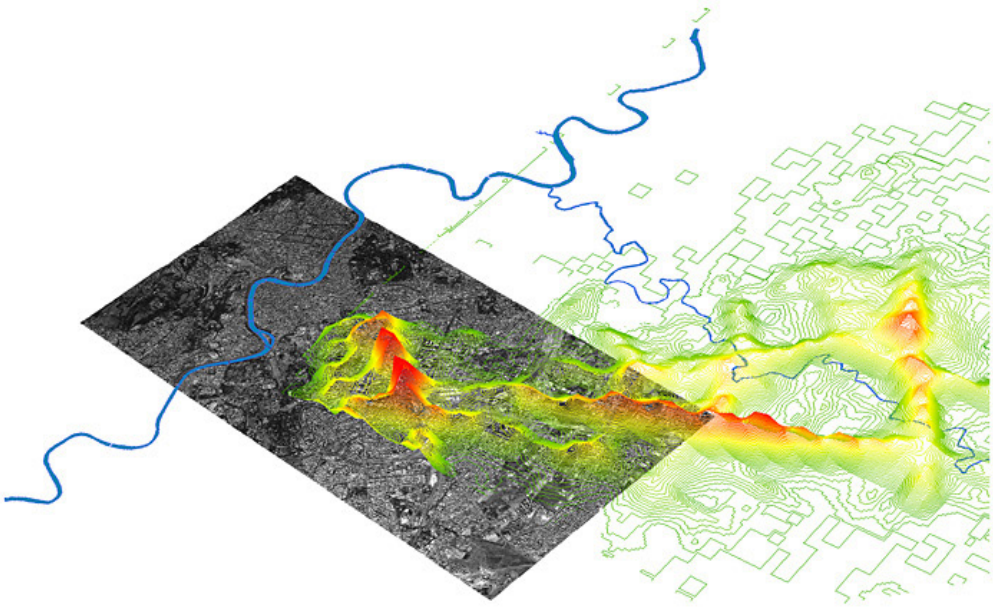
mapping practices. In order to respond to these transformations, as well as to complex cities and their ever-changing relations, the contemporary map must overcome overdetermined, stable structures and fixed dependencies. Instead, it must be defined by diversity, incompleteness and unpredictability. Such qualities bring the map close to DeLanda's definition of a flat condition, which triggers and embraces evolving, dynamic, unpredictable, and indeterminate processes. In constant re-definition, flat conditions transform and maximise themselves by connecting and reconnecting different layers of information, and by initiating uninterrupted interactions between them. Continuous reorganisation is part of a flexible, ever-changing and unstable process, constantly rearranged via new inputs from various authors. Even when a particular mapping process is over, the resulting map remains open, as it can be re-interpreted from various perspectives and become a part of another map through whole or partial transfer.

The World Game, an educational simulation tool created by Buckminster Fuller in the 1960s as a comprehensive and cooperative approach to the world's problems, illustrates this open process. Fuller proposed the game as part of the curriculum at Southern Illinois University, and initially played it with his colleagues and students. [Fig. 5] Seen as a tool accessible to everyone, the game was Fuller's response to technological advances (cybernetics and computerisation), political and physical changes (the post-war period and environmental problems) and social shifts (the impact of human activity).[33] Furthermore, the game was also seen as an alternative to war games, as it allows participants to discover a series of relationships by indicating their runs and decisions on a constantly evolving map. Using the *Dymaxion Map* as basis, the World Game requires the spontaneous participation of a group of players who are expected to cooperate and propose solutions to a given problem (usually a global problem) such as overpopulation or the distribution of resources.[34] The process allows participants to provide personal interpretations and solutions in a non-hierarchic organisation, and to interact with each other's decisions, vis-à-vis the map, as they reach decisions collectively, using a distributed rather than a holistic approach.[35] Through a distributed network that redefines itself with each data input from every participant, the model also redefines itself as part of an indeterminate, unfinished process. By folding and unfolding the map in various ways according to a series of predetermined relationships, the game 'introduced indeterminacy in the form of competition and chance and allowed for the operation of free will, democracy (the will of the majority), and interactive influence (synergy)'.[36]

