

Labyrinths: Mysteries and Methods

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Abstract

This paper presents an introduction to five ways of constructing labyrinths. The first is based on a ‘shift’ method that was apparently used by the Nazca people of Peru to construct spirals. The second is a ‘key’ method that combines turn points and guidelines that was evidently used to construct Neolithic labyrinths and, possibly, the labyrinths of medieval cathedrals. The third was first seen on Babylonian clay tablets where labyrinths were designed upon ‘grids.’ The fourth method is that of ‘modular’ tiles based on combination games. The fifth method is that of ‘switch’ tiles based on a concept proposed by Fenyvesi, et al. (2013). In addition, three types of three-dimensional labyrinths are illustrated.

Introduction

A labyrinth has one winding path with many turns and changes of direction. Technically it should be impossible to get lost in a labyrinth as long as one just follows the path however it twists and turns. In contrast a maze has many pathway choices making it easy to get lost. Over time, labyrinths have become associated with legends and thereby associated with various meanings, particularly concepts of passages to the underworld, or of paths of transformation. For general labyrinth references about background cultures, regions, timeframes and construction methods, see [1], [3], [4], and [5].

Nazca Spirals, Semi-Circles and ‘Shifts’

The Nazca lines are a group of very large geoglyphs created in the soil of the Nazca Desert in southwestern Peru. The geoglyphs are of many forms where some are figurative and some are abstract. A clue as to how labyrinths evolved might lie with the spiral geoglyphs and their possible means of construction. An example is shown in Figure 1(b), a Nazca spiral with an estimated diameter of 275 feet that is dated between 500BCE and 200BCE. Evidently, the spiral geoglyphs were constructed by combining two sets of evenly spaced, concentric, semi-circles, where one set is shifted by the width of the spacing between the semi-circles, see Figure 1(c). It is possible that a single person, see Figure 1(a), used a pole and a rope, knotted and spaced equally, to construct the semi-circles and the spiral. This constructional concept can be extended, and Figures 2 and 3 show how the method could be used to create labyrinths. Figure 3(c) has the same turn logic as the Cretan labyrinth, see the ‘Key’ section of this paper. This is the first time that this concept is being shared.

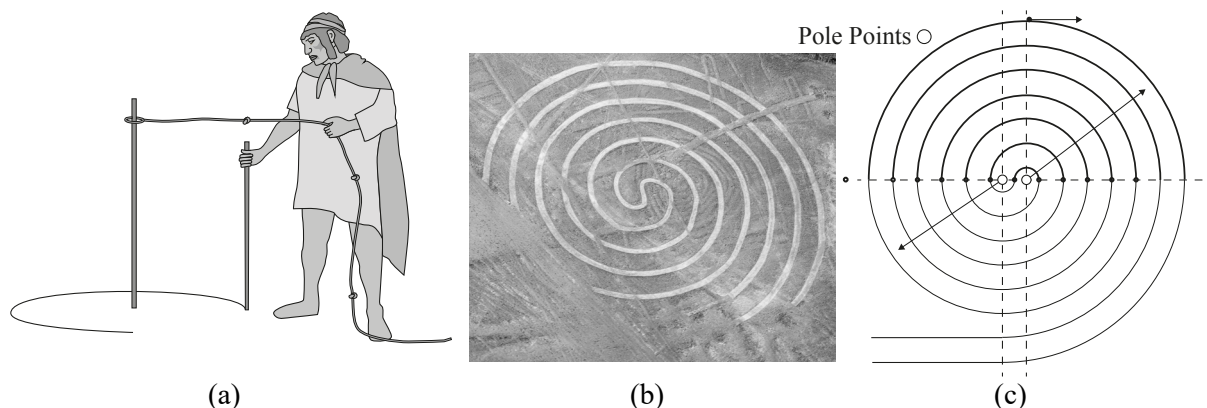


Figure 1: (a) Pole and rope method. (b) Aerial photo Nazca spiral (c) Shift diagram of the Nazca Spiral

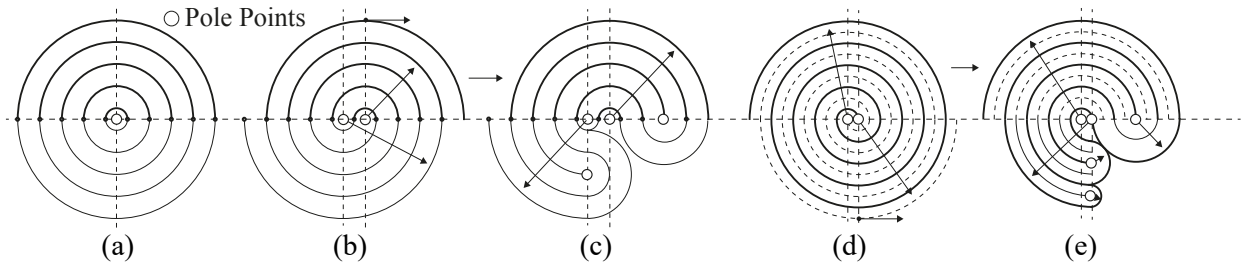


Figure 2: (a) Circles shifts to spiral (b). (c) New pole points. (d) Spiral. (e) New Pole Points.

