Life after Escher: A (Young) Artist's Journey

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Expressing the influence of Escher on my own work is akin to testing a new medical discovery without a control group. I have been exposed to his work for as long as I can remember, and certainly for as long as I've had an active interest in art, making it difficult for me to imagine a world without his work. That is not to say that he has had no impact; some directions I have been exploring were clearly visited by him first; other influences are more subtle.

The most obvious influence is certainly visible through my early experimentation with space-filling shapes. (see Figs. 1 – 3). The object of much of my early work was to explore the structure of two-dimensional space. In fact, Escher, one of the first artists whose work I searched out and studied, also served to teach me a very basic understanding of art. It is through his work, at first, that I became aware of the importance of this underlying structure in art work. Escher didn't just attempt to copy nature as he saw it. He succeeded in exploring the structure of his visual world, and how it would look if he put it together in a different way. His was also the work that allowed me to understand that art, at least visual art, is really the result, one might even say the by-product, of the explorations which are the real interest of the artist. Some of his illusionary work, for example, is really the result of his playing with the 2-D representation of 3-D and how he can stretch it. After so many centuries (until the Renaissance) of trying to represent reality as accurately as possible, artists such as Escher could now *mis*represent reality, deliberately and with perfect control. The most important impact this discovery had on me was that it justified the experimental and at times rather eclectic nature of my work.

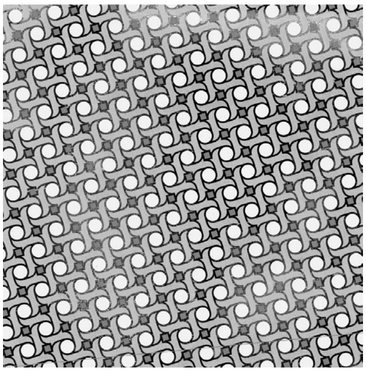


Fig. 1. Eva Knoll, *Frost on a Window*, 1994. Mixed media

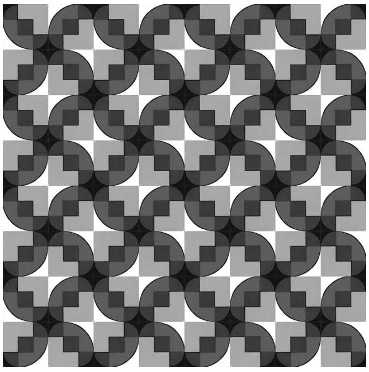


Fig. 2. Eva Knoll, Tiles with quasi-ellipses, 1992. Acrylic on ceramic

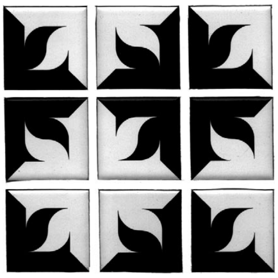


Fig. 3. Eva Knoll, *Balance*, 1993. Adhesive plastic on glazed ceramic tiles

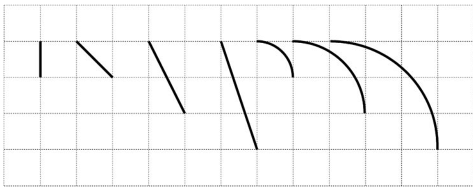


Fig. 4. Generating rules: vocabulary and syntax (from [8])

This experimental outlook turns my work into a continuous process that really only makes sense as a whole; in other words, my work is really a single piece which can only be truly understood viewed in its entirety. Although it is unfinished as yet, here is a glimpse into its current state.

Early Work

My early experiments with space-filling shapes were very methodical, using a square grid, a simple vocabulary, and a set of transformations. The vocabulary comprised simple straight lines joining certain vertices of the grid and quarters of circles inscribed in squares of side length 1, 2 or 3 (Fig. 4). The syntax of transformations comprised all the symmetries of the square grid, including translation, reflection, rotation and glide reflection. I rendered these patterns in color in more formal pieces like the one in color plates xx and xx and Figs. 5 and 7.