Fuller's World Game allows for the reconfiguration of decisions and fosters multiple perspectives by encouraging spontaneous cooperation between participants. The connections and networks generated by the game are extended to include multiple interpretations, establishing an obvious connection between the indeterminate structure of the World Game and Eco's definition of the open work: 'the more improbable, ambiguous, unpredictable, and disordered the structure, the greater the information – here understood as potential, as the inception of possible orders.'[37] It is in this sense that the World Game can be taken for an open work, based on mapping practices and yet altering them through participatory and collaborative definitions. Like the *Dymaxion Map*, the World Game also opens the map to multiple readings which can be arranged in several alternative ways, turning users and readers indiscriminately into authors, participants and spectators of the resulting unstable outcomes and their meanings.

Just like the game's hands-on performance, contemporary digital maps also have a granular front. Recent developments in computer science and information technologies have transformed the game's open approach and its multi-layered readings into grittier digital city maps that register enormous amounts of interrelated information and

Fig. 5: Playing the World Game at New York Studio School of Painting and Sculpture in 1969. Photo: The Estate of R. Buckminster Fuller.



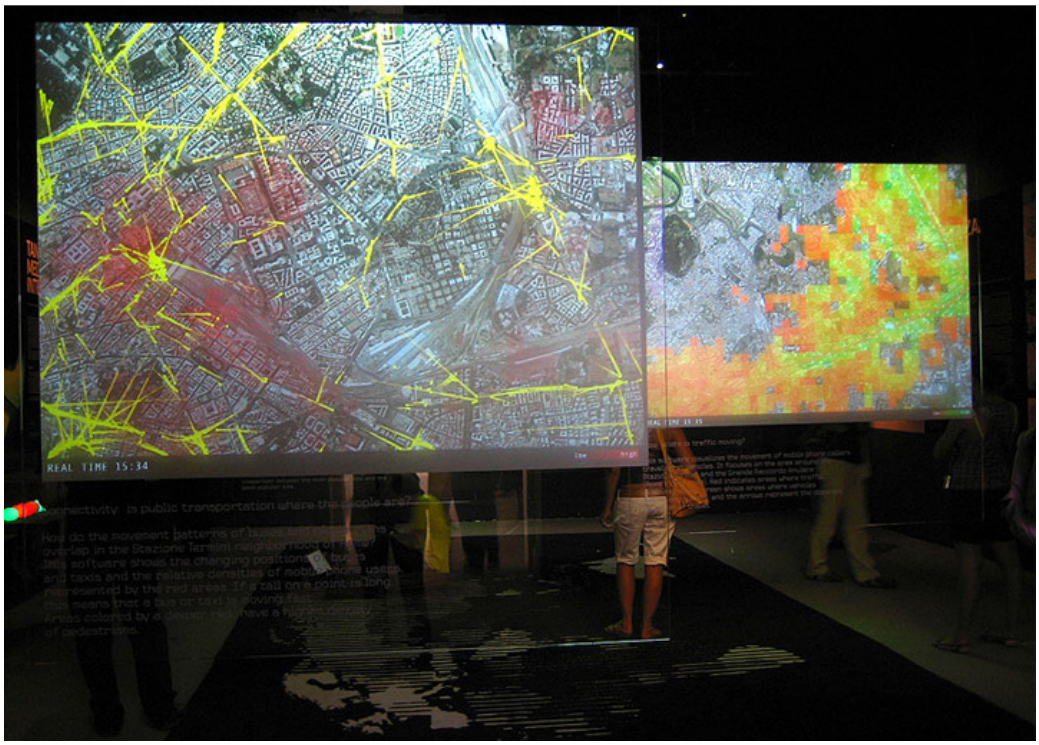


Fig. 6: In the Real-time Rome project, different datasets are overlaid in a single model. Source: MIT Senseable City Lab website.

