

Math at the Service of Meaning: Links Between Geometry, Mythology and Philosophy in Mosaic Art

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Abstract

Through mosaic art we find a link between geometry, mythology, and philosophy. The tessellated patterns of mosaic art have been expressed as: Narrative, Experience, Humanism, Intellect, Ambiguity and Paradox. The creative impulse which responds to a "Zeitgeist" (particular inflection at a given time of a universal energy) links art, mathematics, and science. The energy is common to the experiential (intuitive) and conceptual (analytical) data. As a sculptor of mosaic art in this digital age my interest is in spatial ambiguity and paradox.

Introduction

Through mosaic art we embark on a journey of geometry, mythology, decoration, and technology. The interest in the perception of our world is connected to the understanding of it in terms of structure or a hidden formal order. The rhythms of life and structure reveal a tessellated pattern which has inspired its exploration in intuitive and analytical terms. We discover the rhythms of life as we perceive the motion of form and understand its "significance". Flaubert called the abstractive power of art the "idea" of a work, and Clive Bell named it "significant form". From prehistoric times through the classical Greek era, and from the ages of Christian and Byzantine art to the computer experimentation of today, we discover a mind-body totality (an intuitive grasp of Gestalt) as mosaic art continues to develop from the ancient to the new. Throughout the history of mosaics from the ancient Greek and Roman pavements, and Islamic architecture, to the computer tessellated patterns, artists have used geometry as a framework for their art. Geometric designs found expression as symbols in mythology as labyrinths or mazes, or as decorative borders separating the figurative elements as in the Roman villa, 4th cent. AD at Orbe, (Switzerland). Still other examples depict optical illusions which serve purely decorative ends. Geometric principles are important in religions where representation of images is forbidden as in Islam. Islamic mosaics contain mathematical principles which are equated with the divine order, and geometric principles in India aid the meditation in Tantric designs [1].

Geometry is an important conscious feature in all art from the cave to the computer. Interest in geometric designs of balance and symmetry can be seen in the mosaic Cretan mazes [2] as well as the *Kufic* script inscribed in hexagons using the Koran [3]. The Geometric system of proportions using the Golden Section and spatial perspective is the hallmark of the Italian Renaissance art, and current inquiry into the nature of tessellation on the hyperbolic plane using today's technology of the computer, addresses the interest in concepts of geometry as well.

Art is universal. It is the process of creation, interpretation and communication. It is the artist's private and emotional response to the human condition which he converts into a visual form. His personal organization of form in a particular way reconciles a larger societal consciousness and transmutes it into a universal visual language. In this way, the synergistic relationship between art and society, transfigured by the artist in a given age, links the ancient art of mosaic with the expression of the new. The process of re-experiencing ancient mosaics in the present day engages the viewer in cognitive

play, as he re-interprets the historical context of the visual form, and reconciles the universal organization with his contemporary consciousness.

Ayn Rand, philosopher, writer, and educator, argued that there is a link between ancient and contemporary art; the essential function of art pertains to the nature of human consciousness, in that it depends on sensory, perceptual, and conceptual awareness. It is the “sense of life”. Although the work of art emerges from the realm of ideas, there is always the ultimate involvement with the senses: form, color, composition, and space.

Artistic experimentation with tessellated mosaics has been an ongoing process, but it has not followed a continuous linear path. Rather, it has developed into various intermediate techniques. A fundamental difference in concept defines these techniques: the use of the narrative and the decorative, versus spatial structuring through color and reflected light. Two strands are imbedded in the narrative story or concept the artist convey, and the formal means to execute it. It goes beyond the materials to the nature of form and light. This raises important questions about the connection of art to a “Zeitgeist” (particular inflection at a given time of a universal energy). That energy is common to the art and scientific and mathematical theories at a given time.

When you look at the art and science of a given period, you see formal links between them. It is this link that is the starting point for the inquiry into the nature of visual expression and scientific theory and the nature of its manifestation in art. That is to say that the interest in the perception of our world is connected to the understanding of it in terms of structure or a hidden formal order. It is not to say that the artist intentionally appropriates mathematical concepts or scientific formulas, but that they co-exist through the expression of space, time, and light.

Artists have been drawn to mosaics as both a medium and a technique. The practical nature of the material of stone and glass encouraged their application and widespread use, and the durability of the materials allowed mosaic art to remain virtually unchanged. While scholarly opinion is divided as to the origins of “true” mosaics, some suggest that mosaics originated in the form of games which date back to Asia Minor circa 5000 BC. Others argue that mosaics may have originated with terra cotta cones which decorated the facades of Mesopotamian temples and resulted in shadow-play and an illusion of depth. Still others assert that the ancestors of “true” mosaics were found in the form of pebble mosaics dated circa fourth century BC.

