ABSTRACT

Margaret Earley-Thiele. CREATING WEARABLE JEWELRY USING EXPERIMENTAL ENAMELING TECHCNIQUES. (Under the direction of Linda Darty) The School of Art and Design, December 2009.

My thesis explores the topic of creating dimensional enamel forms through the use of experimental enameling techniques. While the pieces are based on the foundation of basic enameling, I pushed the material's limits to make the enamel come off the surface of the metal. These techniques allow me to create a visual energy on the surface of the copper with glass. I placed the enamels in sterling silver settings to make each one a wearable piece of jewelry. The jewelry pieces make up three series of work: *Potential Energy*, *Contained Energy*, and *Free Radical*.

CREATING WEARABLE JEWELRY USING EXPERIMENTAL ENAMELING TECHNIQUES

A Report of Creative Thesis
Presented to
The Faculty of the School of Art and Design
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Master of Fine Arts

By
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INTRODUCTION

Enameling, the process of fusing glass to metal, is typically a two-dimensional process. The enamel can be applied to either a two or three dimensional surface, but traditionally the enamel itself takes the same dimension as the metal base to which it is adhered. However, it is possible to make the enamel itself a free-standing object, making the surface of the enamel visually activated and energized. This activation is caused by the ability to capture the effects of movement within the enamel, as if it were frozen in the air. I created these energetic surfaces through numerous experiments, after thoroughly understanding basic enameling techniques. I then set the finished, vitreous enamels into jewelry, creating functional, wearable pieces for this thesis exhibition.

BACKGROUND

In order to achieve a limited amount of control in creating dimension in an enameled surface, it is essential to have an understanding of basic enameling methods. The enamel (ground glass) is applied to copper, or another type of metal such as pure silver or gold, through a sifting technique. The enamel is fired in an electric kiln until it reaches a fusing temperature of approximately 1500 degrees Fahrenheit. It is important to fully comprehend the properties of fusing enamel using traditional methods prior to investigating it experimentally because knowing how the enamel behaves inside the kiln provides insight into the characteristics of the material.

When a layer of enamel is placed on copper and put into the kiln, the enamel powder fuses to the metal, changing into a glass-like state. The enamel spreads across the surface of the metal with surface tension. When the enamel is fired in the kiln for approximately two to three minutes, the enamel fuses consistently and evenly. If fired for less time, the enamel does not fully fuse and it retains some of its powder consistency. If fired for more time, the oxides from the metal go into solution with the glass, disturbing the surface tension of the enamel.

When using traditional enameling techniques, visual depth is achieved through firing layers of glass onto the metal. Transparent enamels are often used to build depth because it is possible to see through the layers to the base metal, or the color beneath. The layers of enamel fuse to each other so it is possible to build up many layers this way. Opaque enamels can also be used to create depth. While, it is not possible to see through the opaque layers to those underneath, the opaque enamel can be partly removed to expose layers below. These techniques are traditionally referred to as sgraffito or stenciling.

In addition to understanding how the enamel behaves in the kiln, it is also useful to know some of the history behind applying glass to metal, particularly when it relates to surface textures. Enamel can be purchased in many different forms, a few of which are powder, liquid, waxy crayons, and paint. These forms allow the enamel to be fired in different ways, resulting in varying surfaces. Some of the traditional surface textures achieved through controlled firing temperatures are referred to as sugar, orange peel, sgraffito, and basse taille.

Both sugar and orange peel surfaces begin with an application of powdered enamel and end with a roughened surface. Sugar firing creates a sand-like texture resulting from not fully fusing the enamel to a base coat of glass. An orange peel surface is achieved by firing the enamel slightly longer than a sugar firing, but not allowing the surface tension of the enamel to result in a glassy, smooth surface. The finished texture resembles that of an orange peel. Both methods give the finished surface an uneven texture, but are still flat.

Sgraffito, is a process that results in visual, rather than tactile texture. It is a scratching away process, exposing layers of enamel below the top surface layer. It is often used when the enamel is in liquid or paint form because it is easier to draw a finer line through these materials. The enamel is scratched away with a pointed tool before it is fired, revealing an already fired layer of enamel or metal beneath it. The scratched lines are preserved in the enamel after it has been fired.[1] The visual texture sgraffito creates gives the surface of the enamel depth and interest, but also remains two dimensional.

Basse taille is a technique achieved from firing enamel over a metal relief or textured surface so it is possible to see the texture beneath the glass. Transparent enamels are used for this process because they reveal the detail in the metal's surface. The end result of basse taille looks very three-dimensional, particularly when there is deep texture in the surface of the metal. However, it is the metal that is three-dimensional, not the enamel.

In addition to creating a surface texture on metal, enamel is used historically as a replacement

1 Darty, Linda. *The Art of Enameling.* New York: Lark Books, 2004. p 67-69

for precious stones and for paintings. Enamel can add vivid color to metal work, sometimes for less expense than precious stones such as rubies, sapphires, emeralds, and opals. The Egyptians began using enamel as a substitute for gemstones that were not readily available, and the practice was repeated throughout history. Using a combination of opaque and transparent enamels, it is possible to create enough depth to closely resemble a cut gemstone. The resulting surfaces remain flat, but do provide interesting visual depth, tricking the eye into believing the enamel pieces are precious gems.

Enamel is more durable than paint and it can be applied to jewelry in a painterly fashion. Using various types of painting enamels, it is possible to create a surface that is similar to that of an oil painting. These techniques, also known as Limoge enamels, originated in Limoge, France. They include grisaille, watercolor and acrylic painting and china painting. Grisaille enameling is a process that builds white enamel over black enamel, developing gray tones. The final product resembles a print or illustration.[2] The enamel used in these methods is the same consistency as traditional watercolor or acrylic paint. They are applied to the surface of a fired base coat of enamel using a paint brush.[3] China painting, another method for painting on an enameled surface, was traditionally used to paint thin layers of color onto a ceramic glaze, most often on porcelain tableware.[4] The techniques for painting with it on an enameled surface are similar and the firing temperatures the same, though rather than painting on porcelain the enamelist uses enamel coated metal as the base. With all of these painting techniques, enamel surfaces are as two-dimensional as an oil painting, though they are still visually intriguing.

Camille Fauré was a French enamelist who worked from the 1920s until the 1950s in the city of Limoges.[5] He worked alongside Alexandre Marty and his daughter Henriette and together they "develop[ed] direct flame and drip techniques as well as [Fauré's] most important discovery, the ability

2 Ibid p. 85-7
3 Ibid, p 89-90
4 Darty, Linda. *The Art of Enameling*. New York: Lark Books, 2004. p 94-95
5 Marcheschi, Cork. *Camille Fauré: Impossible Objects*. Library of Congress, 2007. p 55

to sculpturally build up the surface of the vase with thick enamel."[6] The enamel was built up on the walls of copper vases and occasionally lines were ground through to create distinct forms and shadows. The surface of the enamel was voluptuous and smooth and adorned with art deco patterning. The surfaces created through Fauré enameling are more textural than most traditional enameling. The enamel is so thickly layered that the texture seems to take on a form. The profiles of the vases allow the viewer to see the three-dimensionality of the surface. Fauré credits Marty with helping develop the three-dimensional surface through experimentation.[7] The secrets behind Fauré's enameling techniques were closely guarded and those apprenticed to him in his Limoge shop did not even fully know all of the techniques used to create his surfaces. As a result of the secrecy, no one has been able to completely replicate his methods, despite the continuation of the Fauré shop in France.

6 Ibid, p 57.

7 Marcheschi, Cork. *Camille Fauré: Impossible Objects*. Library of Congress, 2007. p 59

Mistakes happen. Sometimes the maker must repair them either through beginning again or by changing the piece to incorporate the mistake. If the resulting mistake is a "happy accident" then the challenge becomes how to control the mistake and recreate it purposefully. Such was the case in my own studio when I was making some enamel color samples: simple squares that were examples of different colors of glass. When I took them out of the kiln, the enamel had begun to drip from the surface and when the pieces cooled, the drips were frozen in the air, creating a three-dimensional surface. The pieces looked as if water had frozen as it was being poured from a pitcher and splashed into a glass. I became intrigued with how to recreate this accident and pushed the boundaries of basic enameling techniques onto a path of experimental enameling. The following are the results of my experimentations.

