The Architectural Continuum
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"Ουδείς αγεωμέτρητος εισήτω" reads the inscription believed to have marked the entrance of Plato's Academy. Although often mistranslated, it's literal meaning is: "Let no *ungeometered* person enter". Plato addresses not geometers, but the geometered[1], as if mathematics were a practiced, embodied quality, and a modality of being, instead of mere knowledge. Indeed, Euclid's rigorous axiomatic system, doubles also as a first formal scientific method, that Plato will employ as an instrument to better understand reality[2], while expecting from his students and guests the ability to employ the empirical sequential methodology of constructible geometry in their rhetoric[3]. Mathematics thus, becomes a form of ideology.
Centuries later, Alberti's "De Pittura", on mathematical perspective, bridges geometry with the experience of the world and initiates the scientific revolution[4,5,6,7]. Cartesian rationalism, will employ geometry to represent and understand the world, while Kant will advocate for "absolute space" as the petri dish of reality[8]. In the millennia to come, Euclid's geometry will become the most intuitive model of space. However, the search for a proof of his infamous 5th postulate, will trouble mathematicians for centuries[9]. Gauss' "Theorema Egregium" will provide a paradigm shift and alternative to cartesian space, while his student Riemann, addressing the "hypotheses which lie at the bases of geometry"[10] will generalize the theory for N-dimensions. Einstein will adopt such a geometry[11] to theorize reality as spacetime, accounting for phenomena unheard of in euclidean space, and providing the first significant rupture between visual space and reality.
Meanwhile, videogames become the most prominent entertainment medium and the field of game studies is established[12]. Scholars will write on space; as the "raison d'être" of games[13]; as a parallel to architectural practices[14]; and as a paradigm shift[15] of this cultural medium coming of age. Space has indeed become the underlying substrate in both the production and consumption of games, with gameplay seen a spatial practice[16,17,18]. From military flight simulators to contemporary videogames, "gameplay" have been proven to develop and expand one's spatial skills[19]. Although architectural design is locked in a euclidean paradigm[20], a few videogames show our capacity to conceive and engage with spaces impossible to construct physically[21].
Through a short historiography of the evolution of spatial concepts, this contribution intends to suggest the possibility of a *Virtual Architecture*[22]. Based on both theory and experimental practice[23] we will discuss sensible, post-physical-world navigable environments residing in the VR-videogame medium, and the vast aesthetic potential stemming from their capacity to tap into currently latent spatial-cognitive abilities. As Van Schaik suggests[24], our ability to harness and cultivate "spatial intelligence"[25] is the essence of architecture par excellence, and the well of its future.

Picture 1: Entrance to the rotunda of the Werner Oeschllin Library in Einsideln. Picture of the author.

1 Researchers disagree on the actual wording of the phrase, with the most common being: “Μηδείς άγεωμέτρητος είσίτω μον τήν στέγην” and “Αγεωμέτρητος μηδείς εισήτω”. At any rate, Plato’s formulation of “geometered” (α-γεωμέτρητος, γεωμετρημένος / un-geometered, geometered) can be said to be an embodied quality, of the same nature as “cultivated” or “educated”.

2 Ten out of fifteen years at the Academy were devoted to the study of mathematics (geometry), while Plato in Timaeus (360 BC) will provide a symmetry between regular (platonic) solids and “elements” or atoms of the universe, that can be seen as a parallel to Euclid’s Elements (300 BC) - which will introduce the first formal system of mathematics in the face of geometry.

3 Besides, as Carpo describes, architectural elements were described textually and with proportions in the “books on architecture” of Vitruvius and Alberti, as their construction with a basic knowledge of geometry is self evident. Mario Carpo, “Building with Geometry, Drawing with Numbers,” in *When Is the Digital in Architecture?*, ed. Andrew Goodhouse (Montréal: Sternberg Press, 2017), 464.

4 Paul Feyerabend, “Brunelleschi and the Invention of Perspective,” in *Conquest of Abundance: A Tale of Abstraction Versus the Richness of Being*, ed. Bert Terpstra, New. edition (Chicago: Univ of Chicago Press, 1999), 89–128.

5 Giuseppe Longo, “Mathematical Infinity ‘in Prospettiva’ and the Spaces of Possibilities,” *Visible, a Semiotics Journal* 9 (2011).

6 Martin Jay, “Scopic Regimes of Modernity,” in *Vision and Visuality*, ed. Hal Foster, 1. edition (Seattle: The New Press, 1999), 3–28.

7 Samuel Edgerton, “The Renaissance Development of the Scientific Illustration,” in *Science and the Arts in the Renaissance*, ed. John William Shirley and F. David Hoeniger (Plainsboro, NJ: Associated University Presses, 1985), 168–197.

