Archives of Industrial Engineering
Short Communication

Art and Science
Euclidean Geometry-The Five Axioms *via* Art

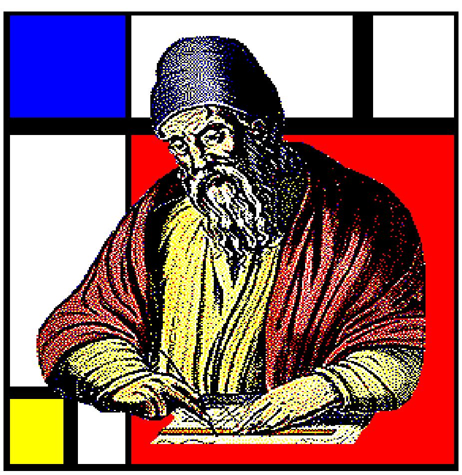
Tamir A*
Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Received: 26 September, 2019**; Accepted:** 30 September, 2019**; Published:** 07 October, 2019

***Corresponding Author**: Abraham Tamir, Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel. E-mail: atamir4@012.net.il

The major objective of this article is to demonstrate by artworks Euclid's five axioms, which are the basis of his planar geometry. Euclid, a Greek mathematician and philosopher, lived between 325 BC and 265 BC where his image is demonstrated in (Figure 1). It was transplanted on an artwork of the Dutch painter Piet Mondrian (1872-1944) consisting of a grid of vertical and horizontal black lines which are the basis of Euclidean geometry.

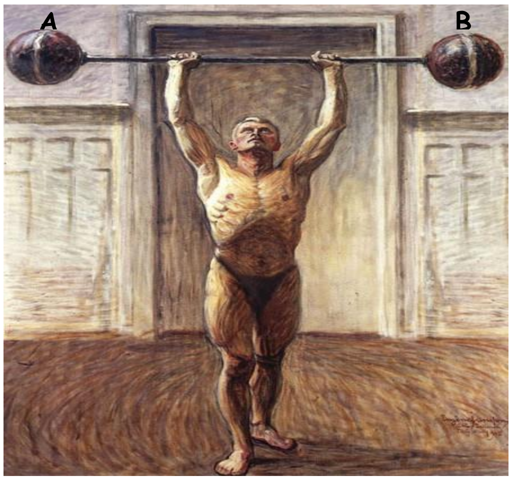
Figure (1): Euclid



Euclidean geometry is two-dimensional thus, curved spaces cannot be demonstrated by it. These are described by the Spherical and Hyperbolic [1] non-Euclidean geometries. Spherical geometry is basically the surface of a sphere where all lines will eventually intersect, namely no parallel lines exist! In addition, the sum of the interior angles of a triangle is greater than two right angles. Hyperbolic Geometry is basically the surface of a saddle. Here many lines can intersect where the sum of the interior angles of a triangle is less than two right angles.

Euclidean geometry is based on a set of five axioms where an axiom is defined [2] as "A principle that is accepted as true without proof". Euclid's 1st axiom states that "Any two points A and B can be joined by a straight line" and is demonstrated artistically in (Figure 2) painted by the Eugene Janssen, a Swedish Painter, 1862-1915. In essence, what Euclid is saying is that given any two points in space, one can draw a straight line to connect them. Given this line segment, one can technically extend either end of this line an infinite distance in either direction. The latter, as a matter of fact, is the "gate" to his 2nd axiom stating "any straight line can be extended indefinitely in a straight line". An example of applying this axiom is: Extending a side of a triangle can help to prove that two angles on a line formed by the intersection of a second line always add up to 1800. In conclusion, the above two axioms characteris-e completely the nature of the straight line.