As in the case with traditional enameling techniques, I discovered making the enamel stand dimensionally off the surface of the metal relies on surface tension, though in a different way. The surface tension only occurs within the enamel, not between the metal and the enamel. When the surface tension between the metal and the enamel breaks, it allows the enamel itself to become three dimensional, creating its own form. It seems to leap off of the surface of the flat metal. The enamel must fuse to itself in order to maintain a form after it has broken away from the metal. The enamel is self supporting. In my test experiments, the metal only serves as a base for the enamel to initially attach itself.

It begins with a flat sheet of thin copper, with a thickness between 22 and 18 gauge. Two layers of opaque enamel are sifted and then fired onto the front side of the copper in the same manner as traditional firing. After the second firing, enamel is fired on the reverse side of the metal; this is called a counter enamel. The counter enamel plays a crucial role in the formation and success of my experimental process. Counter enamel is used to prevent warping and cracking. It counter balances the enamel put on the front of the metal to ensure that the expansion and contraction rates of the metal and glass are equalized. In traditional enameling techniques, a proportional number of counter enamel layers are needed to balance the number of layers on the front of the piece. For my pieces, I used only one thin layer of counter enamel, despite the number layers on the front. I learned that the greater the disproportion of enamel layers on the front to the counter enamel layers, the more dimensional the thicker enamel becomes.

After one thin layer of counter enamel is applied to the piece, more layers of enamel are added to the front. Transparent enamel sifted over the previous opaque enamel allows for greater visual depth in the layers. After the addition of three more layers of sifted enamel to the front of the piece, the ratio of counter enamel to enamel on the front begins to become a factor. As the piece cools, the enamel on the front of the piece begins to crack, due to the uneven expansion and contraction between the metal and the enamel. The cracking is what breaks the surface tension between the metal and the enamel, allowing it to come off the metal surface when it is placed back in the kiln.

Once there are cracks in the surface of the enamel, no additional enamel is sifted onto the piece. It is placed back in the kiln, except this time the piece is inverted, so the front of the piece is facing down in the kiln. Since the surface tension between the enamel and the metal is broken due to the cracking, as the enamel heats up, gravity pulls it away from the metal. The pulling away occurs between 1480 and 1510 degrees Fahrenheit, just as the glass reaches its molten state. The surface tension between the enamel itself prevents the glass from falling and separating completely.

At a certain point, the weight of the enamel that pulls away from the metal becomes too heavy to maintain the surface tension between the enamel itself, and will fall off the metal completely.

Therefore, it is necessary to remove the piece from the kiln quickly, as the enamel is pulling away from the surface of the metal. Once the piece is out of the kiln the enamel cools fast enough to maintain the three-dimensional form caused by the breaking of the surface tension.

Occasionally, the enamel can cool too quickly and more cracking will result. To repair the additional cracks there are two options: re-fuse the enamel with the front side facing up in the kiln, or replace the piece upside down in the kiln, allowing additional enamel to break away from the metal. In both cases, the initial enamel form is altered. If the piece is placed in the kiln with the front side up, the initial enamel will likely collapse when heated to fusing temperature. If the piece is placed in the kiln upside down, then the weight of the enamel will potentially break the surface tension and it will fall off completely. In either case, the end result is only achieved through multiple attempts. The best way to avoid additional cracking is to cool the initial enamel pieces slowly.

In addition to the methods already mentioned, it is possible to gain more dimension through further manipulation of the enamel once it comes out of the kiln. When the enamel is removed from the kiln, there is approximately a ten second time-frame while the enamel is still molten enough to be manipulated with tools. The enamel can be pinched and drawn upward with tweezers or pushed and pulled across the surface. The additional manipulation gives me more control over how the enamel moves across the surface of the metal.

CONNECTING MY EXPERIMENTS TO HISTORICAL METHODS

There are some important differences between the dimension that Camille Fauré achieved in his vases and the dimension I achieved through my experiments. Some differences are in the techniques used, but primarily, they are in the final product. Fauré built up his voluminous surfaces by layering the enamel in thick coats. He was building up surface depth and creating more surface tension. In his methods, the enamel never broke away from the surface of the metal. In my experimental approach, heavy layers of enamel are important, but the breaking of the surface tension is what makes the unique dimension.

My experiments also begin to build a bridge between enameling and glass working. When artists work with glass, either through glass-blowing or through flame-working, the glass is in a molten state. The material's fragility is lessened in the molten state and it is pliable. The same properties are advantageous for making the enamel pull away from the metal. When the enamel transitions from its initial form (powder, paint, liquid, etc) to the molten glass state, it allows for the enamel to be manipulated.

Gravity also plays an important role in both the creation of glassware and the enamel pieces I make. Glassblowers spin the molten glass on a rod, allowing gravity to distribute the weight of the form evenly. I also use gravity to break the surface tension of the enamel, making it take form in the kiln. Without gravity, the enamel would simply re-fuse to the metal base. There is a distinct range of temperatures for both enameling and glass working during which the material is manipulated. In enameling, the glass fuses around 1480 and 1510 degrees Fahrenheit, while glass workers have a higher working temperature of 1600 to 1900 degrees Fahrenheit. The glassware also must be cooled incrementally and slowly over a period of time in order to prevent cracks, similar to the way I am slowly cooling my enamel pieces.

Yet another way that the experimental enameling relates to glass working is through historical accounts. Historically, enamel is a two-dimensional process used to decorate metal objects, either jewelry or otherwise. Glassware has always been three-dimensional. Not only glass blown vessels are three-dimensional, but so are flame worked beads and figurines. During my experiments, knowing about the properties of glass work helped me to better understand the behavior of the enamel.

CREATING ENERGETIC SURFACES – DESCRIBING THE WORK

I chose to take the finished enameled pieces and place them in settings to create functional, wearable jewelry. Three series developed from my research behind experimenting with raising the enamel off the surface of the metal: *Potential Energy* (plates 1-6), *Contained Energy* (plates 7-13), and *Free Radicals* (plates 14-20). The brooch format works well for these particular pieces because they are highly visible and can be worn in various positions on the body. A brooch is a traditional jewelry object and when combined with the non-traditional enameling, it creates an interesting dichotomy and adds to the energetic nature of the pieces.

I especially enjoy the way the enamel pulls away from the metal in the kiln, making the surface appear to move across metal. The enamel in the finished piece of jewelry is inverted from the way it was created in the kiln, so the enamel itself seems to defy gravity. The viewer is left pondering what caused the movement of the enamel. The motion of the enamel pieces resembles the way water moves. When the enamel is in its molten form and gravity breaks the surface tension, the enamel behaves similarly to water. It drips off of the surface, and creates waves and ripples. When the enamel hardens the drips, waves, and ripples appear to freeze and its energy is captured on the surface of the piece. Water has a lot of potential energy that is released through drips, waves, and ripples. My pieces mimic water's potential energy. This is particularly evident in *Potential Energy #5* (plate 5) and *Contained Energy #3* (plate 9).

Since enamel is glass it is fragile. The movement that the enamel creates on the surface of the metal represents a powerful energy and that energy contradicts its fragility. Another contraction that is apparent in my work is the combination of a two-dimensional surface and a three-dimensional surface. With the techniques developed from my research, both dimensions are represented in one piece. To further strengthen the visual contradictions, the surface is finished both matte and shiny. The two-dimensional surfaces are matte finished, while the three-dimensional surfaces remain shiny. I find that working with these contradictions strengthens the impact of the pieces.

Finally, the strength of the finished pieces relies heavily on the use of color. Enamel comes in many different colors, both opaque and transparent. When complimentary colors are combined they make each other stand out. For example, when green is next to red, we see the green and red more vividly than if they were alone. When a vivid color is paired with white, the white moves to the background, allowing the color to come into the foreground. I used this color combination in the *Potential Energy* series (plates 1-6) because the white enamel functions best on the two-dimensional surface of the metal and the color on the three-dimensional form heightens its sense of energy.

Another color combination that works successfully to energize the surface of my pieces is a monochromatic color scheme. Depth is created when various values of the same color are placed next to each other. The darker color recedes and the lighter color comes forward. For example, when dark blue and light blue are placed next to each other, the dark blue seems farther away than the light blue. In the series, *Contained Energy* (plates 7-13), I energized the enamel surfaces by physically inverting the values of the color. The light enamel is put on the two-dimensional surface so that physically it recedes away from the enamel that comes off the surface. The darker color is used on the enamel forms that rise above the metal surface. The unexpectedness of this combination creates visual energy in these pieces.

