Mosaic Art: from Pebbles to Pixels

Irene Rousseau
Artist /Art Historian, MFA, Ph.D.
41 Sunset Drive
Summit, New Jersey, 07901,USA
E-mail: mosaicartforms@comcast.net

Abstract

The content of this paper will be limited to a brief historical overview of mosaic art of the Greco-Roman period in order to provide a framework of its development and its influence on today's mosaic art. A description of the technique and material will be included in order to present an understanding of the mosaic process. This artist's, creative work using mosaic tiling patterns will be described and concepts which metaphorically bridge the disciplines of mathematics and art will be explained.

1. Introduction

Why is mosaic tiling a popular topic? What has brought about the interest in diverse fields? A big reason for this trend is the use of technology reaching into new categories. The Renaissance in architecture is a result of computer assisted tessellation patterns of prefabricated mosaic material and industrial cost effective synthetic binding agents. The practical nature of glass as a durable, water resistant and colorfast art material has made its use ideal for exterior and interior decoration. Because of this, its successful use has become widespread in hotels, hospitals, transit systems and many urban public spaces. In mathematics and computer science the interest in tessellation patterns has resulted in scholarly works with applications in topology and aerodynamic design. New products have been developed using mosaic tiles as heat shields in space exploration. Archeologists have, within recent years, unearthed new sites of mosaic art in Turkey. These extensive finds offer an explanation why great civilizations of the past have collapsed and point to further study if ours will survive.

What is the problem? The major issue is that only recently has mosaic as a discipline, compared with other fields of study, acquired autonomy. Perhaps the biggest impediment is that mosaic art has been considered a minor art. Its emphasis on the craft technique and as a vehicle for replicating paintings, has given it a secondary place. The minor arts are those that rely on multiples and replication. Driven by economic concerns and specialization, the artist resorted to having his paintings translated by others into mosaic form. The risk factor is that replicating a work is only an approximation of the original matrix. For the translator, however, it allowed great flexibility to display his interpretation. New frontiers lie ahead and solutions will be addressed.

2. A Historical Overview

Surface covering techniques date back to the Neolithic Age as well as the Aegean Islands, Crete and the mainland of Greece. Scholarly opinion, however, is divided as to the true origin of mosaic art and two dominant theories of its evolution persist. The two divergent strains of thought are that of decoration versus function. Some scholars believe that the process of making mosaic art

originated as clay cones decorating the facades of buildings approximately 5000 BC. Others, believe that true mosaic began as a ground cover and carpet mosaic dating back to approximately 400 BC. These were made of pebbles loosely set in mortar such as those found in Pella, Macedonia. Mosaic and architecture have historically been intertwined because of the practical material of stone. As a floor covering it provided a firm surface which was durable and water-resistant. It's widespread application popularized mosaic art in courtyards, as floors, and it provided a decorative appeal [1].

The gradual transition from pebbles to *tesserae,* aided in the proliferation of mosaic art. A *tesserae* is approximately cube shaped. The flat faces of the cubes were more easily laid and adapted to a surface, which could be polished to bring out the colors of stone. The variety of color found in natural stone lead to decorative uses and aesthetic considerations for mosaic designs. Examples of tessellated floors from Morgantina and Syracusa, Sicily date the use of mosaic cubes for tiling patterns to approximately 260 BC.

Syracusa was a Hellenistic Greek center where mosaic *emblemata* were made. *Emblemata* are central panels of tessellated (tightly fit together) mosaic cubes, which show the technical mastery of "painting" in stone. *Emlematas* were executed separately by the artist/mosaicist using *tesserae* as small as one cubic millimeter. These were later transported to the site and inserted into tessellated floors, which were generally geometric in design. The *emlematas* were polychrome and used subtle effects of *chiaroscuro* (light and dark shading) as well as the use of perspective. This technical development of cubic tessellation popularized mosaic art for use in wealthy, private homes where carpet mosaics complemented the use of the room. In public buildings, mosaic *emblematas* depicted the function of the room and thereby also served an educational purpose. From the 1st century onwards, mosaic floors became widespread throughout the Western world and its proliferation is attributed to the use of pattern books where travelling mosaicsts reproduced standardized designs. Later, the refined Hellenistic and Greco-Roman pictorial tradition gave way to stylistic changes under the Romans. The elaborate polychromatic designs became technically simplified and resulted in monochromatic black and white silhouette mosaic floors. These were larger in surface covering, coarser t*esserae* were used and they were less costly to execute. The most renowned, existing examples can be found in Ostia a port near Rome. The architectural milieu, for example, was marine motifs for baths, athletes for gymnasiums and erotic scenes in the bedroom.

