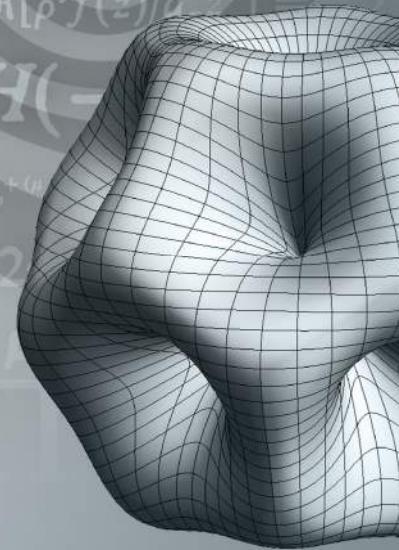


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S-CYLINDRICAL MIRROR

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Abstract: *Stand in just the right place in front of a painting and see an image. Stand in any other position, and the image distorts to become unrecognizable. That is an anamorphic image. The ancient Greeks used such images. Artists of the Renaissance explored the concept in paintings and murals. A great leap forward was made in 17th century France when artists made drawings that had to be viewed with the aid of a cylindrical mirror. In this work we show how anamorphism appears in sculpture, creating distorted 3D scenes that can be viewed in normal proportions in a mirror mounted within the piece. We show examples that use many kinds of cylindrical mirrors but also irregular and S-shaped wave mirrors.*

Key-words: Mirrors, anamorphosis, 3D anamorphic sculpture, vertical S-cylindrical mirror, *Alice in Wonderland*.

1 Mirrors

A mirror is a flat, smooth surface that reflects an image. And over time, mirrors have been endowed with magical, and even supernatural powers; depending on the circumstance a mirror can evoke love, terror, greed, jealousy, or horror.

Literature abounds with examples: the Greek mythology of Narcissus; the Grimm Brothers' *Snow White and the Seven Dwarfs*; Lewis Carroll's *Through the Looking Glass*; William Shakespeare's *Richard II*; Sylvia Plath's poem "Mirror"; Bram Stoker's *Dracula*; Alfred, Lord Tennyson's poem "The Lady of Shalott"; the Mirror of Erised and two-way mirrors in the *Harry Potter* novels; the Manuel of the Planes for *Dungeons & Dragons*; and H. P. Lovecraft and Henry S. Whitehead's "The Trap".

Mirrors are such a part of our everyday life that we take them for granted. We get up in the morning, wash, dress, and before we leave the house, take one last

look in the mirror. Yet what we see is not a true representation of who we are. The flat mirror leaves shape and dimensions unaltered, but shows a reversed left-to-right image of us, which is not how the outside world sees us.

Mirrors that are not flat can change, in a variety of ways, the dimensions, the shape, and even the orientation of an object. Ask anyone who has stood in front of a carnival mirror what they had experienced, and they will respond that they saw distorted, undulating images – images that changed as they moved in close towards and then backed away from the mirror.

Much like the reaction someone would have had with a carnival mirror, when I was a very young child, I saw the most astonishing mirror reflection. Seeing this reflection startled me, and its effect has influenced how I looked at mirrors and reflections to this day. The experience happened when I was around 12 years old, and it took place at a formal family dinner.

For this special dinner, the very best linen, china, crystal, and silverware were brought out. And as I sat waiting for the adults to be seated, my soupspoon caught my gaze (Figure 1).



Figure 1: Soupspoon.

I moved closer to take a better look, and what to my surprise, there was something floating in the bowl of the spoon. To my astonishment, the object was the dinning room chandelier. My eyes were fixed on the reflection in the spoon, which seemed all too real, yet when I tried to grab the floating shape between my fingers, the fingers passed through the image as if it were a ghost. When the dinner was over, I was called to help with the kitchen clean up. And with the spoon reflection fresh in my mind, I looked at the sterling silver coffee urn and large service pieces were looked at in a new way: as the dishes were being dried, I started to move in close and then back away from the curved mirrored pieces. I was amazed by the most delightful reflections, which changed as I moved around the kitchen. There looking back at me were reflections that merged and then changed from a one-eyed Cyclops, to a bird beaked faces without eyes, to a short-bodied, and then a tall-bodied figure.