PROTECTING THE ENAMEL – THE SETTINGS

The silver structures of the enamel's settings not only serve an aesthetic function, but also a practical function. The structures are built so that there is a front and a back. The front is made up of silver wire that creates a cage-like rim that is slightly higher than the highest point of the enamel forms. The wire rims are attached to the base of the setting through a series of tabs that secure both the wire rims and the enamel. The backs of the brooches are silver plates excluding portions that have been removed to reveal the reverse side of the enamels.

Aesthetically, the settings, particularly the wire rims, serve to draw the viewer's eye inward toward the visual energy of the enamel. In the *Potential Energy* series (plates 1-6), both the enamels and the bases of the settings are square. The wire rims mimic and support the movement that is occurring in the enamel. The rims are open enough to draw the eye inward, acting like a funnel for the eye. The enamels and settings are round in the *Contained Energy* series (plates 7-13) and the wire rims on these pieces are aesthetically more involved with the brooch. The rims cause the eye to wander around the piece and invite the viewer to observe different parts of the enamel, almost like a microscope. In the third series, *Free Radicals* (plates 14-20), the pieces are oval and the wire rims are more minimal than in the other series. Unlike the rims in *Contained Energy*, these simply draw the eye in toward the enamels, which are visually sharper and more abrupt than the enamels in the other series.

The functional purpose of the setting and wire rims in all the brooches is to protect the enamel from impact. The three-dimensionality of the enamels leaves them exposed and fragile. The wire rims encase the enamel, preventing damage from all sides. The rims prevent the enamel from breaking when something or someone comes in contact with the front of the brooch.

Another intriguing component in all three series is the use of steel and magnets for the brooch closures. The use of magnets and steel allow the wearer to have more versatility as well as wear-ability.

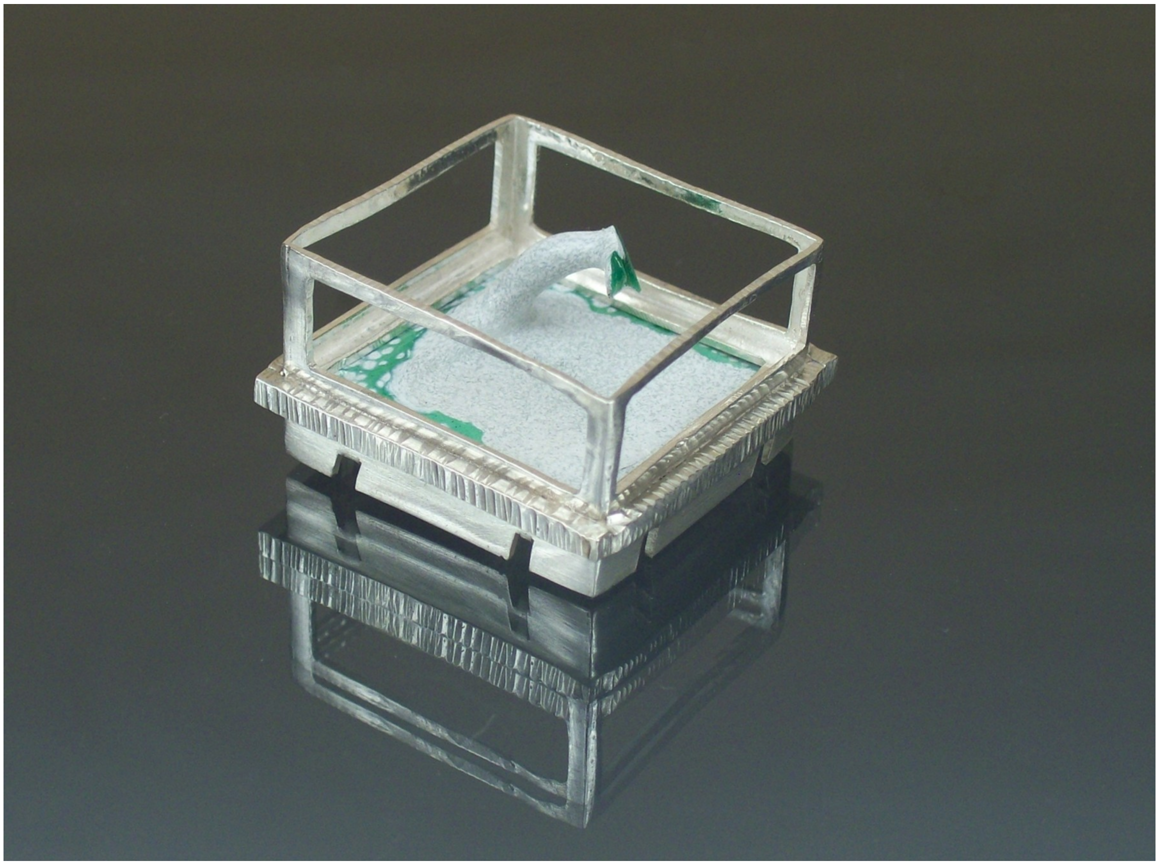
Small pieces of steel are set between the back of the enamel piece and the back of the silver setting. A magnet is then set into another piece of silver. The brooch is worn by placing the small magnet piece underneath the article of clothing and allowing the steel in the brooch to magnetize against the magnet. The magnetic closure is quite strong and holds even through thick fabrics such as wool. Another advantage to the magnetic closures is that they do not poke holes in garments like a traditional pin closure. This makes them more versatile in that it removes any apprehension about ruining a garment by putting holes through it. The use of magnets is appropriate for the brooches I created because they are untraditional closures and are particularly well suited to support the weight of the enamel pieces.

CONCLUSION

My research is exciting because of its potential to add new insights and possibilities to the traditional enameling field. It also provides a viable link between enameling and glass work. Bringing glass work and enameling together to create art that captures both techniques would potentially allow for an increase in scale. The tallest enamel form I have achieved thus far is two and a half inches above the metal surface and is seen in *Contained Energy #3 (*plate 9). This piece has the most impact of all the *Contained Energy* series because it the most dramatic. Additional color combinations and studies would also lead to more exciting surfaces. *Free Radical #1* (plate 14) has the biggest color impact in that series because it seems to closely resemble water. In the *Potential Energy* series, the piece with the most visual impact is *Potential Energy #3* (plate 3) because of the way the setting relates to the enamel. The visual action that takes place in the enamel is round and the wire rim mimics this action. The combination of the square piece to the roundness of the wire rim and enamel create a strong composition.

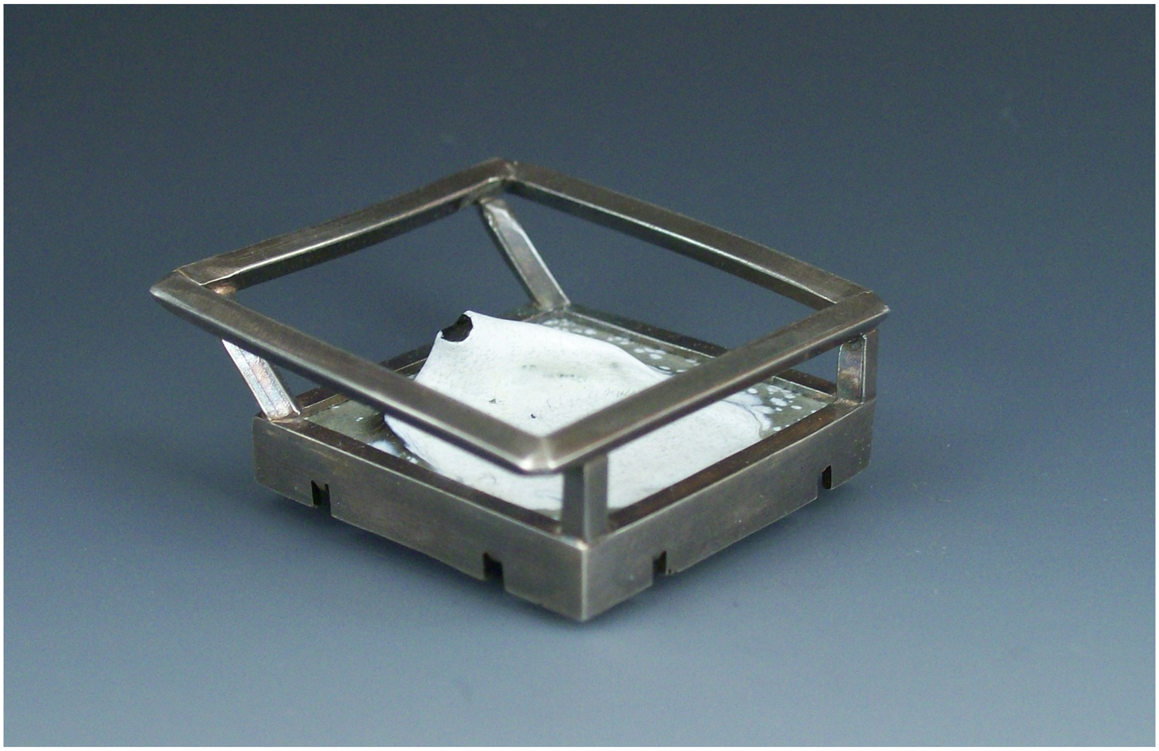
I am continually amazed that what seemed to be a mistake while making color samples, sent me down the path of experimental enameling. The techniques I developed during this research provided me with a basis for future work and I am excited about the possibilities that lay before me. I am going to continue to explore new developments in the enameling field and hope to expand the idea of surface energy using enamels. The innovation of my experimental enameling joins a long-standing tradition of applying glass to metal, a media that encourages creativity and exploration.