allow many different parties to track that information simultaneously. Introduced by Panagiotis Michalatos, granularity is the condition that characterises available data recorded and represented through a model that is accessible, transmissible, and observable.[38] As already noted, new technologies allow many users to participate simultaneously in the same digital model, which, in return, records their acts as forms of concurrent authorship.[39] In other words, a digital model becomes a granular structure when it is able to register the totality of all participants' actions. In the granular model, any manipulation – even the faintest click from a single user – can be isolated, removed, copied, and moved, allowing the model to continue evolving despite the absence of any users. Granularity is therefore not about holding various layers of information together, superimposed on a single map, but about keeping all layers of information constantly open to operation and manipulation. The result is an evolving map that is literally in continuous redefinition. Every piece of information, every act understood as information, increases the content of the map and enables multiple interactions between these information bits.

As a granular structure, the Real-time Rome project developed by MIT's SENSEable City Lab for the 2006 Venice Biennale was able to read urban dynamics in real time and therefore to reveal the city's pulse.[40] The project provided a highly granular map of Rome, combining information gathered from various real-time networks in a single database and offering instantaneous visualisations. [Fig. 6] Taking advantage of ubiquitous connectivity and urban informatics, data was gathered from the city and citizens through mobile phones and transportation networks.[41] Traces of information and communication networks, movement patterns of both people and transportation systems, and spatial and social use of streets and neighbourhoods were all mapped to understand the real-time city. Citizens became active participants in the process, consciously or unconsciously.[42] By matching mobility information with data of Rome's geographic and socio-economic context, the map visualised the use of neighbourhoods, the distribution of goods and services, and the different inhabitation patterns that coexist in the city.[43] These different mapping processes continued even after the initial visualisation processes, since the layers of data could be rearranged, reshuffled, reorganised, removed, or isolated to provide alternative viewpoints and readings. Therefore, the potential number of different maps resulting from this process is infinite and always in progress. In this case, each map's parts do not necessarily define a foundational part-to-whole relationship but rather a flat condition. Hence, the granular structure embraces a flat organisation, which can reorganise itself according to new interactions and does not propose a hierarchic dependency between the parts, that is, the information bits stored in the model. Different from the kind of openness described in Fuller's World Game, the Real-time Rome map is open to near limitless inputs provided by unknown participants, and does not dictate any kind of structure, organisation, or foreseeable visualisation.

Endings

In *The Open Work*, Umberto Eco registered artists' shared decision to leave the arrangement of some of the constituent parts of their art either to the public or to chance, shifting from a single definitive order to a multiplicity of possible orders.[44] In Namuth and Wechsler's film, we see Jasper Johns working and re-working his *Map*, layer upon layer, while constantly checking Fuller's *Dymaxion Map*; scraping the surface and adding another layer, fixing the paint with heat and removing layers of colour; and finally, stepping down from the ladder to zoom out and see the earth all at once. We can also notice the traces of his decisions and revisions in the different reconstructions of the *Map*. It would appear that, more than an author, Johns acts like a participant, performing upon the structure provided by Buckminster Fuller, which remains deeply inscribed on the plane. This shift in the role

of the artist is not different from the granular condition imposed by the contemporary open map. The mapping practices, we have considered in this article, although traced over different periods and with different intensities, all contain some degree of openness through a multiplicity of meanings and the participation of viewers. The non-linear reading of Fuller's *Dymaxion Map* through Johns's wall-size paintings and the World Game epitomise different forms of openness in different mediums. As open works, they have different degrees of openness. The concept of openness here is constant, but the method of satisfying it varies according to society's available technologies and current conditions.

