

## Special Article - Civilization

# A Route Map Proposal as the Topological Equivalent of the Ladder Design (65000 Years Ago) at La Pasiega Cave

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**Abstract**

The ladder design in the La Pasiega cave (Spain) possesses geometrical, entropic and mathematical properties of practical relevance. The approximate 5:3:9 ratio of its enclosed spaces seems correlated with walking areas within the cave. The schema's compositional strokes are directionally inclined mainly at angles of 0° and 90° with a proportion of 7% and 20% respectively. Moreover, the prolific strokes within that defined interval suggest that the author was right-handed. The ladder five-node schema with three enclosed areas seems topologically equivalent to a virtual route map inside the cave. This conceivable scheme, created perhaps 65,000 years ago, still can yield valuable topographical information on paths inside the cave. Additionally, the full panel contains other designs or figures related to other epochs, nevertheless, the ladder entropy-information is smaller than the rest, and consequently, it is more precise.

**Keywords:** Design in a cave; Topographic information; Archaeology; Topologic equivalences

## Introduction

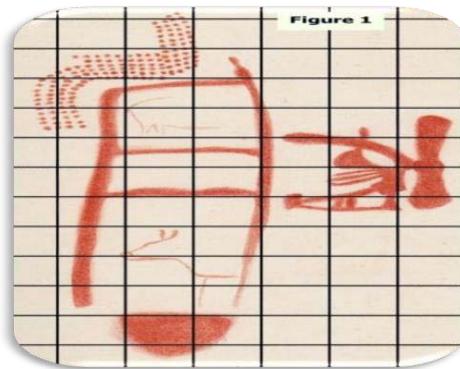
The Cave of La Pasiega, located in Cantabria, Spain, contains a ladder-shaped design among other draws (Panel 78, Hall XI, Gallery C; see Figure 1) and recently attributed to Neanderthals with a date of origin that preceded the advent of modern humans (*Homo sapiens*) by at least 20,000 years in the region [1]. Nevertheless, at the moment, it remains a controversial topic [2,3]. Debates on Neanderthals "complex" symbolic capacities have been intense [4,5,6], however, the hypothetical subject of this paper only focuses on the possible topographical abilities of the author of the ladder. Namely, I modestly conjecture a conceptual topographic ability of the author of the mentioned design.

Additionally, a longstanding debate has centered on the question of whether or not Neanderthals and Modern Humans are different species. Moreover, there is considerable controversy regarding the factors that led to the disappearance of Neanderthals [7-12]. However, these debates are not appropriate to this discussion. As mentioned before, the focal topic here is only the potential significance of the ladder design. An underlying assumption in this work is that Breuil's drawing, shown in Figure 1, is an accurate representation of the original panel, containing the ladder-shaped, found in the mentioned cave.

Related to the rest of the panel, the animal figures in the board were added years after the ladder was inscribed. The series of dots with relative area-variance of 44% have, to the best of my knowledge, an unclear sense (approximately 150, distributed within three respective groups comprising 17, 46, and 87 dots). The lower "triangle" or inverted "tunnel entrance" likewise possesses an unclear significance to me.

## Ladder's Geometrical Properties

The ladder design has measurable geometric and mathematic



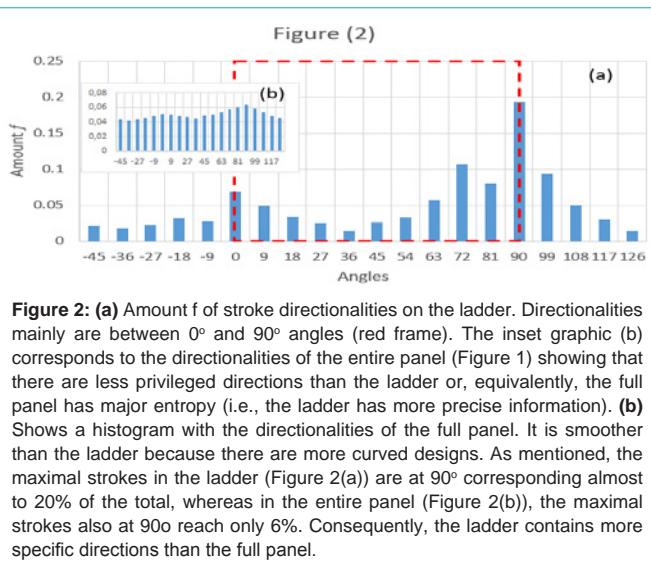
**Figure 1:** Henri Breuil's drawing (1913) of Panel 78 in the La Pasiega cave in Cantabria, Spain. The original "ladder" design found in the cave was apparently painted before the advent of modern humans. Actual photographs of the design can be found in the Web. The ladder encloses three spaces (top, middle and bottom) in an approximate ratio of 5:3:9. This study considers the statistical, geometrical and informational aspect only of the ladder. In general, figures have different dates; nevertheless, the ladder seems more ancient.

properties. For instance, the ratio of the three enclosed areas, extending from the up to the bottom portion, is approximately 5:3:9.