PLATE 1



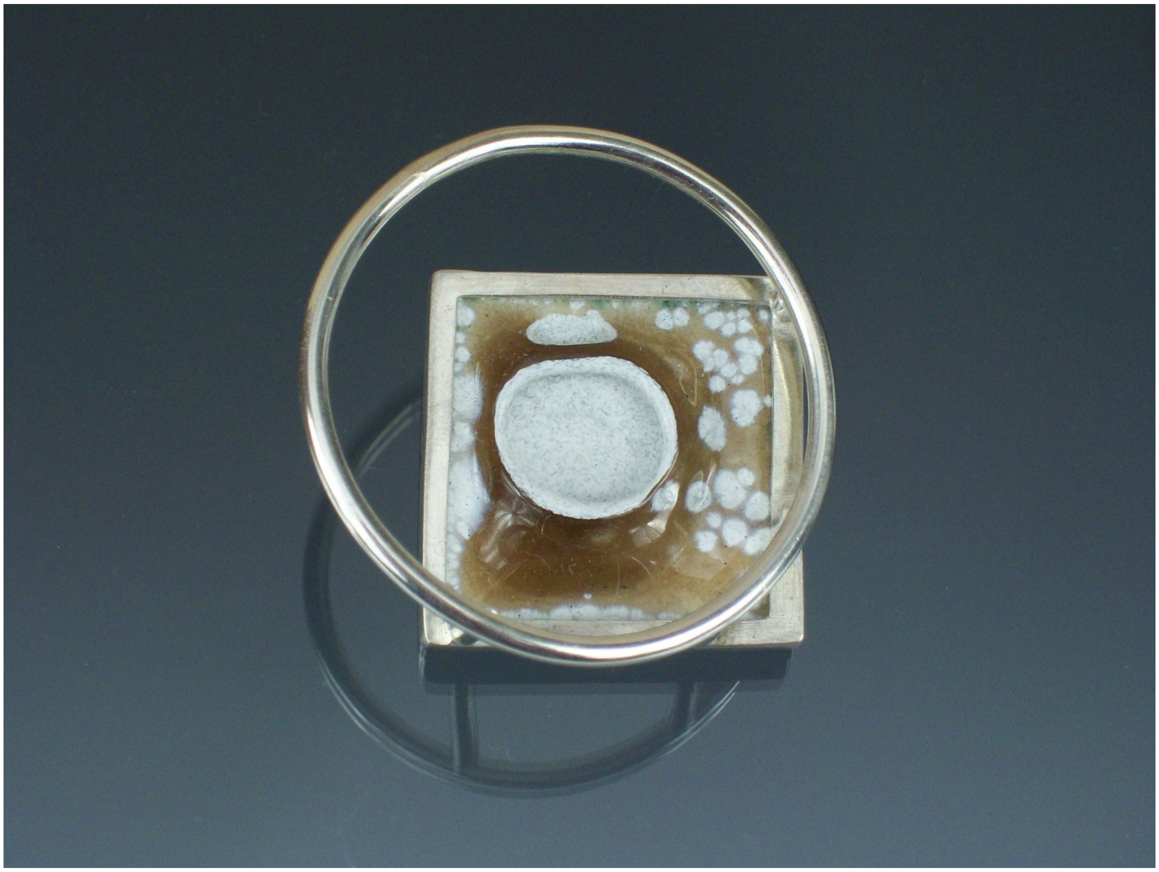
Potential Energy #1
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 2