Major stylistic changes in mosaic art took place during the age of Constantine. The Christian philosophical and religious idea of "Christ the Light of the World" and eternal life (infinity) was now expressed in mosaic art in churches and basilicas. The Medieval examples I refer to are the Basilica of St.Vitale 475 AD and Galla Placidia, 450 AD, Ravenna, Italy [2].

My research gives substance to the idea that ancient mosaics, Impressionism, Neo-Impressionism and Chaos theory are linked. Because of fragmentation, the use of broken color and glass *tesserae* set at different angles to capture the play of light, there is an uncertainty of time and space. It resulted in visually "dematerializing" the interior architectural structure and thereby "transposed" the viewer into a "transcendental" space devoid of time and measure. The pictorial structure is clear. Yet, fragmentation presents an element of uncertainty within a determined order. Despite it being fueled by a different philosophical intent, this mosaic art suggests that it is a precursor to chaos theory, and the art movements Impressionism and Neo-Impressionism of the 19th century [3], [4].

The 13th century marked a shift from a metaphysical concept to pictorial representation of "real" life. During the 15th and 16th century the Renaissance ideal reigned. Great artists such as Veronese, Titian and Tintoretto provided cartoons for churches, that were reproduced as mosaic art. In this respect, mosaic art abandoned the simplification of images and the bold use of color in favor of *chiaroscuro*, forshortening and the use of the grid system and linear perspective. The mosaic medium became enslaved to replicating paintings, and craftsmanship became the

overriding concern. This tradition persisted throughout the 18th century and therefore our understanding of the culture is seen through the eyes of the Renaissance.

Changes took place. The Industrial Revolution brought about shifts in the production of mosaic art. Manual labor was replaced by cheaper methods of mosaic manufacture and by prefabrication of designs in mosaic workshops. It resulted in the indirect method of temporarily pasting the mosaic designs upside down on paper and transporting them to another destination to be installed *in situ*. The process is similar to printmaking in that the image is reversed. Prefabrication was the catch word in architecture.

The 20th century brought innovative uses of mosaic art and included the artist/architect Antonio Gaudí, and the painters Gino Severini and Gustav Klimt. Gaudí used the "poor" material of broken shards for the interior and exteriors of buildings. The use of colorful glazed ceramic tiles gained acceptance as a decorative material in Western art, although it had a long tradition in Islamic architecture.

Today, mosaic art is once again flourishing. This Renaissance is attributable to computer-aided designs and prefabrication techniques. Much is at stake. The opportunity for the new flock of artists is to understand and to be able to use mosaic as an autonomous vehicle for creative works in fine art.

3. Technique

Ancient literature and examples of mosaic provide us with the working methods of artists and craftsmen. Artists drew the large cartoons on wall surfaces using *sinopia*, which is the underpainting on a wall. Cartoons were drawn on paper and the surface of the cartoon was perforated with a stylus so that the dotted outline could serve as a guide for "pouncing" the chalk dust over the holes, thereby preserving the original outline. However, following the outline allowed for flexibility of interpretation by the mosaicists. The tesserae were affixed to the wall using the direct method one *tesserae* at a time, with the rhythm of the hand. It focuses on the play of light. The gestural rhythm and personal interpretation allows us to distinguish the work of different mosaicists. It was a collaborative effort and many hands worked together to complete the design. Small, portable, mosaic emblematas however, were designed and executed by the master artist. They were then transported to the site where they were installed into a tessellated floor made by the lesser skilled craftsman.