For the artist, another interesting question lies in solving aesthetic problems and depicting them in visual form. The process starts with an invitation to explore an inner destiny and a common experience of the mind, which the artist translates into visual form. The metaphorical image of symbols serves as a cultural mirror of a particular time.

Mosaic as Narrative

The “Lion Hunt” [Fig. 1] a Pella mosaic, 375-350 BC (Macedonia) is much more than a mere floor covering or an exercise in arithmetic that fulfills a practical need. It is an artistic response to a private and cultural myth, that of man’s destiny and the human condition of vulnerability and fear. Man’s destiny is at the mercy of a noble lion, whose strength and ferocity are depicted in stone. Although it is literally a floor mosaic, it is an artistic manifestation as well. The pebbles are sorted by color and size, and separated by metal channels which depict the lion in linear form. As we experience the “Lion Hunt”, we recreate the desire and dread, and unmask the hidden meaning: this reconception provokes our emotional response, and resonates as a communal understanding of a primordial sea (our place in the scheme of existence). Although it serves a decorative and practical purpose, at its deepest it depicts our fear.

In the process of communication and re-creation, we rediscover the work in its historical and cultural context and its creative expression and “significant form”. In the process of seeing, sorting, and reflection, we link the ancient art of mosaic with our current reality and consciousness of the new.

Throughout the mosaic world, we find thematic representations and mythological themes. Floor mosaics in Roman times were a common form of decoration and maze patterns were a popular theme. We find examples of these mazes or labyrinths throughout the ancient Roman Empire dating back from the first century BC to the fourth century AD. Wiktor Daszewski, a foremost authority on ancient mosaics has documented the topology of these mazes in the territory from England to North Africa. Most mazes are without bifurcation and lie on certain distinct levels.



Figure 1: “*The Lion Hunt*”

They share common properties of design such as: a center or nucleus and a path that leads to it from the outside, and concentric circles or meandering rectangular lines which result in changes of levels or the topology of design. When represented in Roman pavements and as carpet mosaics they are depicted as optical illusions. In our discussion at Avanches, Switzerland, he described this meandering pattern of the Roman mosaic to me [4].

The representation of these mazes is a metaphor for the legend of the Minotaur and his struggle with Theseus [5] expressed in geometric mosaic design. Anthony Phillips provides a comprehensive description of the topology. Variations of schematic representation of the legend can be found in Pompeii where four fold rotational symmetry and stacking, which are problems in topology [6] are represented as metaphors for mythology and as optical illusions of design in mosaic art.

In Mythology, our relationship to reality was represented as the archetype of power and process translated through art in the structural and abstract. The process was expressed as gods having a higher power of energy and substance or matter as they struggle to overcome and control the dualities of life such as strong/weak, good over evil, and self-discipline/seduction. The separation of these opposites is depicted in the balance of light/dark, even/odd, earth and sky. The Greek myth of creation recounts the split of sky and earth out of chaos. The god Uranus and the goddess Gaea united in passion. Ultimately there came the evolution of human life. The story of evolution is a struggle of the mortal’s gods over the forces of the dualities of life and is represented in the mosaics of ancient times as the battle of the Titans, the patricide by Kronos (time), and Prometheus risking the wrath of Zeus as he steals fire for Mount Olympus to give as a gift to mortals. Themes of mythology refer to the supremacy of virtue and felicity over chaos and the power of evil. They center around the concept of the victory of man over his passions and forces of evil and are represented as the Great Hunt, the Seasons, athletic prowess, races, spectacles, and aquatic scenes. I found the mosaics at the Piazza Armerina, Sicily, from the 4th century AD to be spectacular examples of these themes. These opposites in life are depicted through mythology as power

and process. The artist represented this intuitive perception about his reality as an aesthetic structuring of form, composition and space, and the playwright Aeschylus in "Prometheus Bound" linked the mythology of Prometheus teaching the alphabet and numbers to mortals with the logical and sequential. The alphabet strings out words whose meaning depends on a linear sequence and, therefore, links it to science and math. The use of light and dark, color, size, the balancing of these formal elements mirrors the struggle that is its subject matter. In so doing, the artist makes intuitive use of what scientists and mathematicians study. The artistic impulse to interpret reality is akin to the mathematical or scientific intuition. Max Plank states: *To be sure, when the pioneer of science sends out the inquisitive antennae of his mind, he must have a vivid intuitive imagination, for new ideas are not born of deduction, but indeed of creative artistic imagination.* [7] The creative impulse inspired by the unconscious is the uniting link. It is the insight on a non-verbal level and the struggle to confront universal questions about reality. It is a form of knowledge sensed through an internal (artistic) or external (scientific) perception, which is then synthesized or analyzed as it links philosophy, science, music, and art.