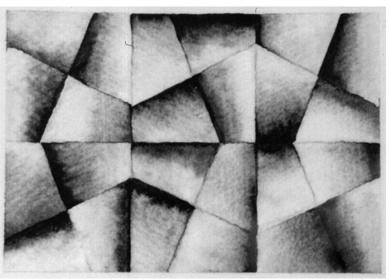


Fig. 5. Eva Knoll, *Study in Green*, 1998. Aquarelle

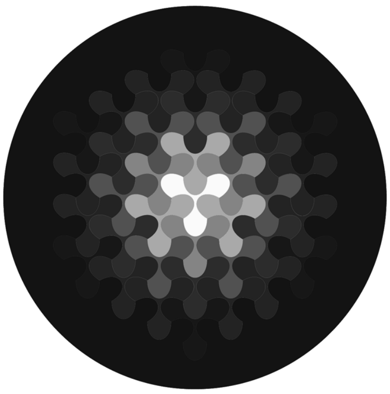


Fig. 6. Eva Knoll, Triangular Pattern, 2001. Computer generated

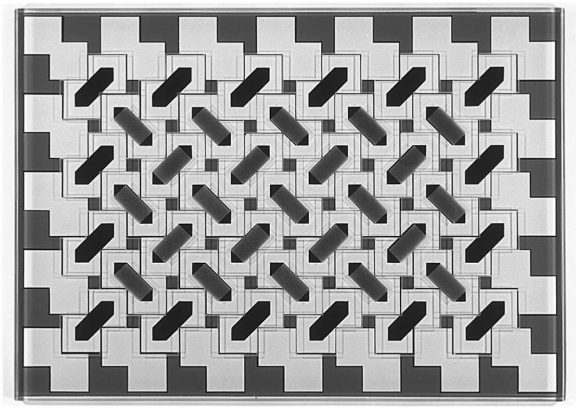


Fig. 7. Eva Knoll, *Depth Perception*, 1995. Sand-blasted glass and adhesive plastic

In some instances, having found many patterns that were "cousins" in that they differed only in one aspect of vocabulary or syntax, I would combine them into one piece, reminiscent certainly of Escher's *Metamorphosis II* (page xx).

Although there are occasional pieces designed to recall natural phenomena (the patterns in the background of color plate xx resemble waves – all the more because they were rendered in shades of blue), most of the time, I deliberately stayed away from figurative art, choosing instead to focus on the structure of space. This conscious decision reflects some of my other influences, in particular, my cultural heritage and my upbringing. Ties with Switzerland through my family, structural engineers in previous generations – these certainly affected my work. The link with Switzerland is revealed if we take a short trip through the art history of the last centuries. As mentioned before, until the Renaissance, the main focus of artists was to represent reality as accurately as possible. With the rise of modernity, this interest changed direction. Some movements, like Surrealism, tried to represent the world of dreams. Other artists experimented with moods and feelings engendered by what they saw. Still others focused on abstract art, where the interpretative element is entirely gone and forms are valued for their intrinsic beauty and not in relation to others [11, p. 62]. The artists of that movement were trying to achieve for the visual arts what had been taken for granted in music for a very long time:

> *Depuis des siècles [. . .] la musique est par excellence l'art qui exprime la vie spirituelle de l'artiste. Ses moyens ne lui servent jamais, en dehors de quelques cas exceptionnels où elle s'est écartée de son propre esprit, à reproduire la nature, mais à donner vie propre aux sons musicaux.*[1] [14, p. 59]

[1] For centuries [. . .] music is the perfect example of art which expresses the spiritual life of the artist. The musician's means, aside from a few exceptional cases where music moved away from its spirit, are never used to reproduce nature, but to give life to musical sounds.

The Abstract movement quickly branched out into different directions. The one that interests us here is the Constructivist Movement, begun in Russia, continued in Germany (where it paralleled the Bauhaus), and finally reaching, in some form or another, most of Europe, as well as North and South America. The Constructivists, instead of representing the known universe, sought to *construct* a new world in their art which would only loosely share its structure with the one we know in order that:

> *released from its attachments to natural phenomena and bound to natural laws, this art gives the feeling and shaping mind, the creative imagination, the greatest possible freedom. This art demands three things from the observer: constant refinement of the senses, serenity of spirit, and alertness of mind. And to those who are willing to learn its language, it returns these three things, the most precious that we can possess, with interest: refinement of the senses, serenity of spirit, and alertness of mind.* [12, p. 142]

Because of its very general mandate, the Constructivist Movement was interpreted very differently in the countries that welcomed it. In Switzerland, in particular, artists searched for a self-expression which would bring an art that is

> *non-figuratif entièrement conçu avant son exécution, dont chacun des éléments plastiques [...] est choisi et justifié en fonction de règles simples, établies la plupart du temps selon des lois mathématiques et physiques et s'appuyant souvent sur la théorie de la forme.*[2] [3, p. 9].