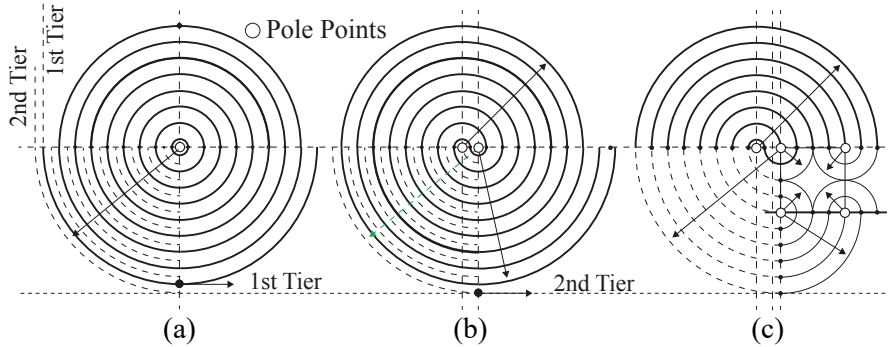


Figure 3: (a) Circles shift to spiral (b). (c) New pole points added to form the Cretan labyrinth.

Ancient Labyrinths and 'Keys'

The oldest known labyrinths can be constructed around a set of points and lines that serve to rotate and guide it, herewith called a 'key.' To create the classic Cretan minotaur labyrinth, using the key method, draw a central cross with four cup shapes in each of the quadrants to guide the path and a rotation point in each of the cups to rotate the path by 180°, see Figure 4(a). The key method begins by connecting the top end of the cross to the nearest end of the upper right hand cup, next the nearest end of the upper left hand cup to the upper right-hand dot, and then successively after that, 1 to 2, 3 to 4, 5 to 6, 7 to 8, etc. Many historic labyrinths can be constructed using variations of this method, see Figures 4(a) through 4(e). The labyrinth, Figure 4(c) is that of a Hopi basket weave with the same key signature as the Cretan labyrinth.

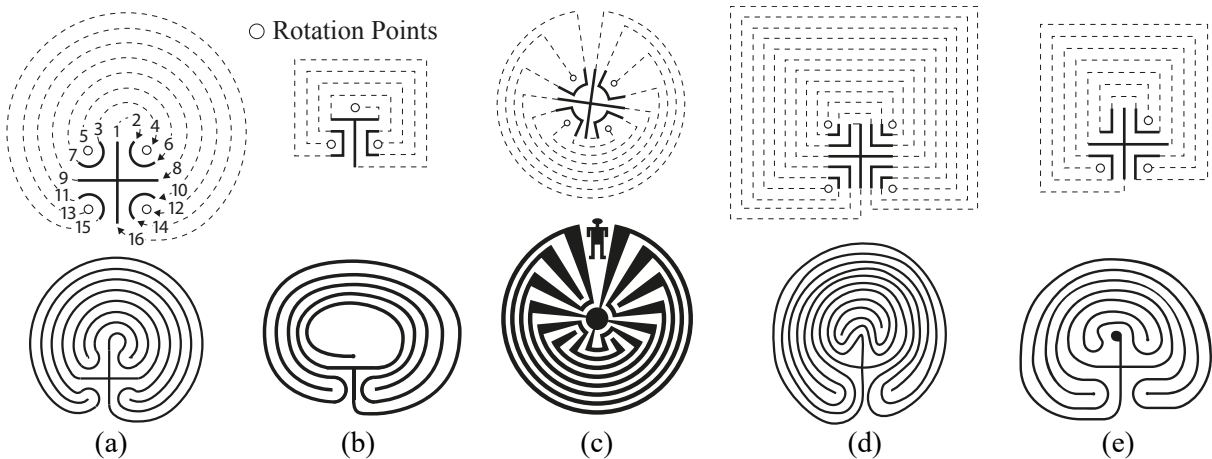


Figure 4: (a) Cretan Labyrinth. (b) Chakravyuha, India, 400 BCE. (c) Hopi basket weave, 17th Century CE. (d) Bolshoi Zayatsky Islands, Russia, 500 BCE (?). (e) Petroglyph, Usgalimol, India, 8000 BCE.