Mosaic as Experience

Philosophy dictates form. When the philosophy changes, the form changes. To this point, we are seeing mosaic and its subject matter as narrative, the story of the Titans, Kronos, etc. When we turn to Byzantine Christian mosaics, we are no longer looking at a story with its linear, sequential forms. The Byzantine basilica evokes the experience of Christ, it is a presence, a feeling, an atmosphere of being in Christ. Believers in the Byzantine tradition expressed this feeling state in terms of light, "Christ is the light of the world." It is an anti-geometry and has to do with the notion of chaos and flux in the sense that it dilutes the sense of being a real space as it rejects the rational aspects of design. It is the precursor of Chaos in that the underlying form is subjected to a change of circumstances, unlike the use of perspective and the addition of the linear which presupposes the viewer is here. Each tesserae (square) is a point of light which is subject to change. The fragmented space is not logical and is anti-geometric without structure. But it is purposeful in its aim to achieve a non-rational, spiritual space as it dematerializes substance through the play of light.

Thematic representations of "Christ, the light of the world", a Byzantine influence and Christian ideal, resulted in conceptual changes in mosaic art. The artistic problems of depicting narrative and symbolic iconography now became problems of structuring space with light, as we see in *Gala Placidia*, Ravenna, Italy. Here the image of "Pliny's Doves" [Fig. 2] 440-450 AD shows doves drinking water from the "true faith of eternal life". Mosaics became a vehicle for artistic representation of dematerializing space through the play of light, which would exemplify the religious ideal of the transcending space, standing outside of time. By covering the columns with light-reflecting glass tesserae, placed at varying depths with the rhythm of the hand (as opposed to uniform, mechanical means), the artist allows the viewer to become enveloped by the plan of light which "transposes" him into a transcendental space. Aesthetically, the flickering points of light and broken color visually dematerialize the underlying architectural structure and achieve an ambiguous, undefined, and "spiritual" space. By creating form with this visual interplay of light and color, we link the Byzantine mosaic tesserae with the dashes of painted color by Seurat, Monet, or Van Gogh. [8] Although for different reasons, the Byzantine and more modern painters both wanted to dematerialize form to achieve an atmosphere. It is no coincidence, then that they arrived at a similar formal solution. The Byzantine mosaic artist represented the concept of an ambiguous, timeless space which may be an expression of the notion that space, time, mass, energy, and light are the same, though the impetus for the expression served different ideals.

The concept of space during the Italian Renaissance was expressed as geometry from a privileged point of view. Because of the practice of transcribing paintings into mosaics during the seventeenth and

eighteenth century, our understanding of the reality of our world was through the eyes and knowledge of that time.

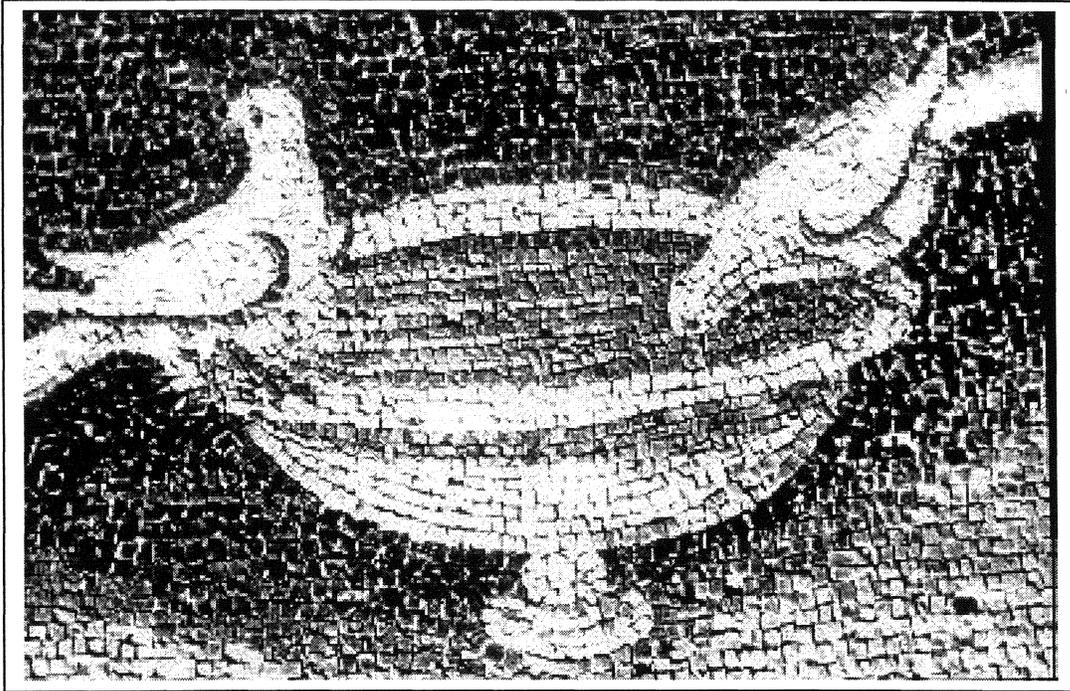


Figure 2: "Pliny's Doves"