On these grounds we can criticise conventional mapping techniques for not responding to the complexity and the fluidity of contemporary cities, but also for not being structured to include the many exigencies, defects, uncertainties, intentional or unintentional deviations, and the inevitable arrays of the current urban condition.[45] An augmented granularity of the open map, on the other hand, holds the potential to accommodate the visible and invisible, related and unrelated, existing or yet-to-come conditions that define every context. In this respect, granular open maps could render the complexity of the contemporary city and define the fluidity of the relations as a critical input for performative mapping practices.

Reconceptualising the map as an open work also allows us to revise the position of the architect as designer, and dissolves dependencies between designers and maps. The flat condition defined through granular open maps includes designers as part of a network of relations made up of many other actors. The dissolution of the authority of a single author in the definition and visualisation of the map makes room for multiple other actors – especially those who have historically been rendered invisible. The uninterrupted gathering, processing, and visualising of multidimensional and massive amounts of data could reveal heretofore unacknowledged features of the city, and make them visible. This way, open maps could allow designers to construct spatial narratives which official data sources do not (or cannot) reveal. Rather than reflecting on politically or ontologically visible statistics, open granular maps would allow designers to overcome legacies of inequity and underrepresentation, and constitute a performative tool for the creation of comprehensive and collaborative environments that are able to incorporate different values.

Notes

1. Daniel Koehler defines resolution in relation to discretisation and discusses the concept in reference to mereology. Daniel Koehler, 'Mereological Thinking: Figuring Realities within Urban Form', *Architectural Design* 89, no. 2 (2019): 30–37.
2. Umberto Eco, *The Open Work* (Cambridge, MA: Harvard University Press, 1989).
3. Guy De Mallac, 'The Poetics of the Open Form: (Umberto Eco's Notion of "Opera Aperta")', *Books Abroad* 45, no.1 (Winter 1971): 31–36.
4. Eco, *The Open Work*, 23.
5. Ibid., 18.
6. *Jasper Johns: Take an Object,* directed by Hans Namuth and Judith Wechsler (1990), 26 min., https://judithwechsler.com/films/jasper-johns-take-an-object.
7. For the art and architecture at Expo 67, see Lynn Sherr, 'Expo 67', *Art in America* 55, no. 1 (January 1967): 76–79, and Mahonri Sharp Young, 'O Canada! O Expo!', *Apollo* 86, no. 67 (September 1967): 234–38.
8. Virginia M. G. Anderson, 'A Map and a Painting: The Re-Working of Jasper Johns's Map (Based on Buckminster Fuller's Dymaxion AirOcean World)', *American Art* 32, no.1 (Spring 2018): 52–73.
9. Jasper Johns, Kirk Varnedoe and Christel Hollevoet, *Jasper Johns: Writings, Sketchbook Notes, Interviews* (New York: Museum of Modern Art, 1996).
10. For the photograph taken by Rudolph Burckhardt, see Varnedoe Kirk, *Jasper Johns: A Retrospective* (New York: The Museum of Modern Art: Distributed by H.N. Abrams, 1996, 231).
11. Joseph Ramsey, 'A Fuller Map: Latent Meanings within Jasper Johns' Map (Based on Richard Buckminster Fuller's Dymaxion AirOcean World)', *Athanor* 35 (2017), 77–84.
12. R. Buckminster Fuller, 'Fluid Geography', in *The Buckminster Fuller Reader*, ed. R. Buckminster Fuller and James Meller (London: Cape, 1970), 131.
13. Christine Macy and Sarah Bonnemaison, *Architecture and Nature Creating the American Landscape* (New York: Routledge, 2003), 317–18.
14. Fuller, 'Fluid Geography', 133.
15. 'Like the mappers, [Dutch painters] made additive works that could not be taken in from a single viewing point. Theirs was not a window on the Italian model of art but rather, like a map, a surface on which is laid out an assemblage of the world.' Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1984), 133.
16. James Corner, 'The Agency of Mapping: Speculation, Critique and Invention', in *Mappings*, ed. Denis E. Cosgrove (London: Reaktion, 1999), 218.
17. Todd Presner, David Shepard and Yoh Kawano, *Hypercities: Thick Mapping in the Digital Humanities* (Cambridge, MA: Harvard University Press, 2014), 15.
18. Eco, *The Open Work*, 8.
19. James Corner, 'The Agency of Mapping', 228.
20. *Encyclopedia of the Bible and Its Reception* vol. 13 (Walter de Gruyter, Berlin/Boston, 2016), 964. For a discussion of the Jericho-labyrinth tradition see Hermann Kern, *Through the Labyrinth: Designs and Meanings over 5,000 Years* (Munich: Prestel, 2000 [1982]), 171–182. For the fourteenth-century map, see https://en.wikipedia.org/wiki/Jericho#/media/File:Map_of_Jericho_in_14c_Farhi_Bible_by_Elisha_ben_Avraham_Crescas.jpg.
21. P. Reed Doob, *The Idea of the Labyrinth from Classical Antiquity through the Middle Ages* (Ithaca, NY: Cornell University Press, 1992), 12.
22. Eco, *The Open Work*, 9.
23. The term *perceptive ambiguities* is taken from modern psychology and phenomenology.
24. Eco, *The Open Work*, 9.
25. For contemporary definitions and interpretations of mapping, see Mark Dorrian, 'Architecture's Cartographic Turn', in *Figures de la Ville et Construction des Savoirs*, ed. F. Pousin (Paris: CNRS Editions, 2005), 61–72; Jeremy W. Crampton and John Krygier, 'An Introduction to Critical Cartography', *ACME: An International E-Journal for Critical Geographies* 4, no. 1 (2006): 11–33; and Jacques Lévy, *A Cartographic Turn* (Lausanne: Epfl, 2016).