(Figure 2): Axiom 1

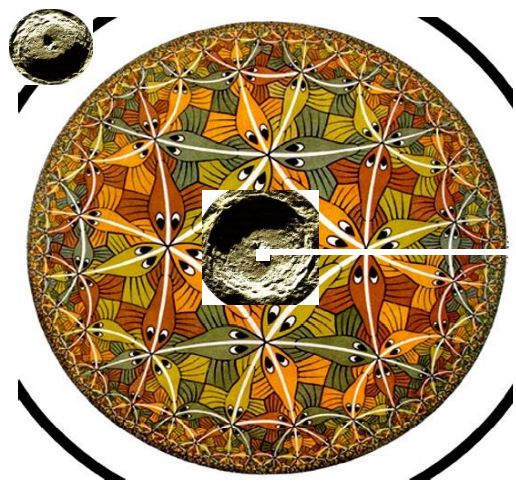


The 2nd axiom is demonstrated in (Figure 3) [3] by the light beam that indeed gives the impression that the beam extended indefinitely. Euclid's 3rd axiom deals with a circle that is a shape with all points at the same distance from its center. The axiom states: "Given any straight line segment, a circle can be drawn having the segment as the radius and one endpoint as center."

Figure (3): Axiom 2

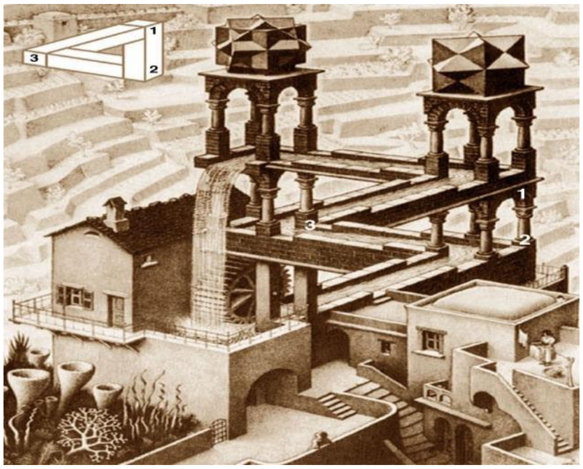
The axiom is demonstrated in (Figure 4) by the artwork "Circle Limit III" [3] of M.C. Escher (1898-1972) a Dutch graphic Illustrator. On the artwork of Escher another photograph of a circle was transplanted, that of Tycho crater on the moon [4]. It is interesting to note that the concave Tycho crater is transformed to convex shape when rotated by 1800 as shown by the top left image. This happens due to the shadow-light effect, which controls the shape. Euclid's 4th axiom is a particular case applied to geometry of the following general stateme n-t that appeared in his book Elements: "Things which are equal to the same thing are also equal to one another".

Figure (4): Axiom 3



In geometry this axiom reads: "All right angles are equal to one another". It is de monstrated in (Figure 5) by the well-known Escher's artwork "The Waterfall" [5] that is based on the impossible triangle shown on to p-left that appears in the artwork three times. This triangle is char-acterised by three right angles, so that their sum is 2700. Although it can be presented in two dimensions, it is cert ainly not possible to be materialised in three dimensions. This astounding artwork demons -trates also a "perpetum mobile" because there is a continuous flow of the water in the waterfall without any pump. The fifth and the final Euclid's fundamental axiom is known as the parallel postulate.

Figure (5): Axiom 4



The axiom reads: "Through a point outside a line can be drawn only one parallel line" and is demonstrated in (Figure 6) by the artwork of Tullio Pericoli (1936) an Italian political artist, caricaturist and sculptor.

Figure (6): Axiom 5

In conclusion it is believed that the artistic demonstrations of Euclid's five-axiom s makes them more understandable and easy to remember.

References

1. http://www.as.utexas.edu/astronomy/education/spring05/komatsu/lecture14.pdf

2. http://www.thefreedictionary.com/axiom

3. http://www.geometry.ms.unimelb.edu.au/

4. http://en.wikipedia.org/wiki/File:Tycho_crater_on_the_Moon.jpg

5. www.meridian.net.au

***Citation*:** Tamir A (2019), "Art and Science Euclidean Geometry-The Five Axioms via Art". Arch Ind Engg; 2(1): 01-03.

DOI **10.31829/2637-9252/aie2019-2(1)-110**