Mosaic as Humanism

Vasari, [9] a writer and critic during the Renaissance admirably stated, upon viewing Ghirlandaio's "Annunciation" of 1491, that mosaic art is a "painting for eternity". These words literally became the ethos of the seventeenth and eighteenth centuries when Master paintings were transcribed into mosaic art, a practice that still flourishes in mosaic workshops today [10]. The cartoon for the mosaic transcription by Salvatore Monosilio (1759-67), after Raphael's painting "Transfiguration of Christ", [11] in St. Peter's Cathedral in Rome, is a testament to the Renaissance ideal of technical virtuosity but now in mosaic form. By eliminating the interstices between the tesserae, we experience the development of chiaroscuro as we do in painted form. The fused admixtures of two or more colors of smalti glass tesserae, a technique devised by the Vatican School, [12] provide a gradual transition of value and tone. Mosaic art lost its independence as an artistic medium, of the "Zeitgeist", when transcription became a dominant mode. It was now relegated to replicating paintings in the more durable medium of glass. As exemplified in this mosaic "painting", art was viewed from a Renaissance point of view in the use of intersecting grids, a set of reference points of perspective, and the illusion of depth through shadows and chiaroscuro, which are signifiers of time. The representation in art was linear and sequential, with symmetry and geometry providing a link with the reality at that time. Seventeenth century mosaics really reflect the Renaissance world view. Once again the emphasis becomes narrative, linear, and sequential. They tell stories. However, the additions of perspective signals a new philosophy, Humanism where man is the measure of all things. Now the composition assumes a viewer at a fixed point before the imagery and as such addresses him. Replicating an original art work into duplicate form poses philosophical problems as it challenges the concept of authenticity and creativity in art.

The ancient technique of mosaics involves matching borders of small pieces of tesserae that cover surfaces and result in a tessellated pattern of form. The concern with classical aesthetic concepts in art such as symmetry and creating structures through formal relationships either through experiential or conceptual data has been of interest to mathematicians as well. In our century the interests in the mathematics of how tessellation fits the Euclidean, flat plane has extended into the study of it on the hyperbolic plane and on surfaces of three dimensional objects such as spheres [13]. Roger Penrose studied the nature of packing and tiling. Computer technology now accelerates the inquiries into the nature of tiling as it links the ancient expression of mathematics in mosaics with the understanding of this 3D paradigm change.

Mosaics as Intellect

In the art of Islamic mosaics we find repetitive and interfacing geometric patterns with symmetry groups and strands which weave alternately over and under each other in mirror images [14]. The rhythm is regular and endless and alludes to a symbolic or timeless path to Mecca. In the Islamic world tiling has an underlying Koranic Symbolism. Here we see mosaics as neither in the service of a story nor a feeling state but as an expression of symbolic abstraction. They speak to the intellect. Geometry fuses with religion and makes a direct appeal to the mind. The pattern and color are intricately linked to a religious ideal. The color azure [15] is predominately used symbolically as a dot or raised knob within a pattern of eight point stellar images identified as the "Solomon Seal". By this stone Solomon had controlling power over all living creatures and he understood their language [15] as well. This religious geometric theme is very prevalent in the mosaic tiling of the Islamic Middle Ages and covers the exterior and interior of the religious architecture of Islam. Though the source of inspiration differs, geometric art and math are linked.

Mosaic as Ambiguity and Paradox

Today all kinds of stimuli bombard us. In terms of the visual, words, images, advertisements, fragments hit us head on and peripherally. We don't experience them sequentially or hierarchically as in the Renaissance, but rather "digitally", each fragment commanding equal attention. The uncertainty principle becomes the hallmark of our experience. Categories of space, time, energy, and mass break down.

As a sculptor of mosaics, I am interested in geometric art and in visual paradox. My rules for geometry are problems of symmetry using modules and topology. Fragmented surfaces and irregular characters of a pseudo-alphabet combined with geometry are what I explore. The wall becomes an undefined space which interacts with matter (mosaics) and is an integral part of the work. These sculptures "float" as they visually defy their materiality of marble and glass. My education and training is in art, not in the sciences or mathematics, yet the process of life as structure is what interests me. It is the invisible process that regulates structural relationships that haunts my mind. Through art, I seek to express my perception about our world and the hidden formal order, intuitively as well as through the knowledge I have gained. My interest in ancient mosaics as studies of geometrical relationships links my art with the ideas of the new. Unlike the art of the Byzantine Christian and impressionists, my work does not address the senses but the intellect. As such it has more in common formally with Islamic Art. The emphasis on geometry flows naturally out of that. I construct my own geometric rules. There is no single correct point of view, and in that it is anti-geometry. It is formal but it is not linear nor sequential geometric logic nor a perspective of math. My geometry is expressive. As in the Byzantine-Christian art, it is purposeful in dislocation and disordering. My work is about the simultaneity in this world and about visual ambiguity and paradox.