Potential Energy #2
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 3

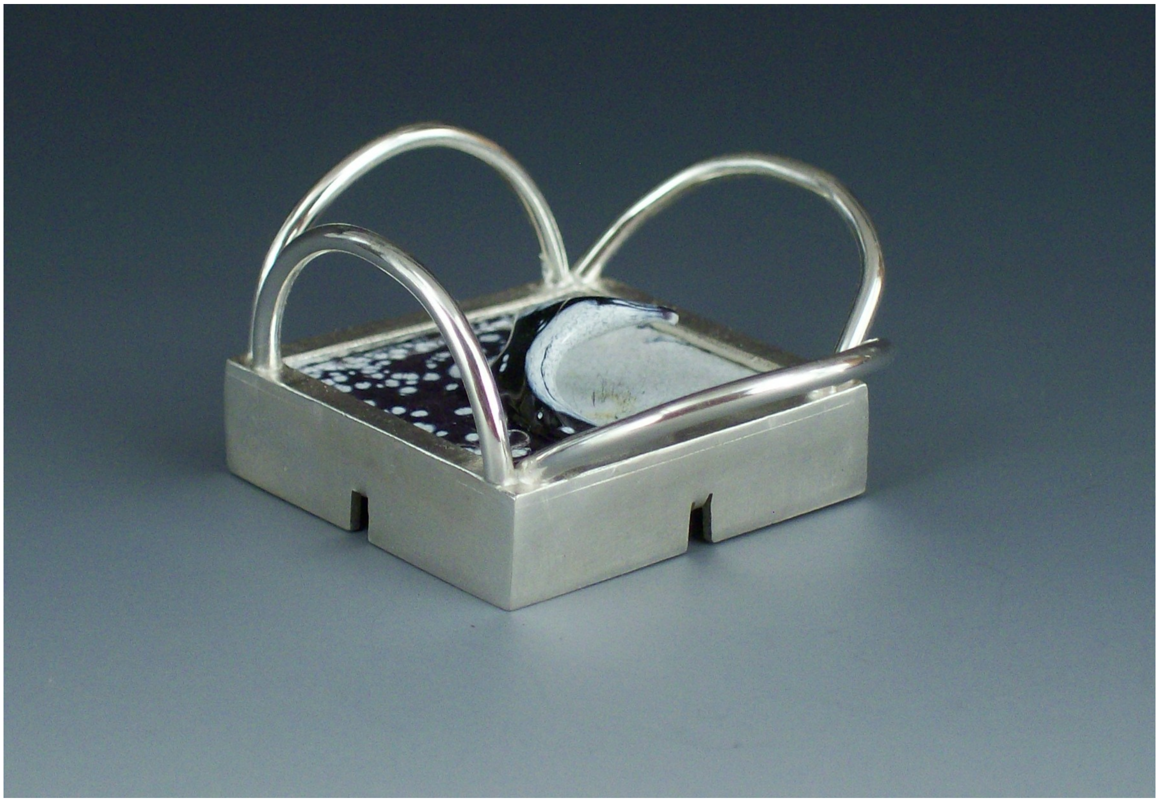


Potential Energy #3
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 4

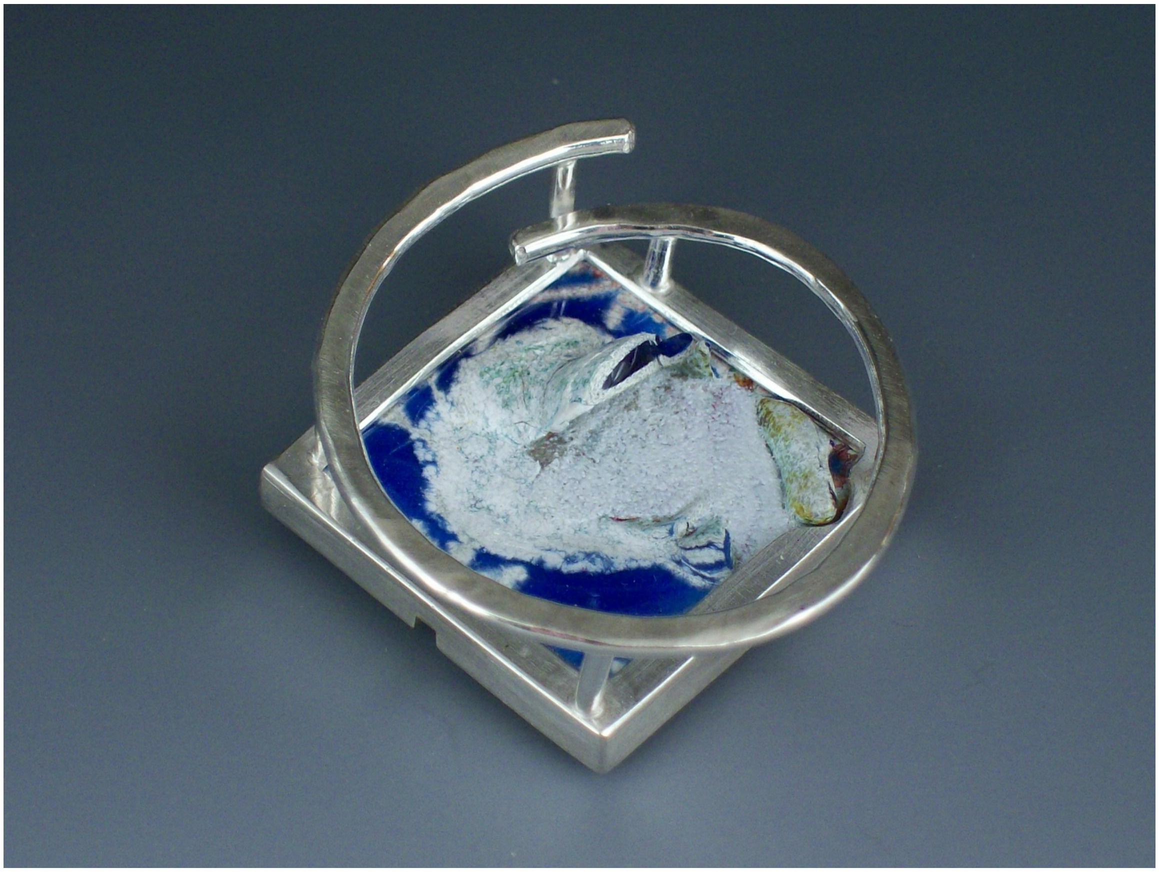
Potential Energy #4
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 5