Today, there are two childhood experiences that have influenced my artwork. The first was soupspoon observation I just mentioned. The second was a discovery of a book about the anamorphic arts. As I look back, I recall being mesmerized by the images in that book, an eighteenth-century French anamorphic art book with pictures that were flat, very distorted, and only recognizable when the images were viewed in a cylindrical mirror.

2 Anamorphosis

The anamorphic arts have held a special fascination for both the artists and viewers, with possibly one of the earliest examples being found in the prehistoric Lascaux caves (Figure 2).



Figure 2: Lascaux caves.

The cave paintings have oblique angles and distorted images and viewing angles, all of which might have been created with the intuitive use of anamorphic perspective.

Then there are the examples of the calculated use of anamorphic concepts, which can be seen in the mathematical proportions of the Greek parthenon (Figures 3 and 4) and the varied letter sizes on the Roman triumphal arches. But it was the European Renaissance that brought the greatest advancement in visual perception with the invention of perspective (Figure 5).

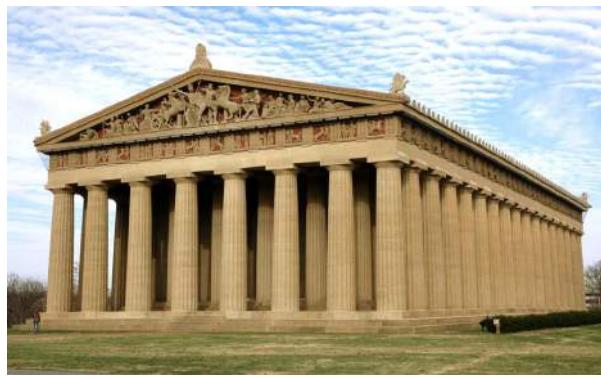


Figure 3: Greek parthenon.

The artists and scientists of the Renaissance thoroughly researched the one-point, two-point, and three-point perspective concepts. For the first time, artists had a tool that let them create, on a flat surface, an image that had depth and a 3D realism.

THE PARTHENON ATHENS: EAST FRONT

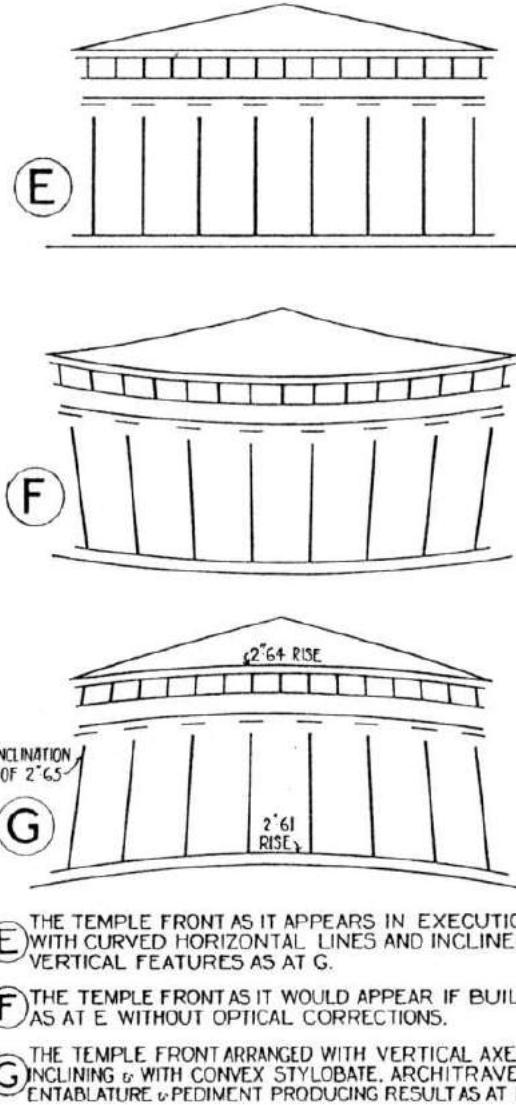


Figure 4: Parthenon drawing.

When first viewed, these images were considered magical. And the magic continued with the addition of anamorphosis, which is just the opposite of perspective. Anamorphosis is a distortion of the shapes and dimensions of an image, making

it impossible for an observer to recognize an image when standing in front of it. There are two types of anamorphosis: oblique and catoptric (mirror). Both types of anamorphosis are distorted images on a flat plane; to view a recognizable image requires that the observer must stand in a particular spot and look at the distorted image obliquely or view a corrected reflection in a curved mirror.