Labyrinths have a single path which winds through it. All labyrinths can be replicated with a single length of rope or string. The path of the Cretan labyrinth rotates in whole turns, alternating four times clockwise and three times anti-clockwise, around a central fixed point, and then three times inwards and two times outwards, towards and from the center. Labyrinths of this type step up and down concentric levels that are shaped by the guidelines and rotation points of their keys, or by following the guidelines of concentric polygons or circles, as is the case of medieval cathedral labyrinths. A labyrinth is considered ‘simple’ if its path makes, essentially, a complete loop at each level. Simple labyrinths are ‘spiral meanders,’ see [6], that can be described by the changes in levels as they are traversed. In Figure 4(a) the Cretan labyrinth, has level changes: 2,1,0,3,6,5,4,7 — where ‘0’ is the outer level and ‘7’ the centre.

The guiding lines and rotation points of keys can be unfolded from their original positions to be aligned about a central axis. This re-arrangement simplifies the path, see Figure 5. If the semi-circular paths above the axis are rotated a further half turn around the central axis the ‘core’ spiral structure of the labyrinth can be seen, see the dashed semi-circles. The spiral structures are repeated in rectangular form in Figure 5. Figure 5(d) has the same rotation and equivalent guidelines (and end points) as the Cretan labyrinth. This unfolding of labyrinths also creates designs that can more easily be constructed with the Nazca pole method.

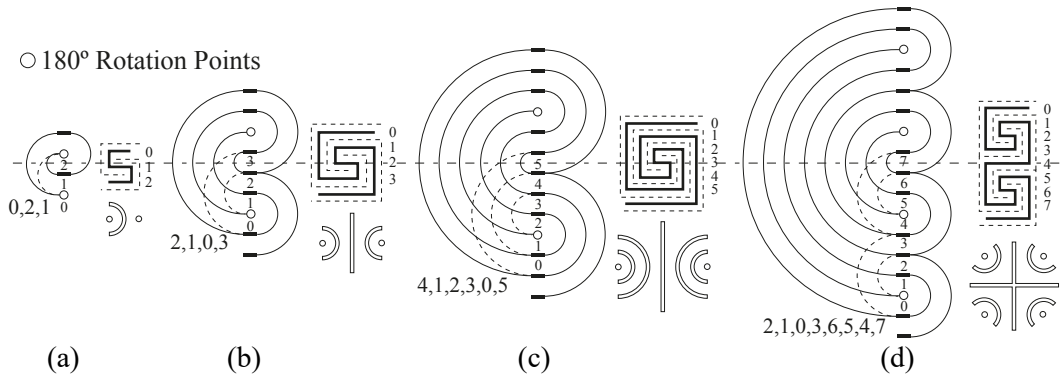


Figure 5: (a) 2-Level. (b) 3-Level. (c) 5-Level. (d) 7-Level turns, equivalent to the Cretan Labyrinth.

Medieval Cathedrals — Keys, Polygons and Circles

The design methods used to create medieval labyrinths were based on developments of key logic. In almost every case concentric polygons or circles served as the guidelines and these were combined with 180° points of rotation. The designs communicated through Christian numerology — by shape and number of layers. They symbolised the struggle between good and evil through associations with Theseus and the Minotaur. They were also functional as pathways for prayer and chanting. In an 11th century CE copy of the *Consolatione Philosophiae*, by the Roman philosopher Anicius Boethius (480–524 CE), there is an illustration of a seven-level labyrinth that contains a prayer, “*Assumpta est Maria ad Caelestia, Alleluia!*” (Mary is assumed into Heaven, Alleluia!). The prayer can be read in either of two ways: by following the path of the labyrinth, which gives one arrangement of lines, or according to the circles, which gives a different combination of the lines, see Figure 6. References [3], [5] and see acknowledgements.

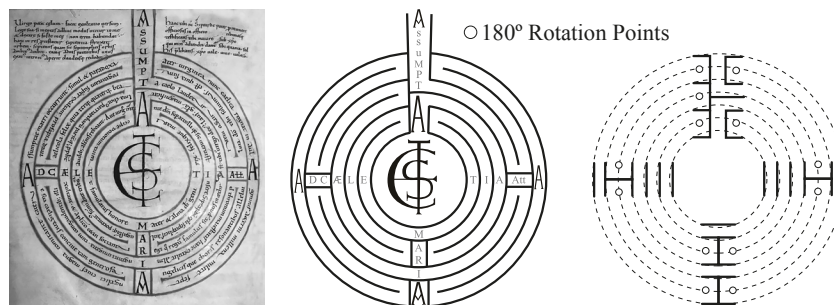


Figure 6: Medieval copy of the Roman ‘Boethius’ labyrinth with a possible ‘key.’