Today large-scale mosaics are placed on wood or mesh using an indirect method. Cost effective production has facilitated mosaic workshops, which reproduce artists' paintings and murals. The *tesserae* are temporarily glued to a paper surface in reverse and transported to the site to be installed. The paper covering the right side of the mosaic is removed. Mortar or grout is then squeezed into the interstices to provide more adhesion of the *tesserae*. The result of this type of mosaic method is flat and functional. The problem is that artist's gesture is lacking and someone else can render only an approximation of the work. The ideal situation is for the artist to understand and to be able to create his own work in this visual language [5]. Today's restoration of ancient mosaics has resulted in combining both the direct and indirect method in the double reverse technique. [6].

4. Materials

Although numerous materials have been used to make mosaic art including shells, semi-precious stones and ceramic, two main materials dating from antiquity are stone and glass. Stone and *smalti* glass (opaque glass paste) can be cut into *tesserae* for tiling purposes of design and

practical applications. Mosaic *tesserae* are cut, cube like shapes used for tiling patterns. The *tesserae* are tightly pieced together and held in place with a mortar as binder.
The individual *tesserae* are dot like individual units of colors and when pieced together form a surface covering. From a distance they visually merge and reveal a design or pattern.

Stone pebbles and marble were cut into tesserae and polished to bring out the color of the stone. The use of glass paste dates back to the 4th millennium BC. Later it became an ideal vehicle to express philosophical ideas of the Christian religion during the Byzantine Middle Ages. There are several types of glass. *Smalti* is mixture of silica, alkali and metallic oxides, which are fused together through heat. Then the mixture is flattened and allowed to to cool and harden. Gold and silver leaf were also used to portray a heavenly glow and became a dominant feature of the Byzantine method of mosaic art. *Filati* is an admixture of several colors of *smalti* glass *tesserae*, which are fused together and pulled into thin threads and cut into *tesserae*. This process was devised by the Vatican School of Mosaics [7] during the late 1700's to reproduce Renaissance paintings. Vitreous glass is prefabricated into standardized tiles.

Binders are crucial in the method of making mosaic art since the mosaic surface consists of pieces that are fitted together and held in place. The binders have varied throughout the centuries with different applications. They have ranged from bituminous glues, to natural resins hydrated lime, slaked lime, gypsum and pozzolano or Portland cement. Today vinyl resins and sand or marble fillers with coloring agents are used. Epoxy resins are employed for exterior surfaces.

5. Hyperbolic Mosaic Sculptures and Non-Euclidean Geometry

My aim as an artist is to bridge the disciplines of art and mathematics and metaphorically represent the concepts to create the art. The mosaic wall sculptures consist of tessellated (tightly fitted together) patterns and each sculpture is a 3 D circular disc with a 23 1/2" diameter. The hyperbolic sculptures are composed of planes, which suggest negative curvature and represent the concept of infinite smallness contained within the bounding edge [8]. The notion of time and energy as related to the sculptures will be discussed. Since the symmetries vary from sculpture to sculpture they will be identified individually. The sculpture exploring metamorphosis of a geometric shape will be described separately.

5.1 Non-Euclidean Curved Space

This space is the counterpart of Euclidean geometry. The Euclidean plane represents flat geometry with zero curvature. A sphere represents spherical geometry with positive curvature. A saddle shape represents hyperbolic geometry with negative curvature. Poincaré discovered that hyperbolic geometry could be represented as the points in a circular disc with a hyperbolic distance defined. In this case, the circular boundary of the circle represents infinity. Circles in the disc that meet the boundary circle at right angles replace straight lines in Euclidean geometry. A hyperbolic plane cannot be metrically represented on an Euclidean plane. Unlike the Euclidean plane, which is infinite, a hyperbolic plane has infinite structures within boundaries.