Potential Energy #5
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 6



Potential Energy #6
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 7

Contained Energy #1
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

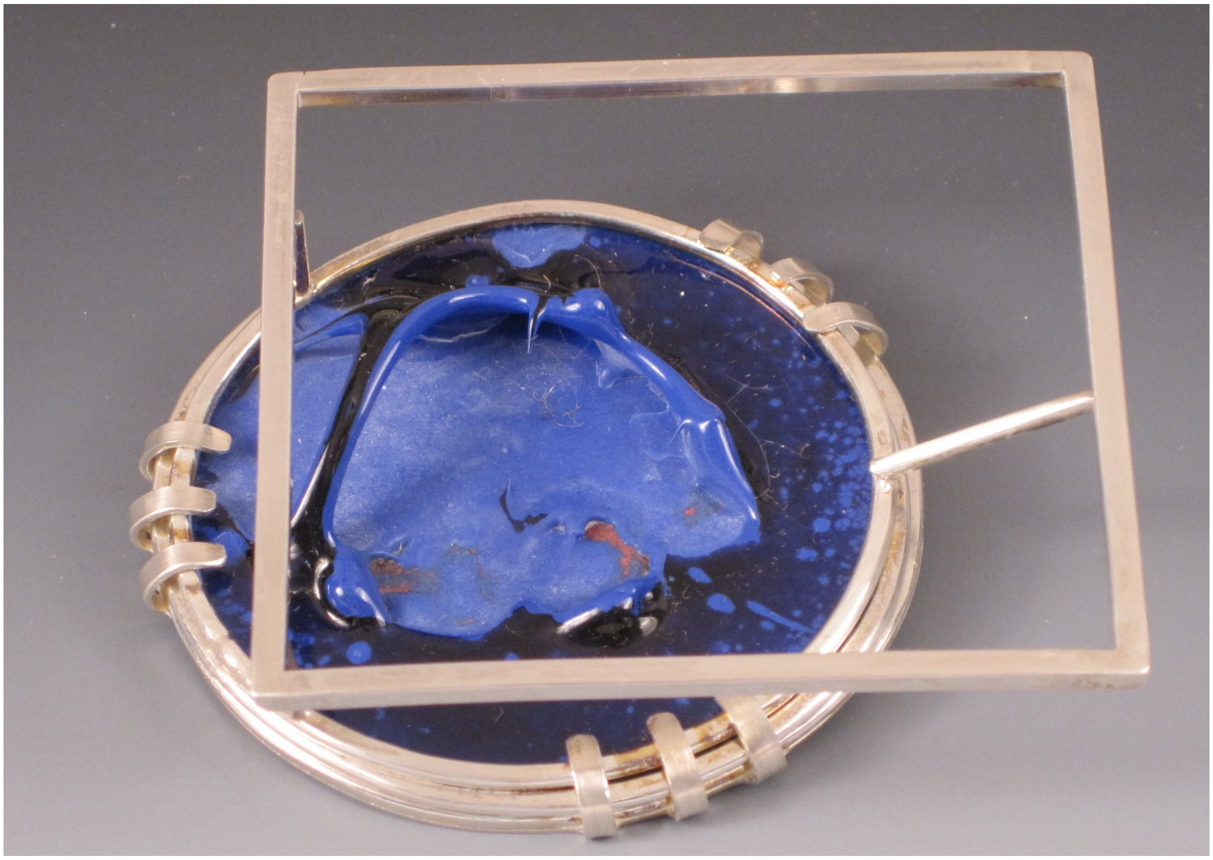
PLATE 8

Contained Energy #2
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 9

Contained Energy #3
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 10

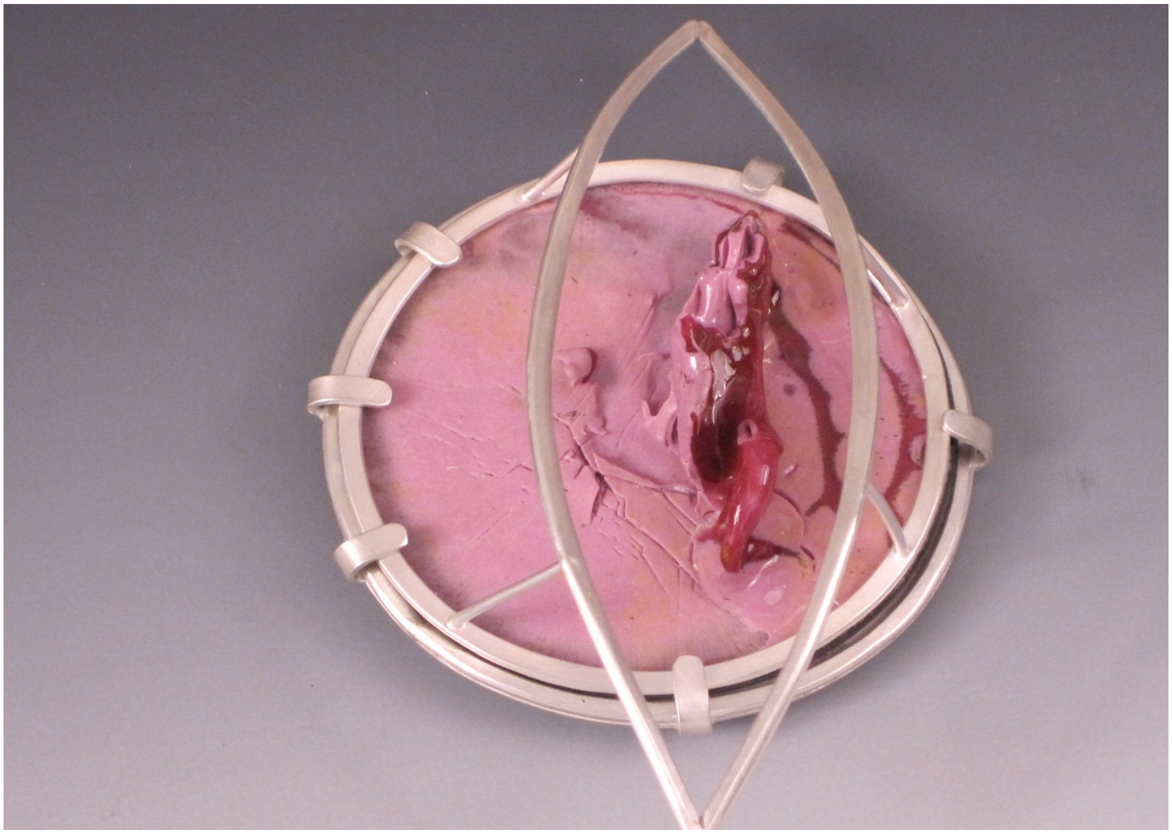


Contained Energy #4
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 11

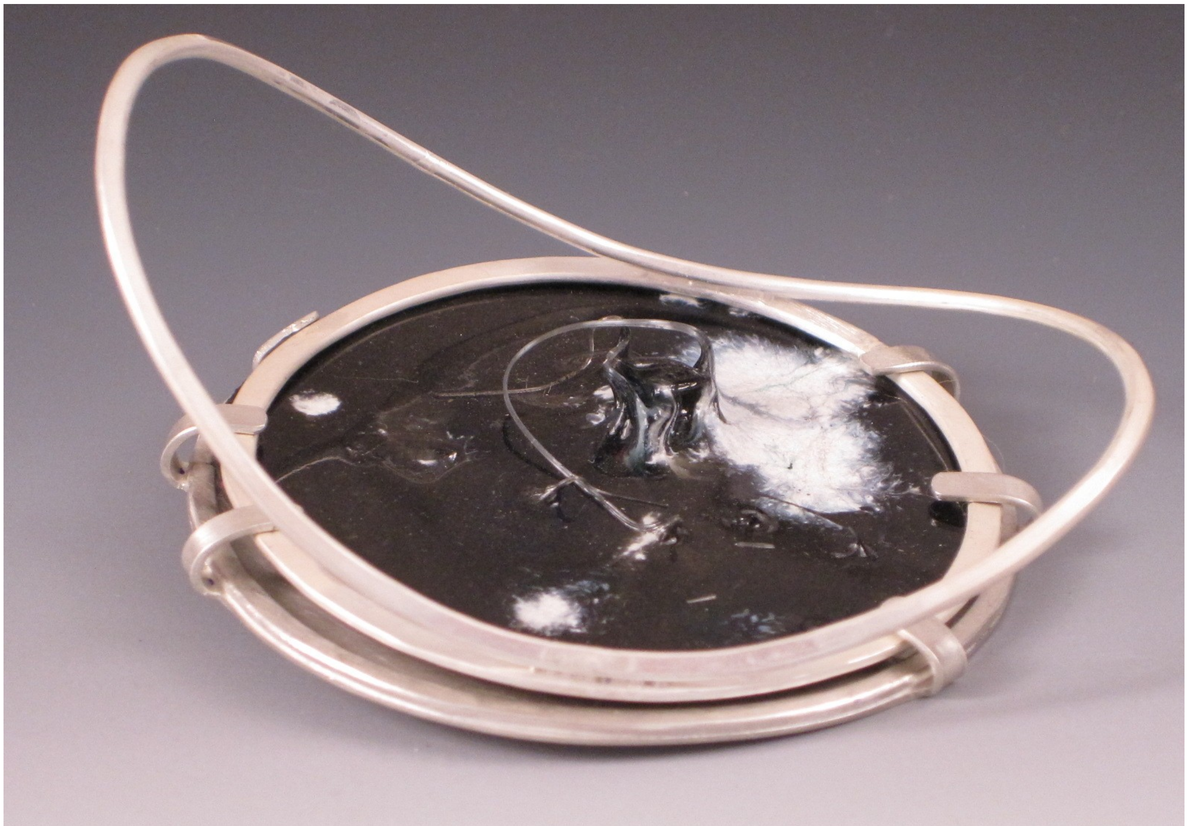
Contained Energy #5
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 12



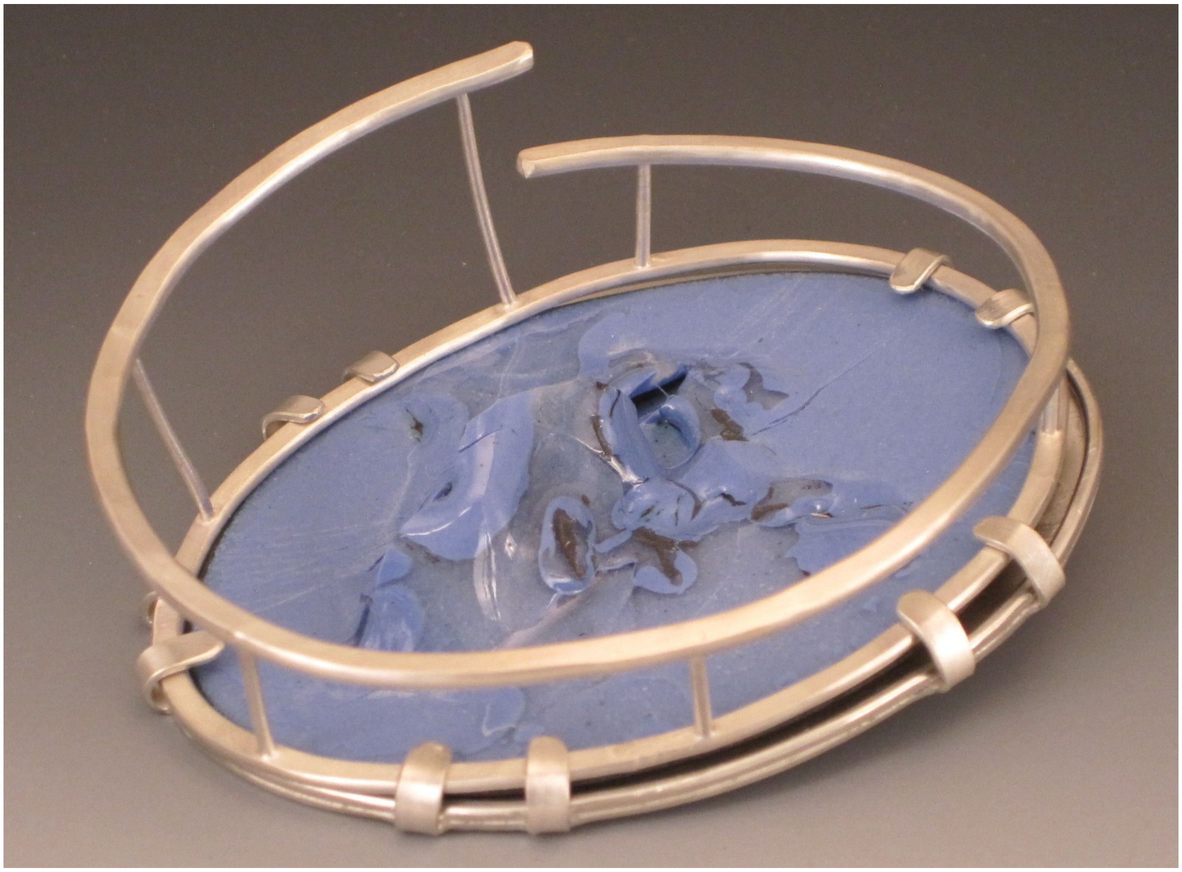
Contained Energy #6
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 13