The 13th Century CE Chartres Cathedral labyrinth, see Figure 7(a) is about forty-two feet in diameter, with a path length of over eight hundred feet. The completed Chartres design has twelve layers with rotation points for half turns, and guidelines for quarter turns, in clockwise, and anti-clockwise, directions. The pathway directs movements towards the center four times and away from it three times. The symmetry of the design forms a cross and the center is in the form of a six-sided rosette where six is used throughout the cathedral to represent the Virgin Mary. The Chartres labyrinth, with all of its numerology, is all about ascending and descending, and, ultimately, about arriving at a point where, ‘Earth,’ meets ‘Heaven.’ In Chartres it is easy to imagine six monks, pilgrims, or students of the cathedral school, chanting (as per Boethius), as they followed the path of the Chartres labyrinth until they stood on one of the six petals of the central flower. One cannot help thinking of Homer’s description of the labyrinth as Ariadne’s ceremonial dancing ground where she danced along the spirals of the labyrinth in a celebration of the grace of life. The 16th Century CE San Vitale Basilica labyrinth in Italy, see Figure 7(b), shares similarities of form with the Chartres labyrinth, see [1] and [3].

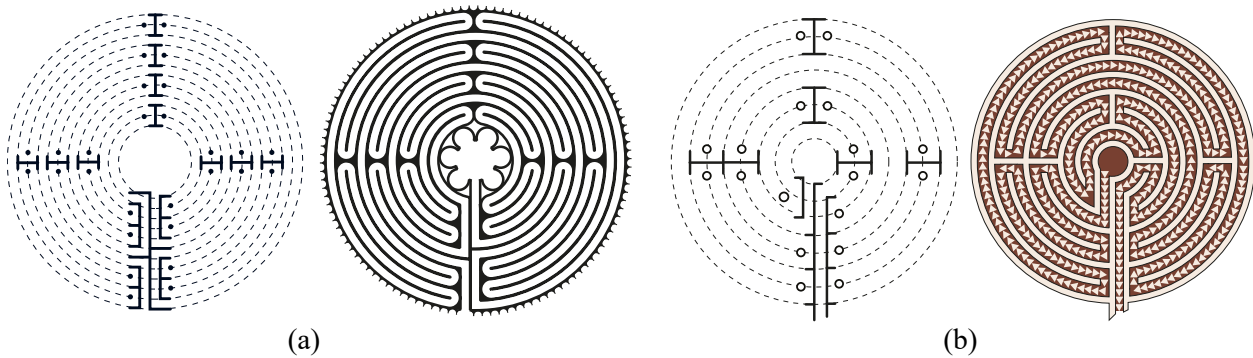


Figure 7: (a) *Chartres labyrinth.* (b) *San Vitale Basilica labyrinth.*

Key Developments

The concept of keys can be developed creatively by, for example, increasing the number of guidelines and rotation points. Figure 8(a) shows a 2-part key. Figure 8(b) shows a development of the Chakravayuha labyrinth key. Figure 8(c) shows connected keys that create a hybrid labyrinth and maze.

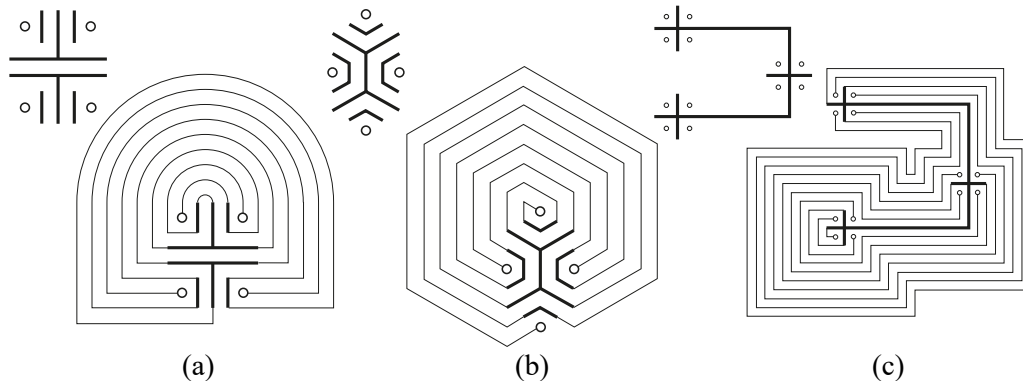


Figure 8: (a) *Open key.* (b) *Hexagonal key.* (c) *Connected keys.*

Labyrinths and ‘Grids’

A labyrinth design survives as an etching on a Babylonian clay tablet, MS3194 dated 2000 BCE to 1700 BCE, see Figure 9. The spacings of its lines suggest that a square grid was used about which the winding path was created with a rough rotational symmetry. Labyrinths in Ancient Rome, almost 2000 years later, were much more refined but often positioned within grids and many with rotational symmetries.