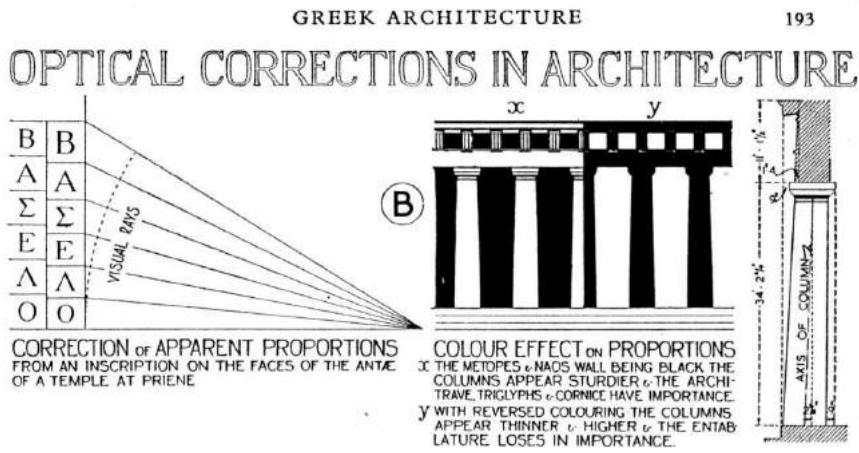


Figure 5: Optical corrections.

Piero della Francesca and Leonardo da Vinci are considered to be among the first Renaissance artists to use geometric perspective and anamorphosis. One of the earliest examples of anamorphosis works is seen in da Vinci's notebook drawing from *Codice Atlanticus*, c.1483-1518, a drawing of a distorted child's face that must be viewed obliquely to see the realistic image of a face and eyes (Figure 6).

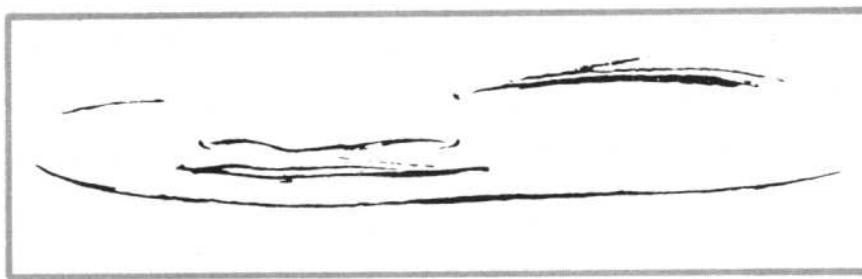


Figure 6: Distorted drawing.

Hans Holbein, the Younger's painting, *The Ambassador*, 1533, is often cited for the use of anamorphic perspective. In this work, Holbein took great care to present near-perfect perspective, but resting in the lower area of the canvas is

an odd, diagonally placed shape. The odd shape is an anamorphic skull that can be viewed only from a position to the right of the painting (Figures 7 and 8).



Figure 7: *The Ambassadors*.



Figure 8: Skull.

The eighteenth century saw the introduction of the cylindrical mirror, which was augmented by the cone and pyramid mirrors (Figure 9). And continuing into the twentieth and twenty-first centuries, there have been a number of creative additions to the anamorphic arts.

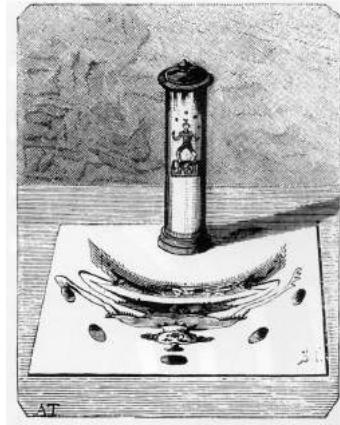


Figure 9: Mirror.

3 3D Anamorphic Sculpture

There are several twentieth-century additions to the anamorphic arts that can be seen in my own artwork. I researched the idea for a 3D anamorphic sculpture was questioned and researched in 1986 and completed my first 3D anamorphic sculpture, *Self-Portrait*, in 1988 (Figure 10).



Figure 10: *Self-Portrait*.

Self-Portrait merged seventeenth-century mirrored anamorphosis with sculpture: instead of using a distorted flat image, I used clay to create a distorted fan-shaped relief. Initially, I used a conventional flat geometric anamorphic technique, but because of the solid nature of the clay, the work required a new approach, which involved sculpting directly in front of the mirror. When the sculpture was placed in front of a 180-degree mirror the distorted relief reflected a 3D image.