5.2 Infinity

Timelessness is suggested by infinity. In my four hyperbolic wall sculptures repeating patterns and regular and semi-regular tessellations, which decrease in size at the bounding edge, metaphorically represent infinity. In the Euclidean plane, regular pentagons cannot tile. However, in hyperbolic geometry, four pentagons can meet at a vertex and tile. In regular tessellation the plane is covered by regular polygons so that the same number polygons meet at the vertex. The symbol 5,4 for instance represents tessellation of the hyperbolic plane by pentagons where four

pentagons meet at each vertex. Semi-regular tessellation refers to a tiling pattern, which are composed of two kinds of regular polygons so that two of each meet at each vertex alternately. There is a constant reduction is size of the polygons as they become distorted in their curved space nearing the circumference. The constant diminution is also represented by progressively smaller arcs, which cut the circle and are perpendicular to the diameter and the outer edge of the disc. The interior arcs mark an angle and parallel lines cross each other in ever-smaller distances. Its circumference represents infinity. The curvature of the arcs is constant as they decrease in size towards the bounding edge. It is a sequence towards the infinitesimal. The curvature of my 3D mosaic sculptures is hyperbolic and consists of a tiled pattern and surface division. The interior is a recessed pentagon within which other pentagons diminish in size. Some are formed through the psychology of visual perception.
(Fig.2),*HyperbolicDiminution–Blue*,(Fig.3),*HyperbolicDiminution-Red,*(Fig.4),*Hyperbolic-Diminution-Red-Five-fold Rotation,*(Fig.5),*HyperbolicDiminution–White.* The distortion that results in hyperbolic geometry led me to explore the use of geometric shapes and gradually alter them, (Fig.6) *Metamorphosis of a Hexagon,* in order to a achieve a transformation. The transformation takes place as the shape traverses the raised and lowered 3D planes. William Huff's work served as an inspiration [9]. This sculpture is a part of a series, which is in the process of being developed to achieve the concept of infinity in hyperbolic geometry.

5.3 Time and Energy

The concept of time and energy is metaphorically represented. One becomes aware of the time and energy expended in cutting and piecing the tiling pattern together from point to segment to shape. The subtractive and additive process is implicit in sculptures. The mosaic units combine to form a surface that resembles pixels on a computer screen. It is a part to whole relationship. The pattern consists of hand cut *tesserae* . The individual pieces are cubic or rectangular in shape. They are made from marble and glass. The *tesserae* cut from the initial large block of marble or glass and involve successive steps of rotating the polygon to achieve the desired small size. These tiny gems of glass or stone are then pieced together with tweezers using the direct method to form a tiling pattern. The process is similar to a jeweler cutting a diamond. Four hyperbolic sculptures as well as the sculpture (Fig.6), *Metamorphosis of a Hexagon* depicts the concept through the process. Time is implied in is the story of the transformation of a hexagon as it traverses different 3D planes. The hexagon bumps against a new plane and becomes distorted and assumes another configuration as it bumps against different planes and ultimately returns as a hexagon. The central axis in all sculptures is a recessed interior pentagon. (Fig.1), *Cutting " tesserae"*

5.4 Symmetry

It is a transformation that preserves the distance. The surface is composed of tiling patterns that have symmetry of design. The four kinds are translation, rotation, reflection and glide-reflection [10. My sculptures illustrate the use of mirror or bilateral symmetry and visually maps the shapes onto each other if cut in half through the center pentagon. There are multiple rhythms and patterns.

The sculpture *Hyperbolic Diminution-Red-Five Fold Rotation*- is composed of tiling patterns with an emphasis on the red square unit that forms a five-fold rotation. Some are constructed using only pentagons such as *Hyperbolic Diminution-Blue* with subdivisions of triangles with a light and dark pattern. *Hyperbolic Diminution-Red* is also composed of pentagons but the pattern looks very different due to the pigmented grout. *Hyperbolic Diminution-White* is a combination of pentagons and quadrilaterals. In these hyperbolic sculptures, the shapes are stretched as they decrease in size towards the bounding edge. The interior of all my sculptures has a recessed pentagon. Additional pentagons undergo rotation towards infinity within the interior of some of the sculptures. Because these sculptures are handmade, mechanically perfect symmetries are not possible.