This passage describes the intentions of the Swiss Concrete Art Movement centred in Zurich and led by such artists as Max Bill, Richard Paul Lohse, Camille Graeser, and very marginally, Hans Hinterreiter. I, of course, did not become aware of this heritage until years later, when I had to explore the antecedents of my formal research in graduate school. It is a curious phenomenon to get acquainted on a conscious level with an art that has had an unconscious influence for such a long time, and to find out that I was not the only one who eschewed the figurative in order to focus more sharply on the structural.

Besides studying the structure of space in two dimensions, I became very interested in the interpretation of color, not on a symbolic level, but in terms of its perception, depending on such factors as juxtaposition, form, and identity. The identity of color itself has an impact in the sense that blue, for example recedes, while yellow or red come forward. Further, a circular patch of red and a triangular patch of red do not produce the same impact. Finally, a specific color will appear differently when juxtaposed with a color opposite or adjacent in the spectrum. This experimentation is better accomplished, once again, without the distraction of figurative or symbolic representation. Color plate xx shows some results of these experiments. The thirteen paintings all use the same design,

[2] non-figurative, entirely conceived before its execution, each one of its plastic elements chosen and justified through simple rules, mostly established according to mathematical and physical laws and often based on the theory of form.

but vary in their colors, demonstrating the influence of color choice on perception. Despite the richness of these two areas of exploration, after about 10 years I needed a new direction, a universe that would show me new things about the structure of space.

New Challenges

Looking for a new direction, I considered at first following the same path I had before, substituting the regular triangular grid for the square grid in the design of my space-fillers. Despite some interesting results (Fig. 6), this new realm proved disappointing, not challenging me enough. I decided instead to explore the structure of 3-D space. Early signs are visible that I was to head that way eventually. In Fig. 7, for example, the pattern called for a spacial layering of its variations in order to show their relationship. The pattern and its variations were layered by using a 7-mm thick pane of glass on the front and back on which the different patterns were applied. This emphasized not only the relation between the two patterns, but created a depth effect that is all the more striking when viewed up close and in real life (the parallax effect adds an interesting dimension).

From the beginning of my systematic explorations of the structure of space, the three dimensions proved much more complex to comprehend than expected. Perhaps due to my almost exclusively planar geometrical experience, I had begun to take for granted the snug fit of regular geometric objects. Since both squares and equilateral triangles (as well as hexagons) tile the plane, I assumed that cubes and regular tetrahedra must each fill space. That is of course only true of the cube: regular tetrahedra need the help of regular octahedra to properly fill space. I discovered this fact the hard way, when I transferred a design from an inexact paper model to a precisely-shaped lathed wood piece. Figure 8 illustrates my attempt at showing the beginning of tetrahedral space filling: join five tetrahedra at a common edge, effectively using the common edge as an axis