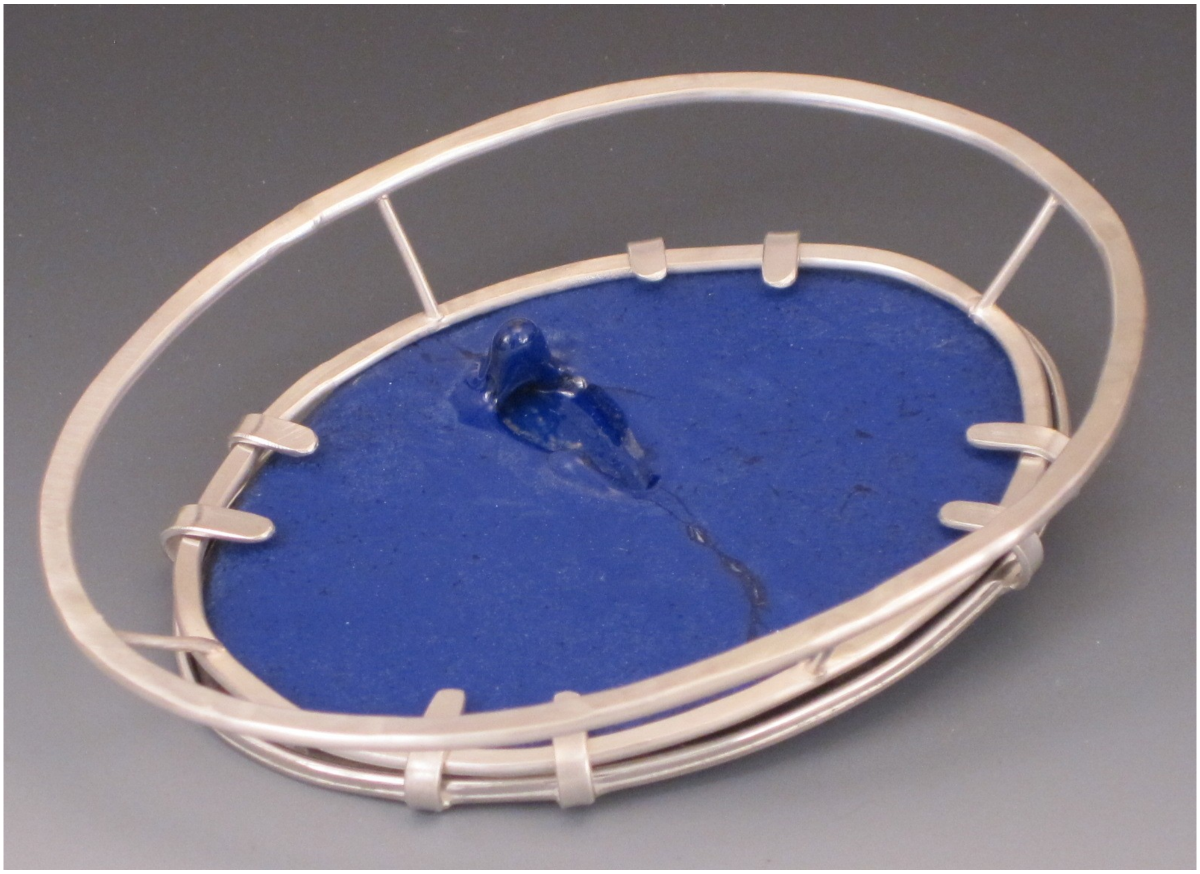
Contained Energy #7
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 14



Free Radical #1
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 15

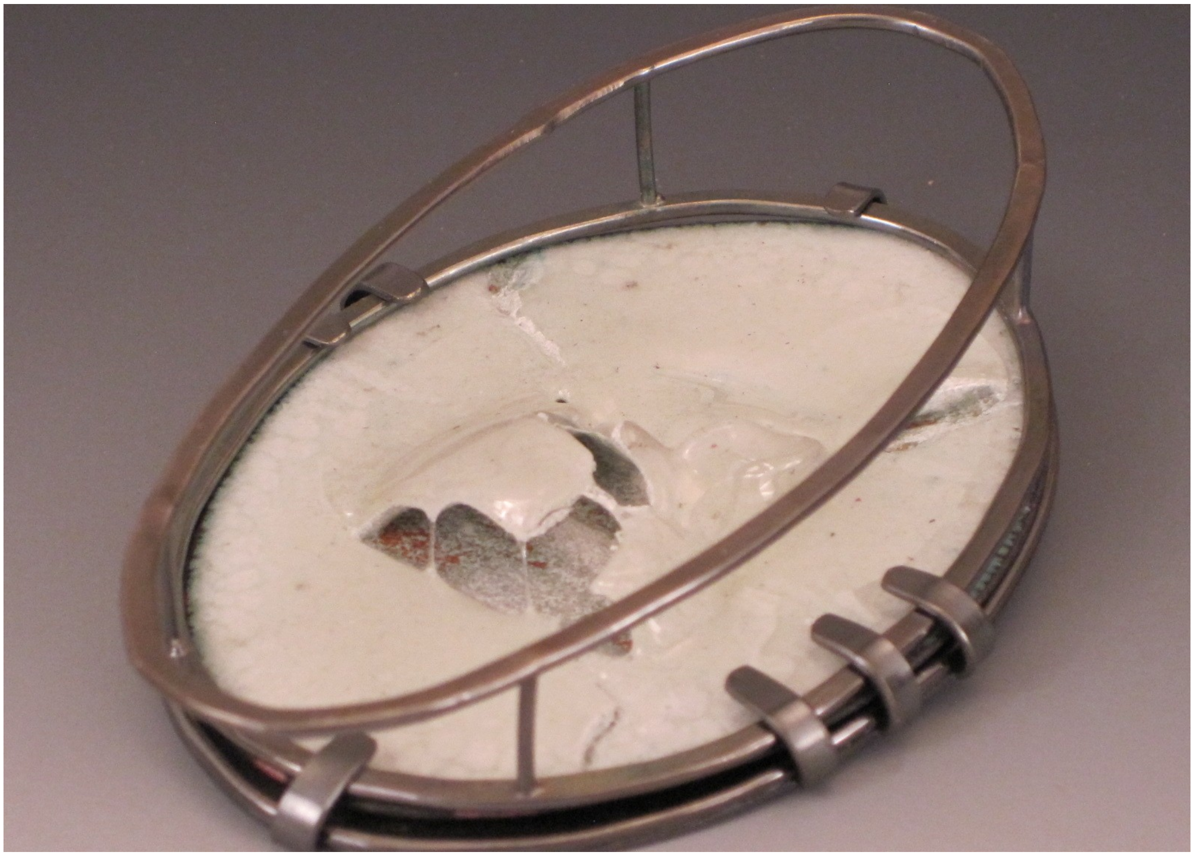


Free Radical #2
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 16

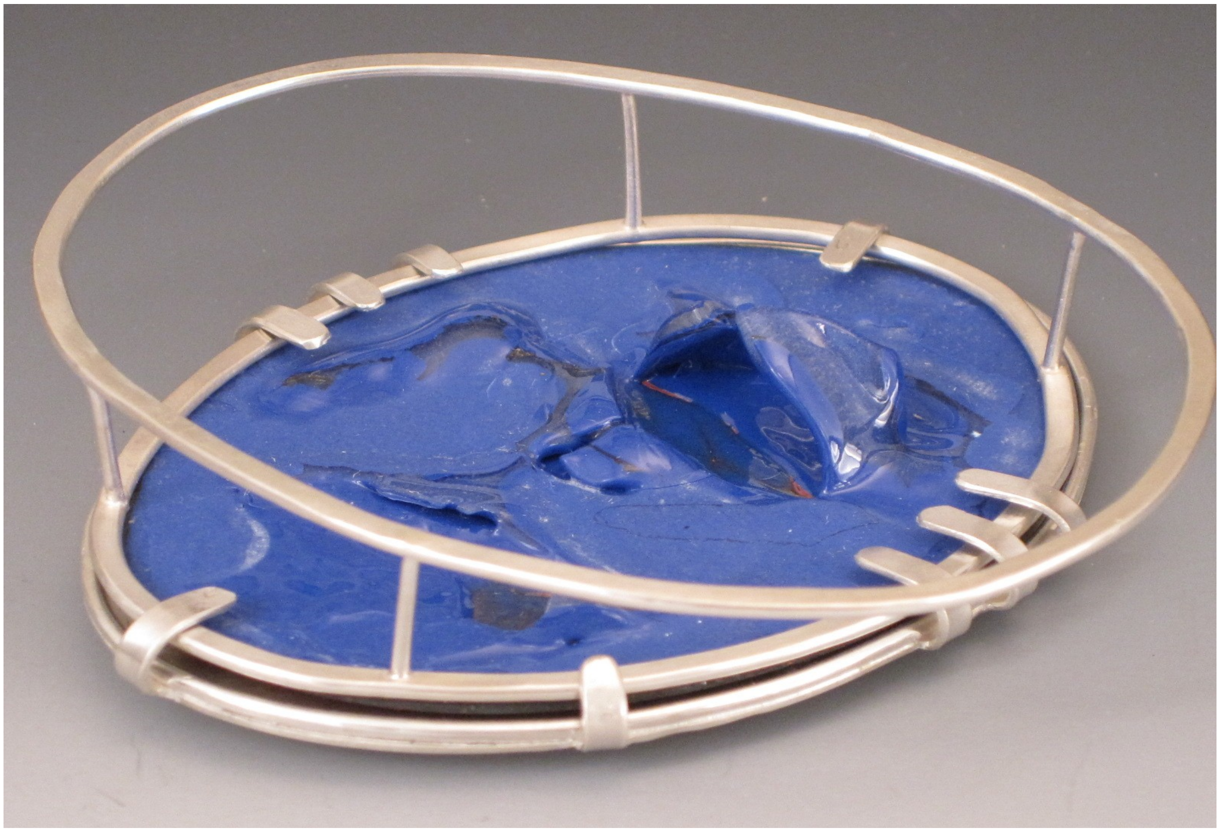
Free Radical #3
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 17