26. Presner, Shepard and Kawano, *Hypercities,* 18.
27. Mike Pearson and Michael Shanks, *Theatre/ Archaeology* (Abingdon-on-Thames: Routledge, 2001), 64–65.
28. Within the scope of this article, mereology is introduced not to frame the entire mapping discussion within the part-whole relationship, but rather to introduce the concept of discreteness that increases with the maps' resolution.
29. Daniel Koehler, 'Mereological Thinking: Figuring Realities within Urban Form', *Architectural Design* 89, no. 2 (2019): 35.
30. Edmund Husserl, 'Investigation III – On the Theory of Wholes and Parts', *Logical Investigations*, vol. 2, trans. J. N. Findlay (Abingdon-on-Thames: Routledge, 2001), 4.
31. Manuel DeLanda, *Intensive Science and Virtual Philosophy* (New York: Continuum, 2002), 47.
32. Manuel DeLanda, *Assemblage Theory* (Edinburgh: Edinburgh University Press, 2016), 226.
33. Timoty Scott, *Buckminster Fuller's World Game and Its Legacy* (Abingdon-on-Thames: Routledge, 2021), 5.
34. R. Buckminster Fuller, 'World Game', *Critical Path* (New York: St. Martin's Publishing Group, 1982), 398.
35. Ibid., 400.
36. Christine Macy and Sarah Bonnemaison, *Architecture and Nature Creating the American Landscape* (New York: Routledge, 2003), 317–18.
37. Eco, *The Open Work*, 93.
38. Panagiotis Michalatos, 'Design Signals: The Role of Software Architecture and Paradigms in Design Thinking and Practice', *Architectural Design* 86, no. 5 (2016): 110.
39. Ibid., 113.
40. Real-time Rome, MIT, SENSEable Lab, https:// senseable.mit.edu/realtimerome/.
41. Ibid.
42. Ibid.
43. Ibid.
44. Eco, *The Open Work*, ix.
45. Arie Graafland, *Understanding the Socius Through Creative Mapping Techniques* (Delft: Delft School of Design, 2008), 7.

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