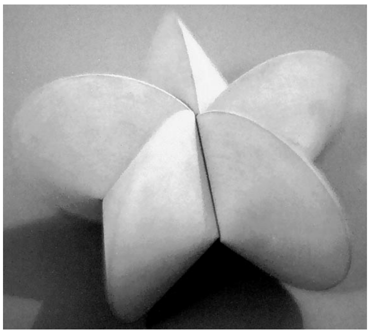


Fig. 8. Eva Knoll, Five rotated tetrahedra, 1993. Lathed wood

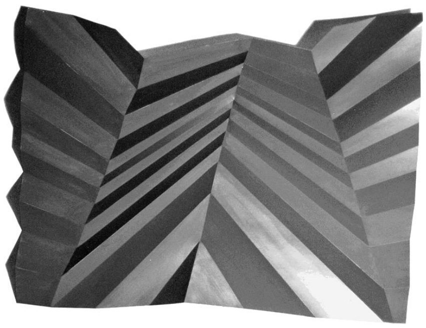


Fig. 9. Eva Knoll, *Folded 2-space*, 1996. Acrylic paint and paper

of rotation. Then rotate each tetrahedron around the opposite edge. This process would only work if five regular tetrahedra placed in this manner spanned 360°. Unfortunately, a few degrees render this untrue except in an inaccurate model: regular tetrahedra do *not* fill space! In Fig. 8, the tetrahedra had to be deformed slightly before they could be rotated about the second set of axes. This early experiment demonstrated the need for a more careful exploration of the structure of space. Indeed, if my experiences with planar geometry were to come to any use, I needed to find a link between the two universes, a kind of metaphorical gateway, a method.

To find this link, I went looking for objects and methods that involved an in-between world, of two-and-a-half dimensions. Origami is a good example of such a world. I set out to discover how a medium that can be considered two-dimensional (paper) acts in the three-dimensional world. Figs. 9 and 10 show some of the results of my experiments: Folded two-space shows the interesting way in which concertina folds can, without running parallel, remain coplanar. Figure 10, a sampling of origami experiments starting with a circular piece of paper, shows the structure of a finite circle (as opposed to the infinite circle of space-fillers), as well as some of its behaviour in space. This early experimentation with circular origami inspired Project Geraldine that I am still involved with at present, which I will describe later.

Origami, even if it allows the creation of objects that exist in three-dimensional space, remains a tool that defines surfaces, not volumes. Parallel to these explorations, I had not completely forsaken my space-fillers. Why not, then, find a vocabulary and syntax (just like I had in 2-D), that would allow me to fill 3-D space at will? Returning to the design parameters I had been using for 2-D space filling, I set out to translate them into their 3-D equivalents. The syntax was easy to translate: instead of using the symmetry groups of the square grid, I would use the symmetry groups of the cubic grid. As for the vocabulary, that would pose a more complex problem. First, I simplified my vocabulary so that it would include only the elements that were entirely comprised inside one square (Fig. 11a). Then I set out to find all the surfaces that cut through a unit cube given that the said surface intersects the faces of the original cube in one of the curves of Fig. 11a. Although the number of these surfaces is limited, it was soon obvious that the search for all of them would be futile. An additional parameter needed to be established. Advised by Conway, I decided to limit my search