“Duet of 3’s” 1998 [Fig. 3] consists of 18 pieces. Two symmetrical columns of nine modules which visually “float” on the wall. The modules are 3-inch squares and the sequence of the modules is graduated from 5 squares to 1 square which share a mutual center and then are reversed from 1 to 5. The space between the modules is also 3 inches and is an integral part of the work. The negative space takes on importance as an undefined, yet, interactive and positive presence. Matter and space intertwine. They are the work of art. Irregularity within the regular modules is manifested through the hand cut mosaic tessera whose edges are constantly challenged and matched. The alphabet is not any known language that has a narrative or a linear time frame. It is a pseudo-language of many civilizations, chromosomes, and musical notation combined into one. It is a simultaneous grasp of communication and the organization of a hidden order to be sensed and explored.

“Tettares-4” 1999 [Fig. 4] is a geometric wall sculpture with four component triangles. The triangles are composed of squares and the sequence is graduated in the number of modules from 4 squares to 1 and then reversed or reflected from 1 to 4. The negative space between the “floating” triangular modules is an integral part of the work. The transposed image is in levels of topology where the visual weight of characters is maintained. While the diagonal symmetry of pairs are related geometrically the neighboring corners are not, but only by type. What they share is the common number of blocks. My rules are artistic and independent in that they break all rules of geometry at times. The tesserae are each hand cut and therefore slightly irregular in the otherwise regular, modular scheme. Here the alphabet or pseudo-language is graduated in intensity and saturation of the blue color in a progression from the outside inwardly and from dark to light. This progression from dark to light emphasizes the negative interior space as a positive presence somewhere not known.

In both mosaic works actual hand cut tesserae made of marble and glass are combined with painted mosaic tesserae. Material reality and painted illusion pose the question as to the nature of its location in space/as space. We simultaneously perceive the relationship of parts to the whole and understand the pseudo-language as a symbol of the fusion of what has preceded and is in the present. It is the perception of time collapsed in the present moment in the NOW.