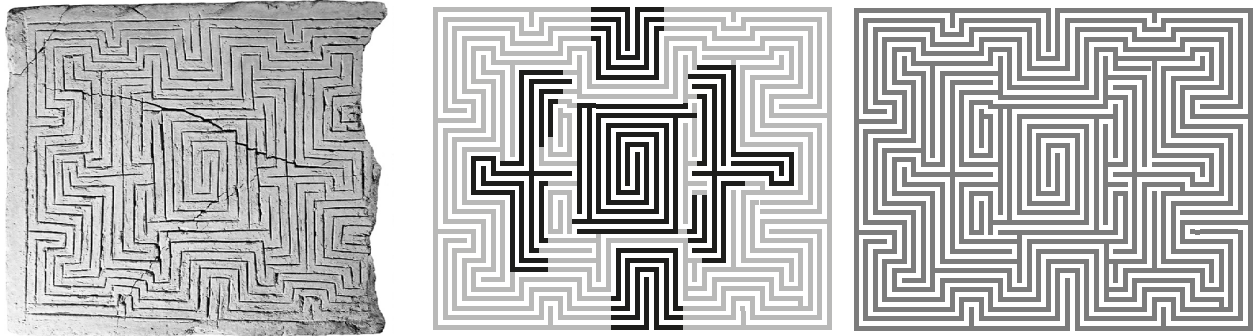


Figure 9: 1700 BCE Babylonian clay tablet grid Labyrinth.

The Chateau du Pont–Chevron labyrinth, France, 2nd Century CE, is a floor mosaic where a Cretan labyrinth key may have been used to create the lower left quadrant and then repeated and rotated clockwise to complete three quadrants and then again to create the fourth quadrant but with two squares ‘squeezed’ to the right to provide an entry way into the labyrinth, see Figure 10(a). The Avenches labyrinth in Switzerland, 250 CE, is a Roman mosaic that shares the same rotational and ‘squeeze’ logic of the Pont–Chevron labyrinth, see Figure 10(b).

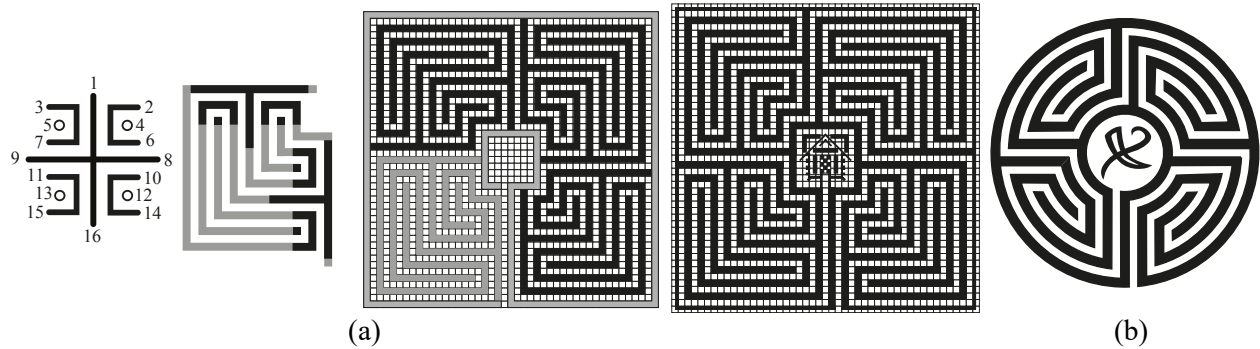


Figure 10: (a) 2nd Century CE, Pont–Chevron, France. (b) The Avenches labyrinth, Switzerland, 250 CE.

Grid Development

Grids of any type can form the guidelines of a labyrinth. In Figure 11(a) a hexagonal grid is navigated with directions, right (R) and left (L) where the sequence shown creates a double spiral, see [1] and [3]. Another development is to combine grids with modular tiles. In the case shown, Figure 11(b), two 3 x 3 modules, one with a straight path and one that turns the path, are rotated to create a labyrinth.