6. Conclusion

Mosaic art provides a document of the great civilizations of the past. Because few sources on daily life exist from this time period, these mosaics are invaluable documents of the ancient times, which would otherwise not be known. The durability of material and permanence of color has survived throughout the centuries. For this reason, archeologists and art historians have been able to use them to provide us with an insight into the history of mankind. It is a fascinating excursion of the cultures that have since disappeared leaving behind their mosaic traces. Turning to the present, labor saving technology and innovations in diverse fields have had far reaching effects. Mosaic as a discipline has gained autonomy. We are witnessing a Renaissance of mosaic art. For now, its own independence seems assured. Fine artists must overcome performance anxiety and embrace the potential of working in mosaic as a medium and autonomous discipline. Bridging the gap will be the key.

7. Illustrations

Figure 1: *Cutting " tesserae "*

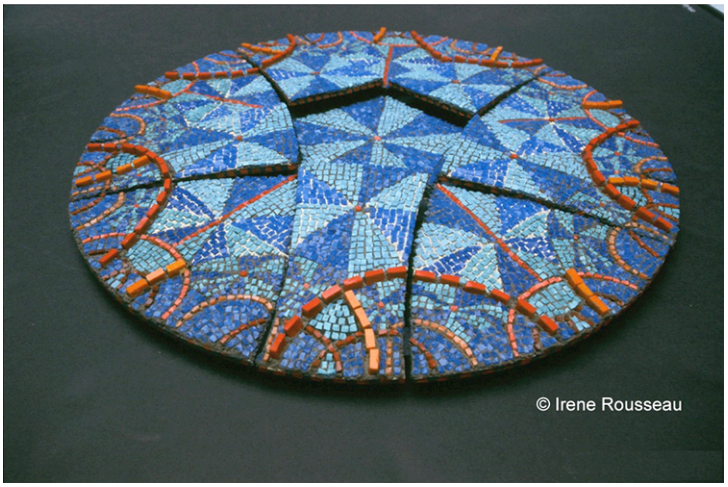

Figure 2: *Hyperbolic Diminution-Blue*

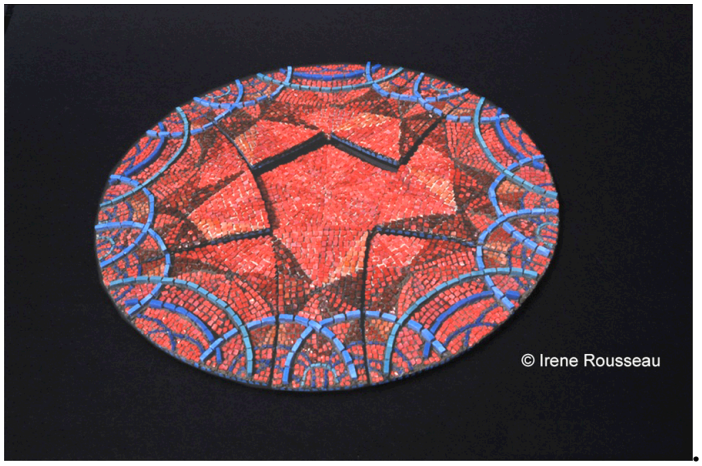

Figure 3: *Hyperbolic Diminution-Red*