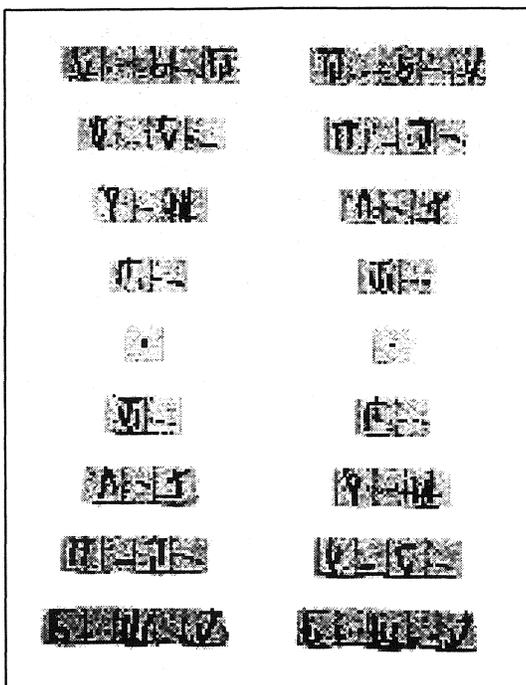


Figure 3: “Duet of 3’s”, 1998

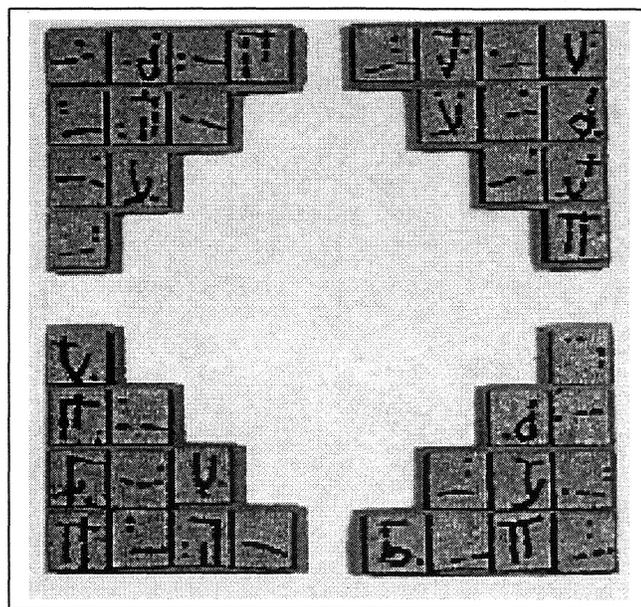


Figure 4: “Tettares-4”, 1999

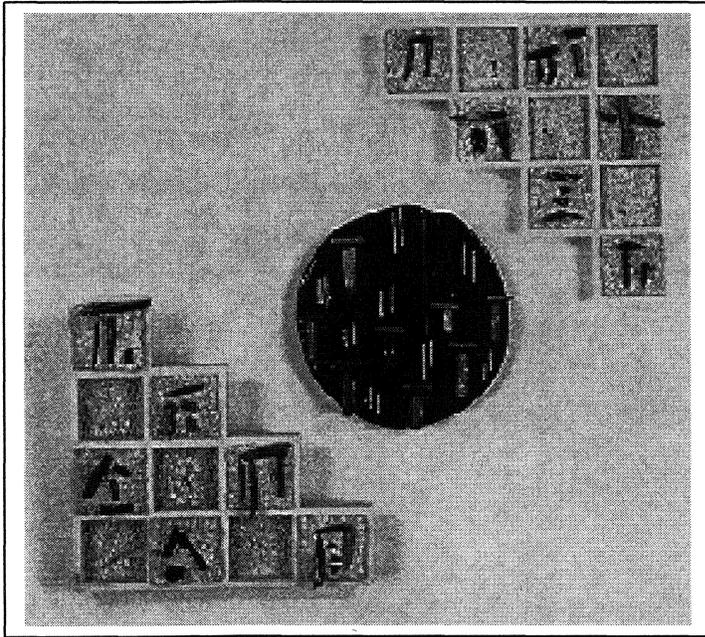


Figure 5: "3 Part Construction", 1997

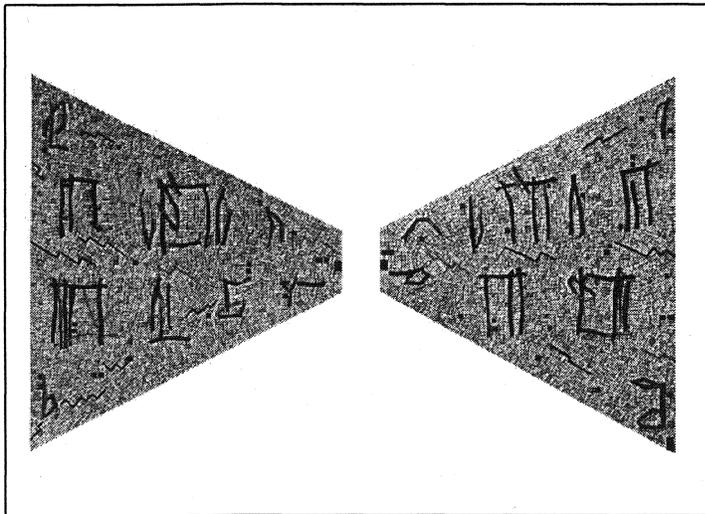


Figure 6: "Allegro-Allegra", Concert Hall, Lausanne, Switzerland, 1996

"3 Part Construction" 1997 [Fig. 5] is two triangles and a circle forming an implied square. The "floating" triangles are composed of mosaic squares graduated in numbers from 4 squares to 1 and then inverted from 1 to 4. The triangles "float" and the central disc as the neutral center at the point of inversion also "floats" in an unknown space. The disc is a whole glass palette from which the component tesserae that form the alphabet are also made. This space surrounding the 3 parts interacts and acts upon the part to whole relationship as tension visually combines the parts and the negative is transformed into a positive square. It is a concept of Gestalt.

As previously described in the works "Duet of 3's" and "Tettares-4" and "3 Part Construction" we simultaneously understand the part to whole relationship. We become aware of the process of making the mosaics. This process is two-fold and the components are the use of creative energy and physical time. Creative thought and the cutting of mosaics combine these energies and we experience them simultaneously in the work. The tension in visual closure of the "floating" parts can be understood as energy acting to complete the whole (Gestalt). We understand it in the NOW.

"Allegro-Allegra" [Fig. 6] 1996 mosaic mural (Concert Hall, Lausanne Switzerland) is an expression of a metaphor of a melodic line in visual graphic terms. The characters are a pseudo-language. It explores the temporal dimension which is fundamental to music. There are intervals which form a visual rhythmical beat. Like music, they grow from a point to highest intensity, varying in acceleration as they build up tension, then dissolving and letting go. The color is graduated from dark to light and there is a color change from blue to green and from orange to red. In its transformation of one color to the next, graphics and music are linked. The process is linear in that each tesserae may be analogous to a note. It is not a continuous sound, but is made up of points and segments. The visual movement is in the third dimension physically as well as visually in the use of color and line. Colors visually advance and recede. Tempo and pitch in music may be expressed as the sequence and transformation of color on a spatial

plane [Fig. 7]. The spacing of the linear elements is achieved through visual balance and harmony. The paradox is that although there is the linear and sequential order, it can be understood as “virtual” space and is like music in that it is not clock time but experienced time. The pseudo-language (non-notes) that I created are not communicable as a narrative and therefore these invented symbols can be understood simultaneously. The concept of this visual music is ambiguity and visual paradox.