The working method I used initially used to create *Self-Portrait* included a 12-inch flat glass mirror, a 6-inch cylindrical Mylar mirror, an 8 × 12-inch black and white self-portrait photograph with a 1-inch inked grid drawn to the borders of the photograph, a curved fan shaped 14 × 24-inch grid that was drawn on a sheet of paper, a 14 × 24-inch inked fan shaped grid on a sheet of clear plastic, and oil-based clay. I numbered the grid units were numbered across the horizontal border of the self-portrait photograph and then alphabetically labeled each grid unit on the vertical border. The curved grid was identically labeled on the horizontal and vertical borders. Then I placed the self-portrait photograph next to the curved grid and translated the photograph into a curved image by drawing each square of the self-portrait photograph grid with pencil in gray values on the paper's curved grid units. From time to time, during the drawing process, I put the drawing in front of the cylindrical Mylar mirror to check on my progress (Figure 11).

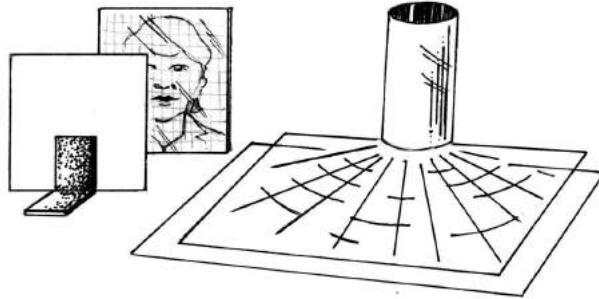


Figure 11: Method.

Once the distorted curved-grid drawing was completed, I placed the clear plastic inked fan grid was placed on top (the plastic was used to insure that the pencil drawing was not damaged by the clay), making sure that the overlapping grids matched, and then placed both the drawing and the plastic in front of the Mylar mirror, which I used to make a final check for accuracy; the drawing had the depth and width of a seventeenth-century anamorphic drawing. The next step was to achieve the height that was needed to create the piece's 3D feature. Starting at the outside edges of the drawing and working towards the Mylar mirror, I spread a thin layer of clay on top of the drawing. Adding the clay did start to give the piece height, but at the same time, the drawing under the

plastic grid was being eradicated and the facial features were gone.

The course I took to solve the sculpting problem involved making a few changes to the set-up. I placed the self-portrait photograph so that it faced the flat mirror, with the mirror facing out towards the viewer. I then placed the photograph and mirror next to the cylindrical Mylar mirror and the distorted fan-drawn grid. While standing in front of the mirror, and while looking at the flat mirror, I then applied clay to the flat distorted grid, and at the same time, I looked into the cylindrical Mylar mirror to check on the progress of the sculpting. Working the clay in this manner required me to create the figure upside down and reversed.

4 A New Mirror: The Vertical S-Cylindrical Mirror

I created a much more complicated 3D anamorphic sculpture, *Brothers*, in 1990. For this new piece, instead of using a cylinder, cone, or pyramid mirror, I created a new mirror by slicing a cylindrical mirror in half, then shifting and joining the opposite edges together, which created an “S” or wave, cylindrical mirror (Figure 12).

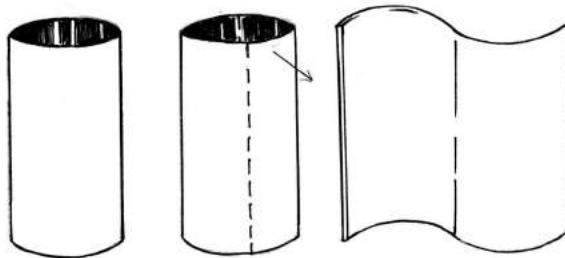


Figure 12: S-cylindrical mirror.

Because of the design of the mirror’s design, I used two distorted anamorphic sculptures for *Brothers*, distorting each sculpture in a uniquely different way than the other¹³). The first sculpture is a high-relief fan shaped man sitting in an overstuffed chair with his feet up on an ottoman; this figure is placed in front of the S-cylindrical mirror’s convex area and reflects a traditional anamorphic image. The second sculpture is a standing figure that appears wider than normal, but when the sculpture is placed in the concave area of the S-cylindrical mirror, the figure’s reflection appears slimmed down and normal. What the viewer experiences is a parabolic reflection, which is much like a hologram for an off-the-surface and floating-in-space reflection¹.