8 Mark Wagner, *The Geometries of Visual Space* (Mahwah, N.J: Routledge, 2006), chap. 2.

9 In this time, many mathematicians throughout the world will try to provide a proof of the parallel postulate, but in vain. On the contrary, conditions of parallelism, will prove to be the foundational criterion for different types of geometry -Euclidean being one of them. Bolyai and Lobachevsky are the first come up with the altogether new “hyperbolic geometry”, where many of Euclid’s laws do not stand (independently, in 1831 and 1829 respectively).

10 Riemann’s Habilitation dissertation, was the fist systematic approach to generative “non-euclidean” geometry. Bernhard Riemann, “On the Hypotheses Which Lie at the Bases of Geometry” (University of Göttingen, 1854), http://emis.ams.org/classics/Riemann/WKCGeom.pdf.

11 More specifically a 4-dimensional Minkowski manifold, as the fusion of space and time.

12 Espen J. Aarseth, “Computer Game Studies, Year One,” *Game Studies* 1, no. 1 (2001): 1–15.

13 Espen J. Aarseth, “Allegories of Space. The Question of Spatiality in Computer Games,” in *Cybertext Yearbook 2000*, ed. Raine Koskimaa and Markku Eskelinen (Jyväskylä: University of Jyväskylä, 2001), 44–47, http://www.eastgate.com/catalog/CT2000.html.

14 Henry Jenkins, “Game Design as Narrative Architecture,” *Computer* 44 (2004): 53.

15 Stephan Günzel, “The Spatial Turn in Computer Game Studies,” in *Exploring the Edges of Gaming* (Vienna games Conference 2008-2009, Vienna: Braumüller, 2010), 147–56, https://fedora.phaidra.univie.ac.at/fedora/get/o:1741/bdef:Container/get/Guenzel_The_Spatial_Turn_in_Computer_Game_Studies.pdf.

16 tockburger argues for gameplay as a relational spatial practice, stemming from Lefebvre’s production of space. Axel Stockburger, “Playing the Third Place: Spatial Modalities in Contemporary Game Environments,” *International Journal of Performance Arts and Digital Media* 3, no. 2–3 (2007): 223–236.

17 Fraser suggests a developable and practiced intelligence in games, in the name of “Metis”, a quality originating in ancient Greece to account for resourcefulness and cunning reason, as exemplified by Homer’s (polytrope - πολύτροπος) Odysseus. Benjamin Fraser, “Why the Spatial Epistemology of the Video Game Matters: Metis, Video Game Space and Interdisciplinary Theory,” *Journal of Gaming & Virtual Worlds* 3, no. 2 (2011): 93–106.

18 Kolb creates symmetries between activities in real and virtual spaces. David Kolb, “Real Places in Virtual Spaces,” *Nordic Journal of Architectural Research* 3 (2006): 69–77.

19 Gagnon’s early study proved that videogameplay can improve the score of standardized spatial cognition and skills assessments. Diana Gagnon, “Videogames and Spatial Skills: An Exploratory Study,” *Educational Communication and Technology* 33, no. 4 (1985): 263–75.

20 As well as game design: from AutoCAD and Maya to Unity3D and Unreal, both architecture and game design rely on software that are developed on a euclidean-cartesian (flat earth) foundation.

21 For example: Antichamber (Demruth, 2013) is a game which draws multiple examples from “non-euclidean” geometry, while Portal (Valve Corporation, 2007) is based on a mechanic inspired from spacetime relativity and wormholes.

22 For the emergent properties of virtual space, and its justification as a novel spatial platform for architectural experimentation see: Constantinos Miltiadis, “Project Anywhere: An Interface for Virtual Architecture,” *International Journal of Architectural Computing* 14, no. 4 (October 7, 2016): 386–97, https://doi.org/10.1177/1478077116670746.

23 See the two past iterations of the Virtual Spaces Master Studio, founded and taught by the author at the Institute of Architecture and Media of TU Graz, in which architecture students develop spatiotemporal VR prototypes in a wide

range of topics, including spatial constructions: http://studioany.com/teaching/vsms2017/ and http://studioany.com/teaching/virtual-spaces-iam-2016/.

24 Leon van Schaik, *Spatial Intelligence: New Futures for Architecture*, 1 edition (Hoboken, N.J: Wiley, 2008).

25 Gardner divided intelligence into seven distinct categories (spatial intelligence being one) that can be individually observed, studied and trained. Howard Gardner, *Frames of Mind: The Theory of Multiple Intelligences*, 3 edition (New York: Basic Books, 2011).