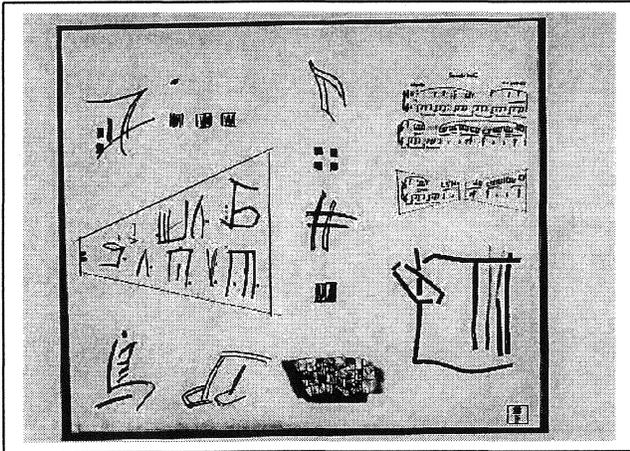


Figure 7: “Abstraction for Allegro-Allegro”

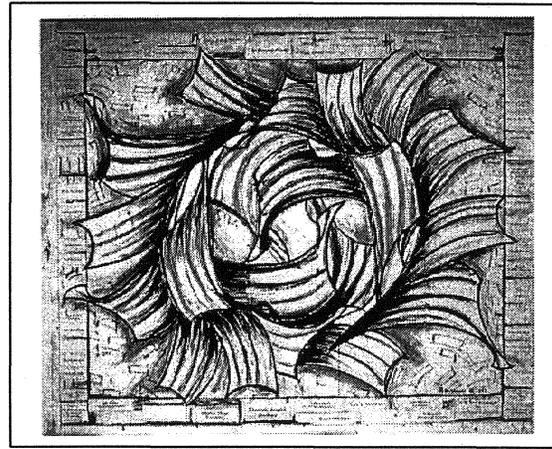


Figure 9: “Plan for Spiraling Light”
(placement of tesserae)

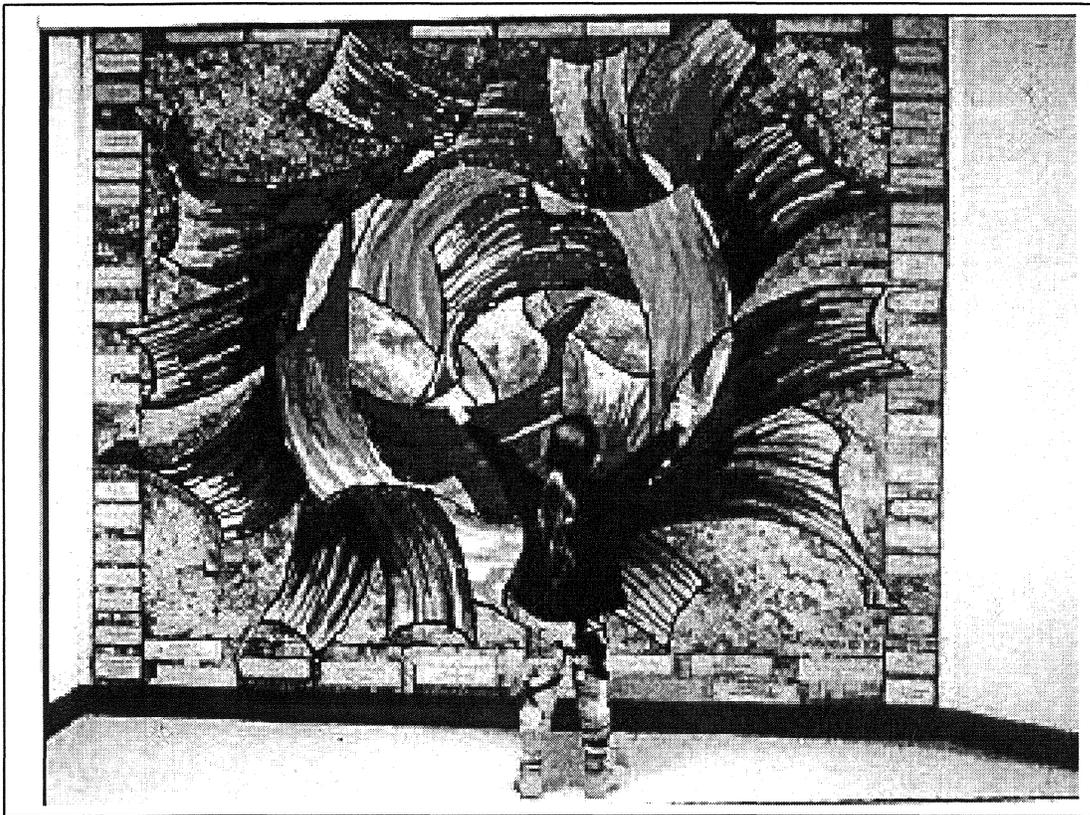


Figure 8: “Spiraling Light”, Overlook Hospital, Child Care Center, Summit, NJ. 1993