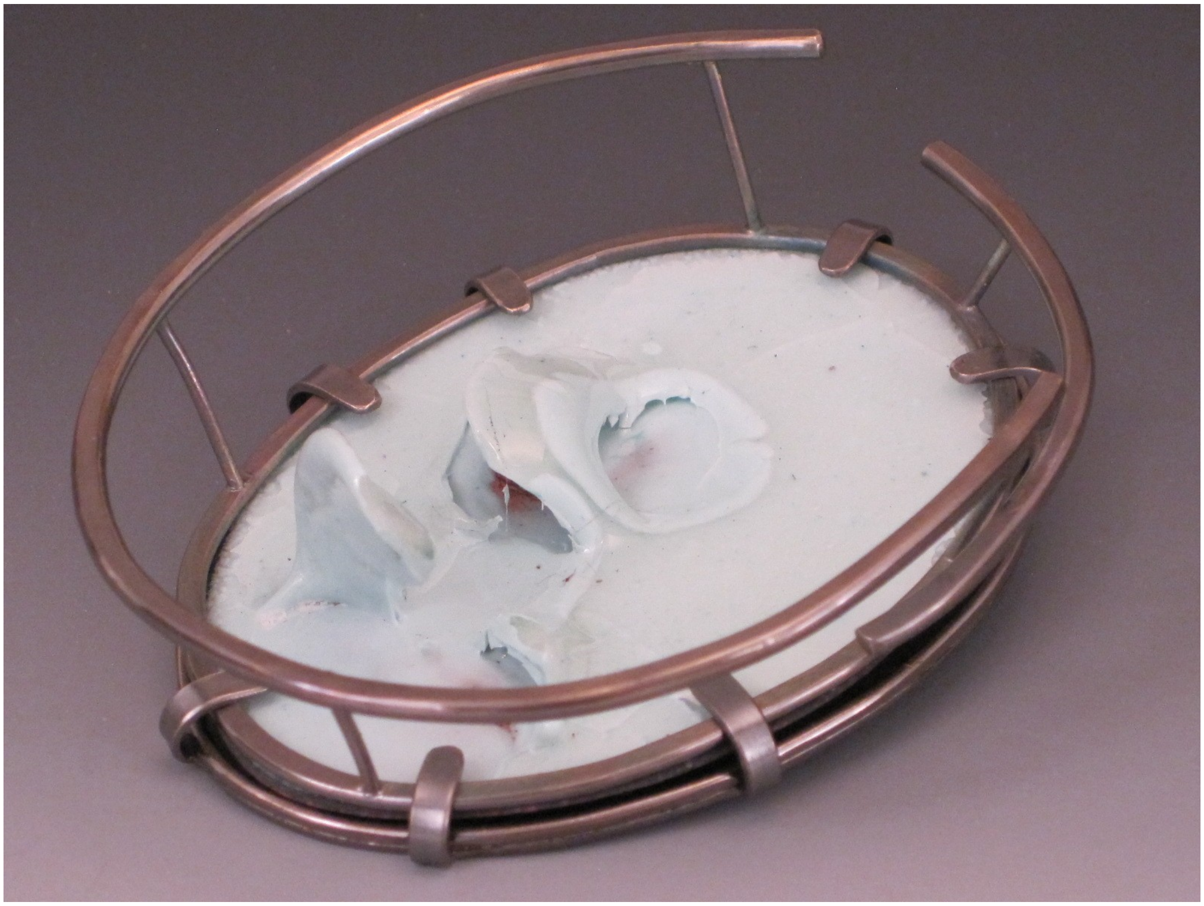
Free Radical #4
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 18



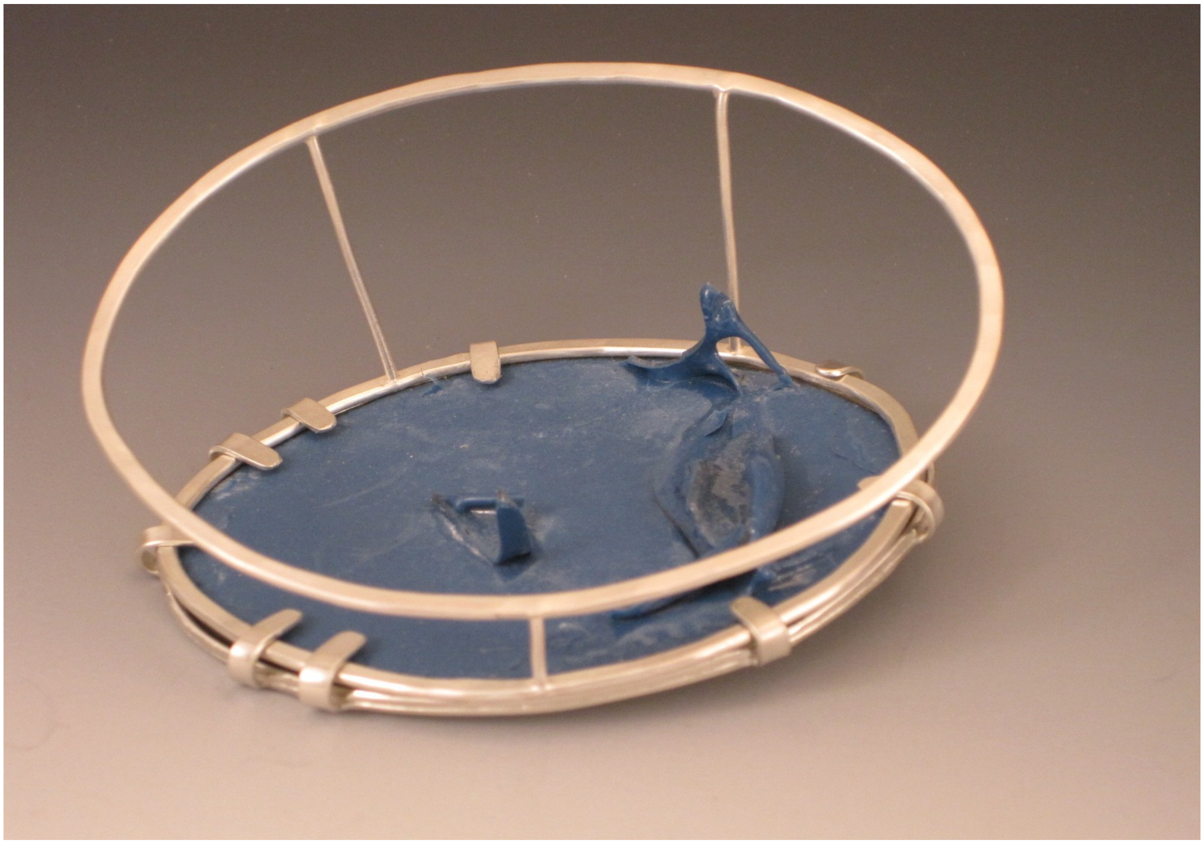
Free Radical #5
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 19



Free Radical #6
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

PLATE 20



Free Radical #7
Enamel, Sterling Silver, Copper, Rare Earth Magnet, Steel

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