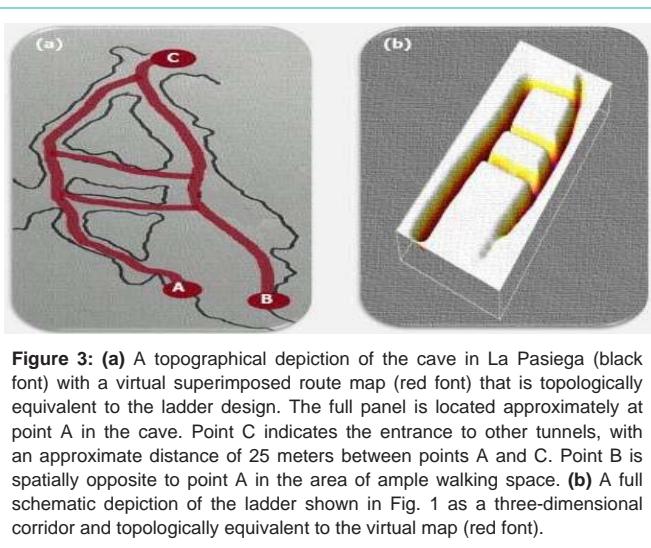
Moreover, as the twenty bars histogram depicted in Figure 2(a) shows, the main directionalities of the "brushstrokes" are at 0° and 90° angles (Image-J software) with a percentage of 7% and almost 20% respectively.

The ladder strokes, or traits, are not fully symmetric around 0° or 90°. In fact, traits are more frequent between 0°-90° (43%) than in the complementary range (30%) and indicating that the author was possibly right-handed.

Additionally, as occur for painting [13], entropy-information can be associated with histograms like Figure (2). It is not the focus in this



**Figure 2:** (a) Amount  $f$  of stroke directionalities on the ladder. Directionalities mainly are between  $0^\circ$  and  $90^\circ$  angles (red frame). The inset graphic (b) corresponds to the directionalities of the entire panel (Figure 1) showing that there are less privileged directions than the ladder or, equivalently, the full panel has major entropy (i.e., the ladder has more precise information). (b) Shows a histogram with the directionalities of the full panel. It is smoother than the ladder because there are more curved designs. As mentioned, the maximal strokes in the ladder (Figure 2(a)) are at  $90^\circ$  corresponding almost to 20% of the total, whereas in the entire panel (Figure 2(b)), the maximal strokes also at  $90^\circ$  reach only 6%. Consequently, the ladder contains more specific directions than the full panel.



**Figure 3:** (a) A topographical depiction of the cave in La Pasiega (black font) with a virtual superimposed route map (red font) that is topologically equivalent to the ladder design. The full panel is located approximately at point A in the cave. Point C indicates the entrance to other tunnels, with an approximate distance of 25 meters between points A and C. Point B is spatially opposite to point A in the area of ample walking space. (b) A full schematic depiction of the ladder shown in Fig. 1 as a three-dimensional corridor and topologically equivalent to the virtual map (red font).

work; nevertheless, the entropy associated with the ladder (Figure 2(a)) is smaller than the entropy associated with the full panel (Figure 2(b)). In this way, from the information theory standpoint, the ladder contains more precise information than the whole group.

## A Topological Equivalent: A Route Map Proposal

The ladder shape in Figure 1 contains, in my view, still more practical information than provided in the above section. I suggest that it entails a schema for performing permissible actions or restricting approaches in the cave. In other words, it defines routes into the cavern. Figure 3(a) shows a schematic drawing of the cave (black font, [https://en.wikipedia.org/wiki/Cave\\_of\\_La\\_Pasiega](https://en.wikipedia.org/wiki/Cave_of_La_Pasiega)) with a virtual superimposed route map (red font, author suggestion). The black font schema contains three main obstacles (wall-rocks) every one forming around, necessarily, routes or passages. Other barriers are smaller and not designated in the figure.

The ladder design and the virtual route map are topologically

equivalent: each with five nodes and three enclosed areas (Figure 3a&b). Additionally, the 5:3:9 area-ratio mentioned previously corresponds approximately to walking spaces within each region of the cave.

Finally, the original design found in the cave is located roughly at point A in Figure 3(a) and, possibly, correlated with an entrance to the cavern.

## Conclusion

The ladder-shaped design found in La Pasiega cave has various mathematical and geometrical properties. As suggested in this work, it corresponds to a signal of practical relevance (information).

The schema reveals a distribution of compositional strokes or traits with directionalities mainly at the  $0^\circ$  and  $90^\circ$  angles. The asymmetrical details around these two directional inclinations (Figure 2) suggest that the ladder's composer was right-handed.

On my view, the ladder is topologically equivalent to a virtual main-route map within the cave (Figure 3). Consequently, if my view is right, the author of that schema possessed topographical abilities with social implications. Namely, a 65000 years old species with anthropological sense [14,15]. In fact, several works are devoted to joint mathematical aspect with social behaviors [14-25].

In brief, with some risk, I propose that the ladder design at La Pasiega cave contains the following info:

- The ratio of the spaces enclosed by the ladder (5:3:9) is possibly related to walking areas.
- Corridors or passages description. They are topologically equivalents to a map in the cave.
- Presumably point A, where the ladder was drawn (Figure 3), is related to a cave-entrance at that epoch.
- Ladder Information-entropy is smaller than the full panel. Accordingly, the ladder contains more precise information.

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