“Spiraling Light” [Fig. 8] 1993 mosaic mural (The Overlook Hospital, Child Care Center, Summit, NJ). The symbol I chose is a pinwheel in motion. The reason was two-fold. Children can relate to that symbol and it enabled me to use formal means of design to structure space through light. Symbolically the multi-colored paddles of the pinwheel represent the ethnic, religious, and cultural diversity of the children in the center and formally the rotational design results in a visual effect of motion. The linear pattern for the placement of tesserae is crucial to achieving an effect of spinning motion. [Fig. 9] The angled tesserae reflect light and the dynamic spiraling light of the pinwheel appears to exist as a “virtual” space, in addition to its physical attachment to the wall. This duality results in visual ambiguity and paradox as light structures space.

Conclusion

Tessellated patterns have interested the artist and mathematician. The rhythms of life and structure reveal a tessellated pattern which have inspired its exploration in intuitive and analytical terms. My expression of geometry is artistic and I have devised my independent rules based on principles of philosophy and aesthetics. The questions to be raised are: Does the brain prefer the artistic manifestations as opposed to prescribed mathematical rules? Are theories of aesthetics and Gestalt perception such as the step-down in color, height, and visual weight from the darker outside frame to the lighter interior as in “Tettares-4” an additional element of visual merit? Do my rules enhance the artistic merit to which people respond? Can the tessellated pattern of my pseudo-language (non-notes) be transcribed into the temporal dimension of sound?

Through our journey of mosaic art we have explored the link with geometry, mythology, and philosophy. We have connected the experiential and conceptual data which links the creative impulse in art, science, and mathematics. It transcends cultural and religious barriers as it unifies the diverse expressions about our reality. It is the understanding of a universal order and is a response to a universal consciousness that links the energy of thought.

Footnotes

1. R. and S. Michaud (photos) and M. Barry (text) *Design and Color in Islamic Architecture* (Vendome Press: New York-Paris, 1996).
2. A. Phillips, “The Topology of Roman Mosaic Mazes” *Leonardo*: 25 Nos ¾, 323 (1992).
3. Ahuja and A. L. Loeb, “Tesselations in Islamic Calligraphy” *Leonardo*: 28 Nos 1, 45 (1995). and in *Design and Color in Islamic Architecture* (Vendome Press: New York-Paris, 1996) p. 34.
4. Discussion with Wiktor Dazewski (AIEMA) Association Internationale pour l’Etude de la Mosaïque Antique. VIII Coplleque International dela Mosaïque Antique, 1997, Lausanne Switzerland.
5. A. Phillips, 322-323.
6. A. Phillips.
7. Max Planck, *Autobiographie scientifique et demiers ecrits* (Paris: Editions Albin Michel, 1960) pp. 152-153.
8. Irene Rousseau, research – Ravenna, Italy.
9. G. Vasari, *Lives of the Artist* (trans. George Bull. Middlesex England: Penguin 1965).
10. I. Rousseau, research and interviews at mosaic schools and ateliers throughout Italy 1994.
11. Discussion with Dario Narduzzi director STUDIO DEL MOSAICO DI S. PIETRO IN VATICANO (Vatican Studio of Mosaics) Rome, 1996.
12. Discussion with Dario Narduzzi, Rome, 1996.
13. D. Schattschneider, “The Fascination of Tiling” *Leonardo*: 25 Nos ¾, 341 (1992).
14. B. Grunbaum and G. C. Shephard “Interlace Patterns in Islamic and Moorish Art” *Leonardo*: 25 Nos

¾, 331 (1992).

15. R. and S. Michaud (photos) and M. Barry (text) p. 34.
16. Michaud and Barry p. 11.
17. Irene Rousseau presented portions of this article at (AIEMA) Association Internationale pour l'Etude de la Mosaïque Antique. VIII Colloque International de la Mosaïque Antique, 1997, Lausanne, Switzerland.

Bibliography

1. R. Arnheim. *Art and Visual Perception*, (Univ. Cal. Press, Berkeley, 1971)
2. S. H. Bartley. *Principles of Perception* (Harper & Row Pub. NY. 1958)
3. F. Bejaoui, S.B. Mansour, M.H. Fanter, L. Foucher, H. Slim, M. Yacoub. *Mosaici Romani Di Tunisia* (Jaca Book SpA. Milano 1995)
4. J. Gleick. *Chaos Making a New Science* (Penguin Pub. NY, 1988)
5. M. Lipman. *Contemporary Aesthetics* (Allyn & Bacon Inc. Boston, 1973)
6. W. Rotzler. *Constructive Concepts* (Rizzoli Pub. Zurich, 1997)