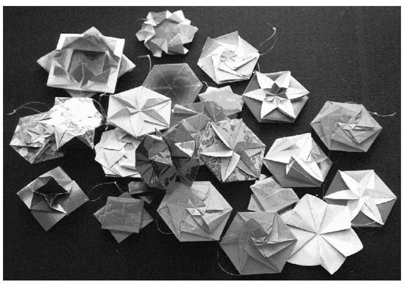
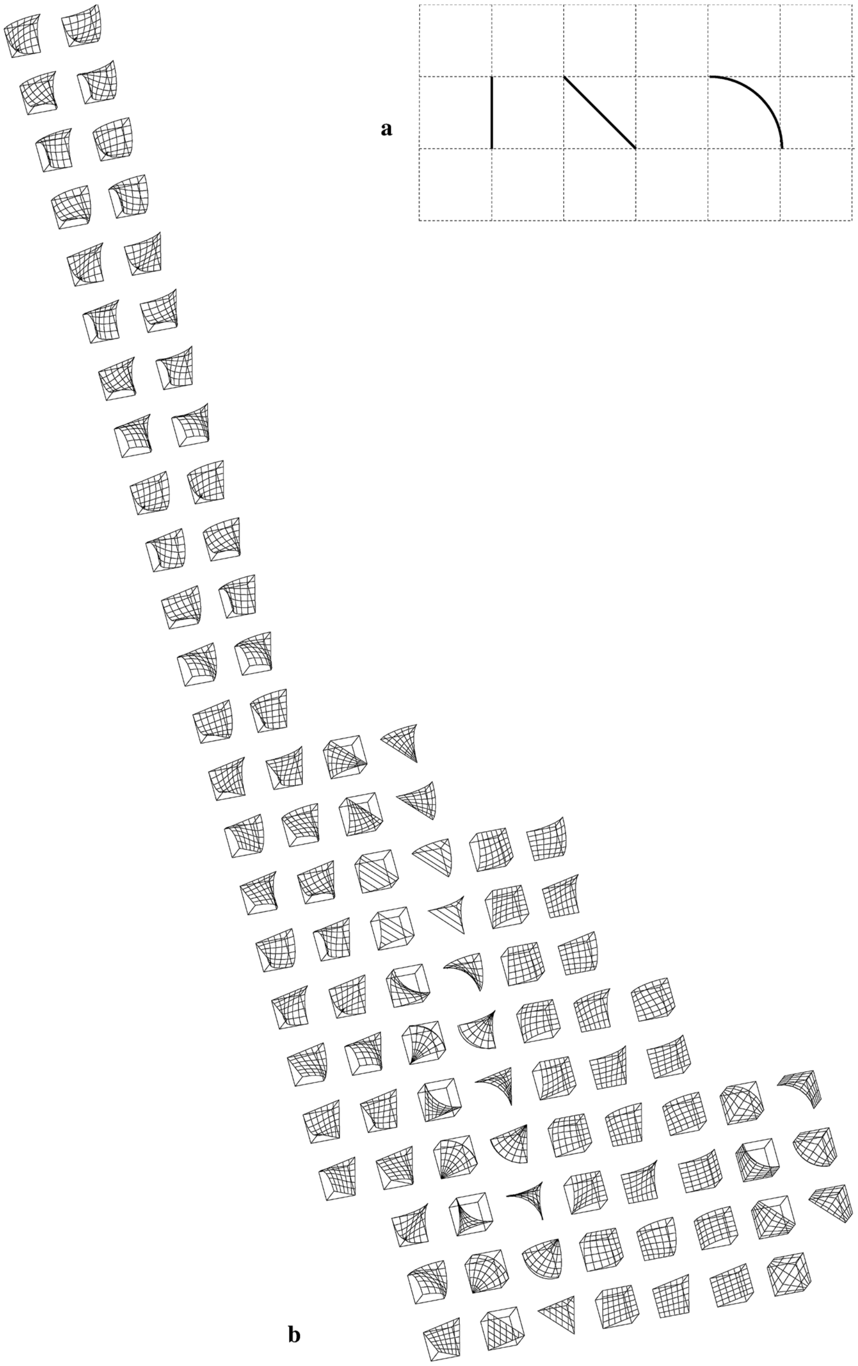


Fig. 10. Eva Knoll, Origami decorations, 1997. Paper



a

b

Fig. 11. (**a**) Simplified Vocabulary. (**b**) 91 cubes: 3-D vocabulary (from [8])

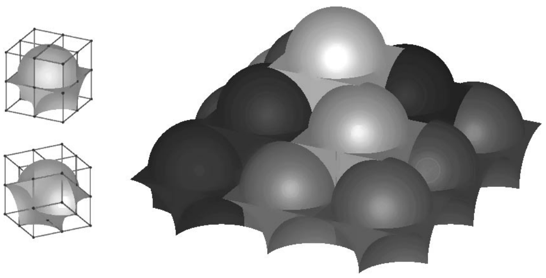


Fig. 12. 3-D Space-filler 1 (from [8])

to the surfaces that, following the previously defined criteria, would be bounded by only three or four of these curves (Fig. 11b). Once the vocabulary and syntax were established, I found myself with a complete medium for the design of 3-D space-fillers!

Figure 12 illustrates a simple example of such a space-filler composed only of eighths of a sphere of unit radius and their complementary elements D-2 and E-2 from Fig. 11b. These explorations, accomplished as part of my Masters' thesis, were made using SGDLsoft, a very powerful computer-modelling program developed at the Université de Montréal. Unfortunately, static computer modelling does not easily allow for the playing around with 3-D objects that is required to determine more elaborate space-filling compound elements using the vocabulary and syntax described above.