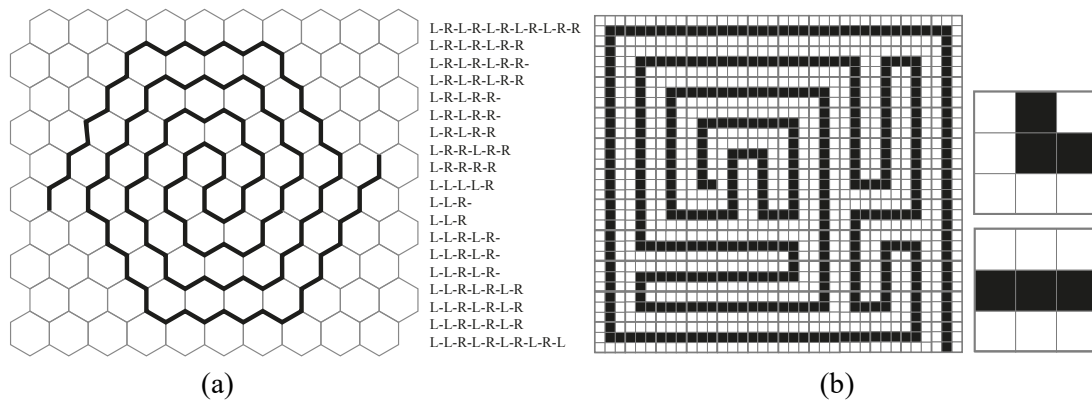


Figure 11: (a) Navigated hexagonal grid Spiral. (b) Modular grid.

Modular Tiles

Modular tiles are of the type used for combination tile games. They are designed so that however they combine, edge-to-edge, their surface details will align to form patterns, tracks or roadways. In this case the tiles are designed to create labyrinth or maze-like structures. Figure 12 shows four examples of square labyrinth tiles. Figure 13 shows four examples of equilateral labyrinth tiles.

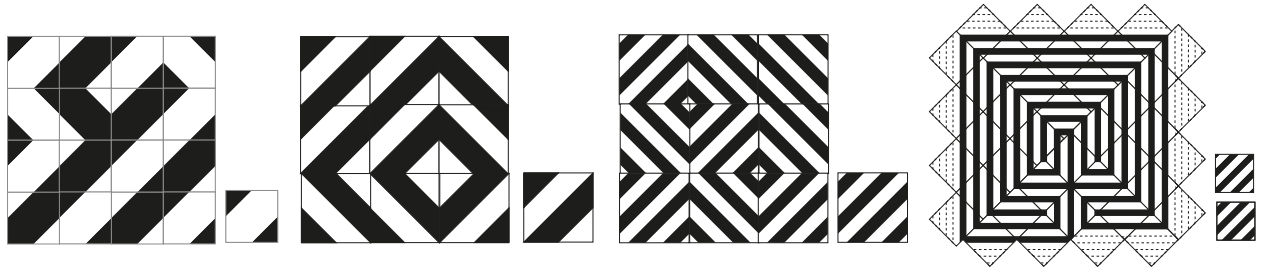


Figure 12: Modular tile configurations in squares.

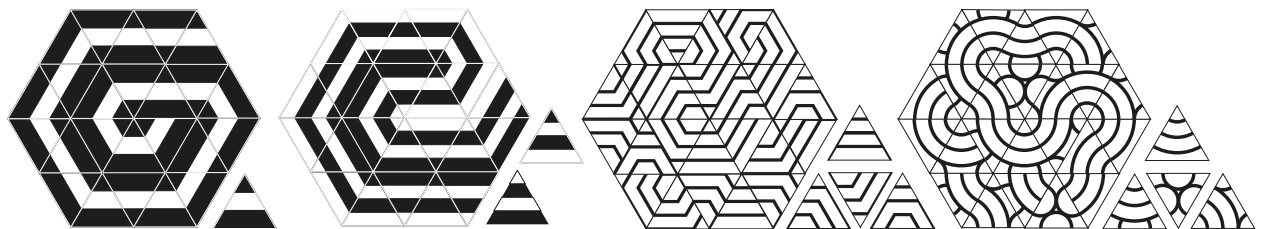


Figure 13: Modular tiles configurations in equilateral triangles.

‘Switch’ Tiles

Switch tiles are polygons with equally spaced parallel lines that will exactly map onto grids of parallel lines, when placed over them, so that they virtually disappear — but, when they are rotated by 90° they create ‘turn’ points that can be used to create mazes or labyrinths, see [2] and Figure 14. The concept originates in [2]. Switch tiles can be applied to spirals, see Figures 15(a) and 15(b) and to concentric polygons, see Figures 15(c) and (d), both are copies of designs that appear in [2]. The switch tile created octagonal-labyrinth, Figure 16, corresponds with that of the 13th Century Notre-Dame de Reims Cathedral in France — the same path logic as that of the Chartres Cathedral labyrinth. The switch tile created hexagonal-labyrinth, Figure 15(d), is new and original. The switch tile created spiral-labyrinth, see Figure 15(b), corresponds to a Cretan labyrinth and is strikingly similar to the labyrinth on a Knossos bronze coin, dated 30 to 14 CE, in the Staatliche Museum, Berlin.