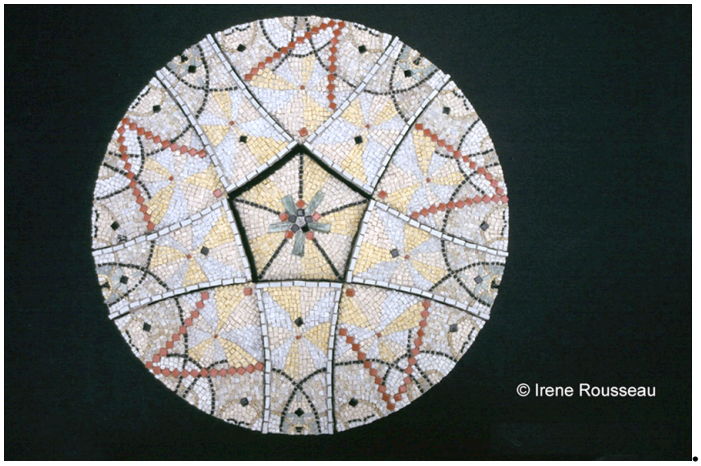

Figure 4: *Hyperbolic Diminution-Red-Five-fold Rotation*

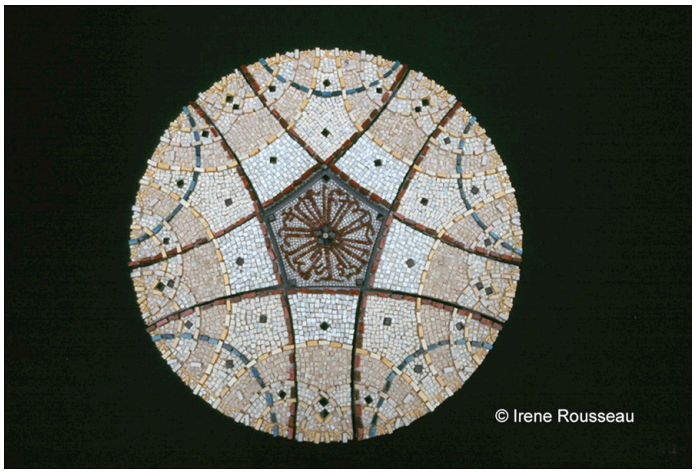

Figure 5: *Hyperbolic Diminution-White*

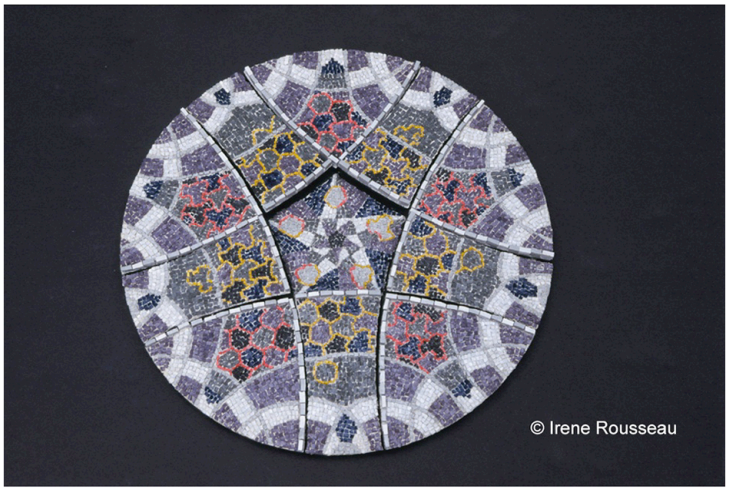

Figure 6: *Metamorphosis of a Hexagon*

References

[1] Cimok, Fatih. *Antioch Mosaic,* A Turizm Yayinlan Li.Sti., 1995.
[2] Irene Rousseau, primary research on location in Ravenna, Italy.
[3] Gleick, James. *Chaos: Making a New Science*. Penguin, New York, 1987.
[4] Rousseau, Irene. Colloque De L'AIEMA (archeology and ancient Greco-Roman mosaics) Paris, France (at press, in process of being published)
[5] Irene Rousseau, primary research at mosaic workshops, Italy.
[6] Fiori, Cesar. Quaderni IRTEC, nr.3 *Mosaico E Restauro Musivo*, Edit Faenza, 1992.
[7] Irene Rousseau, primary research at the Vatican School of Mosaics, Rome, Italy.
[8] Rousseau, Irene. *Geometric Mosaic Tiling on Hyperbolic Sculptures*, Proceedings, Bridges: Mathematical Connections in Art, Music and Science, 2003.
[9] Hofstadter, Douglas. *Metamagical Themas*, Basic Books Inc., New York, 1985.
[10] B. Grünbaum, G.C.Shephard. *Tilings and Patterns*, W.H.Freeman and Co, 1987.