The second part of my Masters' project involved testing the method of transfer I had just developed on an independent system. I chose for this *Opus 84* by Hans Hinterreiter, a round painting with a diameter of 82 cm, depicting a deformed regular space-filling pattern [2, p. 31]. This painting proved an interesting challenge with its layers of patterns and its high level of complexity. In fact, the painting was so rich in its own right that the 3-D version became too complex to be fully grasped (even the computer was not powerful enough!).

Returning to the circular origami exploration, I discovered that beginning with the circle allowed me to subdivide my paper accurately into a regular triangular grid (because $\sin 30° = 1/2$), opening the door into triangular grid spaces. Soon thereafter, I found that I could use this method to construct deltahedra (polyhedra composed exclusively of equilateral triangles) [4, p. 78, 142]. It was thus that *Geraldine* was built (Fig. 13). Thanks again to John H. Conway, I learned that she was in fact an endo-pentakis-icosa-dodecahedron.

The interesting aspect of this experiment was the process of transformation between the flat triangular grid and the assembled deltahedron. Practical considerations came into play and forced additional steps in the process. After forming the first dimple by folding and tucking in the extra 60° of paper, I realized that I would end up with so much extra paper inside the polyhedron, that I would not be able to close it. This problem prompted me to cut off some of the excess, leaving enough to provide a tab to help with the stability of the shape. Repeating this process until the polyhedron was finished, I disassembled it again and

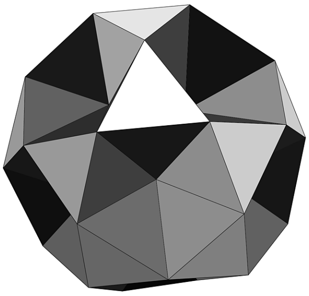


Fig. 13. *Geraldine*, assembled (Endo-Pentakis-Icosa-Dodecahedron), 1998. Paper model

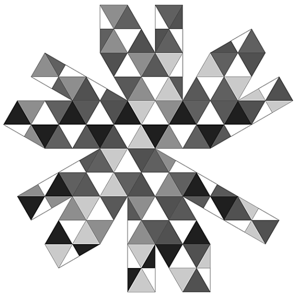


Fig. 14. *Geraldine* "snowflake" fractal net, 1999. Computer generated

was left with a strange snowflake-like shape with its own aesthetic! (See Fig. 14) Using this method to construct a deltahedron is meaningful because every cut made in the "snowflake" directly reflects the shape of the polyhedron, allowing the builder to experience the building of the shape in a new way.

The flat shape is built by subtraction, each cut corresponding to a 5-vertex on the assembled polyhedron. This new link between the plane and space has prompted further experimentation to find other deltahedra and their corresponding "snowflake," even to systematic exploration of the mathematics of these shapes [9]. In the meantime, a version of the project was completed out of material used for making kites, using 1-meter-edge triangles. It is now being used in a special project in mathematics education at the Rice University Math School Project in Houston Texas in joint work with mathematician Simon Morgan (see Fig. 15). The set was first used in a participatory event at "Bridges: Mathematical connections in Art, Music and Science" in July, 1999 at Southwestern College in Kansas where the audience was actively involved in the construction process, experiencing first-hand the relationship between the two forms of the object. This is the first work of mine that is intended to be experienced through

Fig. 15. *Geraldine*, assembled, 1999. High-tech textile and carbon fiber

its building process. Participating in the process is important because it gives the opportunity to understand the shape of the polyhedron and the nature of space, the subject of much of my work.

Future Endeavours

Although my work certainly has a distinct 'air de famille,' it is difficult to say what is still to come. There are many possible directions still to be explored, and every one has unlimited potential. My approach is definitely experimental, and an interesting consequence of my focus on the process is that I will often let my hands do the figuring out, observing the phenomenon from outside in a practical manner and then try to understand on a rational level what is occurring. This leaves much room for serendipity, certainly, but has given interesting results so far. Stylistically speaking, this has assuredly taken me far away from Escher. After all, I come after him, and I am not a printer by training. Though I respect Escher immensely for what he has given us, I do not intend to imitate him, but rather to build from where he left off. This is equally true of the Constructivists, and of other media and traditions such as origami, which I seem to be following a bit as well.

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