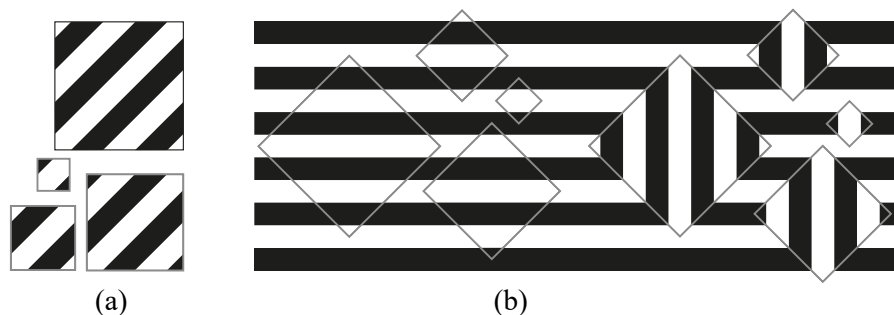


Figure 14: (a) Switch tiles. (b) Switch tiles in neutral and rotated positions on parallel lines.

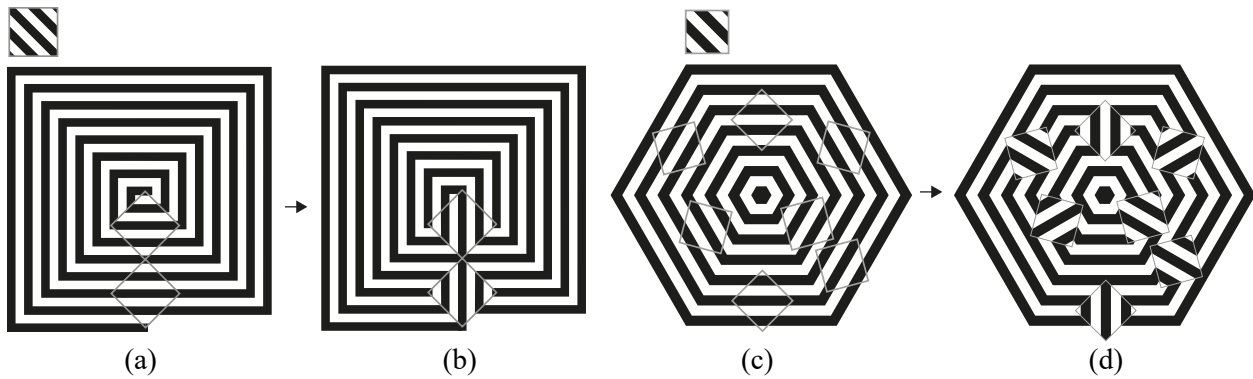


Figure 15: (a) and (b) Switch tiles on a spiral. (c) and (d) Switch tiles on concentric hexagons.

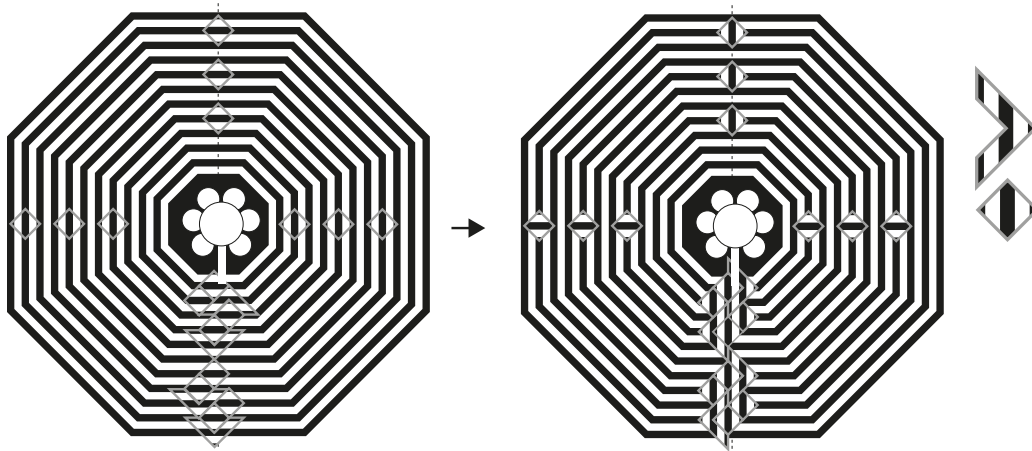


Figure 16: Switch tiles on concentric octagons create the Notre-Dame de Reims Cathedral labyrinth.