¹<http://www.karenmortillaro.com/videos.php>

Figure 13: *Brothers*.

5 Alice in Wonderland

Lewis Carroll's *Alice in Wonderland* was written during the Victorian era, an era that produced extraordinary advancements in the areas of mathematics, science, literature, art, politics, and exploration. In writing his children's book, Carroll took the creative energy of his time and, instead of writing a story that was dull and moralizing, he wrote a book that was magic for a young reader, a book that is filled with fun, puns, nonsense logic, math, science, and popular culture.

Figure 14: *Alice table*.

Alice in Wonderland is a classic story that has been illustrated by many fine and accomplished artists over the past one 150 years; but there had never been an attempt to illustrate the story in sculpture. Such a task seemed to me to be quite an interesting and worthwhile undertaking.



Figure 15: One more Alice table.

Using Lewis Carroll's masterpiece, along with the richness of the Victorian period, I found it difficult to create just one piece of sculpture that would fully illustrate Alice's dream journey. So, I decided to create, in 3D anamorphic sculpture, one table-like sculpture for each chapter; when all twelve Alice tables are brought together, they will create one united sculpture. Each table-size sculpture is first sculpted in clay, then cast in bronze, and includes a stainless steel S-cylindrical mirror. The S-cylindrical mirror is ideal for this project because it allows for the figures on one side of the mirror to be sculpted realistically, while on the opposite side of the mirror are distorted and unrecognizable. The mirror is symbolic of the parallel worlds that Alice might have experienced in her dream state; the world of reality is on one side of the mirror; and the world of illusion is on the mirror's opposite side (Figures 14, 15 and 16).



Figure 16: Even one more Alice table.

Having only a minimal background in the areas of mathematics, physics, and the neurosciences, I have created all of the 3D anamorphic sculptures by making intuitive calculations by hand. To date, six of the twelve sculptures of the Alice Series have been completed. The working method I have used since 1988 to create these sculptures involves the following steps: (1) I visualize the sculpture is seen in my mind's eye, (2) I make notebook sketches and notations, (3) I look directly into the S-cylindrical mirror while hand sculpting in front of the curved mirror, and (4) I cast the finished clay sculpture is cast in bronze, with the addition of a stainless steel mirror. It should be noted that 29 years ago, when I first started to create the 3D anamorphic sculptures, many of the technological tools, such as the PC computer and CNC milling machines, were in their infancy or they were not available to me. But within the past few years, today's PC computers and computer software have become greatly advanced. In addition, 3D scanning and 3D printing not only are readily available but also have become much more cost effective and user friendly. Using these new technological tools will lead to design and fabrication possibilities that cannot be achieved by hand, and I am looking forward to using these tools to assist with the completion of the Alice Series, but also with future sculptures.

6 Acknowledgment

I would be remiss if I failed to acknowledge two individuals, Lewis Carroll and Martin Gardner; each of these gentlemen has had a major influence on my *Alice Series*. Their influence can be seen in my notebooks, which are kept in my

studio, close to two other books; Carroll's *Alice in Wonderland* [2] and Martin Gardner's *The Annotated Alice* [1]. My notebooks contain copious sketches and notes that are visual concept interpretations of Carroll's story. Gardner's *The Annotated Alice*, a brilliant analysis of Carroll's story, is an invaluable resource that also adds to the notebook studies. Both men wrote children's literature and were very involved with mathematics. Carroll taught and wrote about math, and Gardner, although not a mathematician, was a prolific writer on the subject. Both men enjoyed puzzles, magic, and games. Both men were also very socially shy, shunning all public recognition, but last year there was a world wide celebration of Gardner's 100-year birthday, and this year there will be a worldwide 150th-anniversary celebration of the publication of Lewis Carroll's *Alice in Wonderland*. To both of these creative individuals, I thank you.

For more information on Lewis Carroll, please check the web for the Lewis Carroll Society; there are societies in the UK, USA, Canada, Brazil, and Japan. Information on Martin Gardner can be found on the Martin Gardner website: martin-gardner.org.

References

- [1] Gardner, M. *The Annotated Alice*, Clarkson N. Potter, 1960.
- [2] Carroll, L. *Alice's Adventures in Wonderland*, 1865.