Labyrinths in 3D

There are many medieval renderings of the labyrinths of Crete, Rome, and Greece and some are of walled structures. There are walled renderings of Egyptian labyrinthine structures described by the Greek Herdotus but excavations of the site have not unearthed anything to support the idea that any sort of truly three-dimensional labyrinth was actually constructed. Coins from Knossos show moulded images of labyrinths, mostly the Cretan labyrinth, but these are just images without any sort of foundation. Popular belief would place labyrinths below ground or at least as walled structures, but all evidence points to above ground non-walled structures — much more in keeping with the turf and rock labyrinths of the Bolshoi Zayatsky islands. In other words, labyrinths were most likely above-ground path structures — winding paths on hillsides, on plateaus and on the floors of cathedrals. It is also possible that the actual act of carving or drawing a labyrinth was considered to have an emotional or spiritual meaning similar to the Sand Mandalas of Tibet.

Three Types of 3D Labyrinth

Labyrinths in 3D can be extrusions of two-dimensional labyrinths, see [3] and Figures 17(a), (b), (c), and Figure 18 (a). Figure 18(b) shows the Cretan labyrinth mapped onto the surface of a cube. Figure 18(c) is a three-dimensional labyrinth created upon a four-by-four cubic grid, see [2].

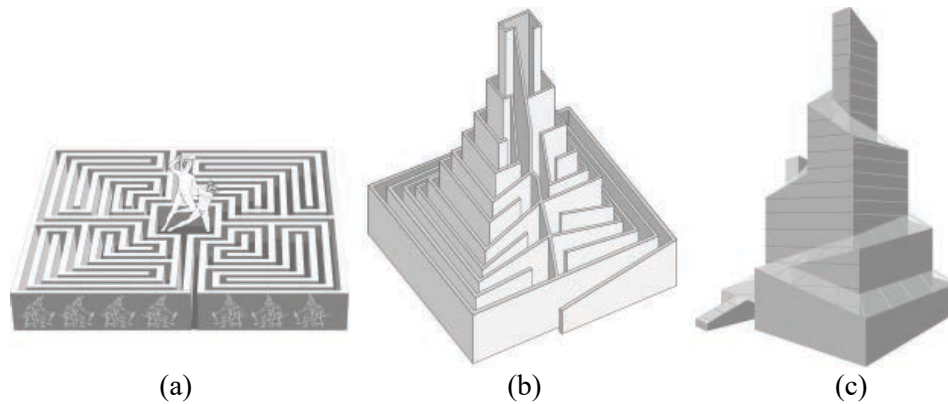


Figure 17: Labyrinths in 3D. (a),(b) and (c) are extruded.

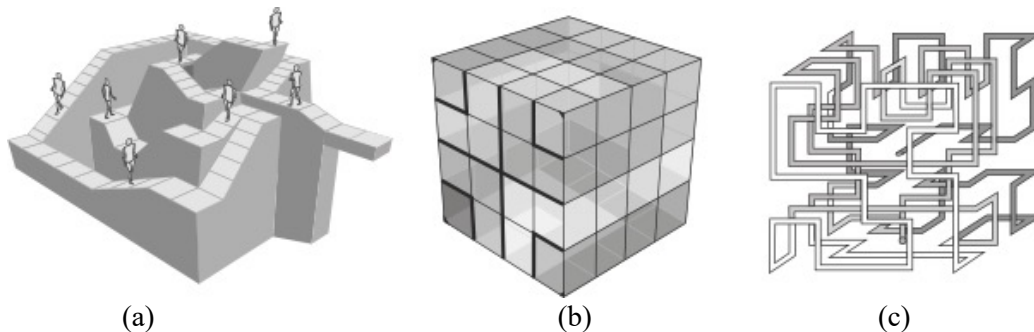


Figure 18: (a) Extruded labyrinth. (b) Cretan Labyrinth mapped onto a cube. (c) A 4 x 4 x 4 grid.

Summary and Conclusions

Labyrinths may have begun as simple doodles but over the millennia they have become symbols, mostly of the passages of life, and functional, as pathways for dance, meditation, and chanting. Mapping labyrinths onto grids and polygons, as well as more freely, can add to their symbolism, function and logic. For many, though, they can just be fun to play with, to walk through, and to build.

Acknowledgements

Figure 1(b): Aerial photo of the Nazca spiral. © Lenka Pribanova, Shutterstock.Com.

Figure 6: Cambridge University Library, MS Kk.3.21. f.1. Boethius, *De consolatione philosophiae*.

Figure 9: Babylonian labyrinth tablet, MS 3194. Image Courtesy of Jöran Friberg, the Schøyen Collection.

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