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Seaforms

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SEAFORMS

By

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I. Introduction

Through this thesis I will illustrate and explain my deep interest in the creatures of the sea.

The appearance, natural functions, and physical characteristics of each creature focused upon are eminently suited to being transferred into metal, both as jewelry and hollowware. Each seaform is a specialized organism, adapted over millions of years to preserve itself as an individual or species in the harsh undersea enviroment.

Evolving in such an environment has provided each creature with a uniquely specialized armature suited to protecting its soft vulnerable body. These protective characteristics make sea forms the perfect containers for precious stones and keepsakes as well as for delicate living creatures.

My interest in seaforms developed at an early age with my first trip to the beach. As all children do, my brother and I collected sea shells. Most of the shells we found were broken or worn away as the result of erosion by water, which made finding a whole shell very special. Once, I found a perfect clam shell with both halves still attached. It wasn't very pretty, but it still had a natural cartilage hinge. The clam was my first sea form box, and I was fascinated by it.

My next trip to the beach was in Florida, and the shells there were brighter and more luminous. There were fewer whole shells, so I collected the brightest colored fragments, most interesting shapes and unusual textures. I didn't discover my favorite shell until a few years later on the

shore of Nova Scotia. The beach there was mostly rocks, with very few shells, but sea urchins were everywhere.

Sea urchins live close to the shore, so it was possible to watch them through the water but I was afraid to touch their spiney shells. Dead urchins lose their spines, leaving a beautiful pebbly green surface similar to granulation on jewelry, so I collected their shells.

Most of the sea urchins were only fragments, but I did manage to find a few nearly whole skeletons. The shape of the shell is squat and roundish, like a partially deflated ball. The sea urchin has a very simple elegant flowing form. In my view it is a very peaceful form, radiating the same relaxing emotional impression as a meditating Buddha.

My interest in these forms developed during childhood through observing nature and science. I loved watching Jacques Cousteau or any TV show that involved underwater photography, such as Flipper and Salty. My father kept freshwater fish, and took us with him to the fish stores, where I spent many hours staring through the glass. Twice we went to the giant Boston Aquarium where I was able to meet the larger and more exotic sea creatures in person.

The languid movement of life underwater inspired feelings of peace and relaxation, while the bright colors and textural richness of the sea life stood out against the diffused background to stimulate the imagination. I depend more on these areas of influence, as well as casual reading about the fascinating characteristics of coral polyps, diatoms, and various other creatures than on any previous artworks for my ideas and inspiration.

My first attempt to consciously use seaforms in my work was during my sophomore year in college. I had just come back from vacation in Florida with some new shells. One was a twisted piece of driftwood encrusted with barnacles. My idea was to fabricate silver barnacles with

stone settings and set them in the wood alongside the real barnacles, to call attention to the similarities between bezel settings and actual barnacles. I was never able to execute this idea, but it stayed in my mind.

Around that time I also began to produce more organic forms, developing shell shapes and textures by fabrication in metal. As I learned raising and chasing, I incorporated these techniques into developing shell shapes.

Unfortunately, my abilities to develop in this direction were limited by my fear of casting. I was forced to stay within the limitations of what was practical to fabricate. This may have been what led me back to the sea urchin form that I had discovered as a child. The form was elegant in shape and easy to fabricate, and it could have many different textural elements hammered on or added to it. I developed many of these forms in my senior year in college, exploring the limits of what could be done by the fabrication alone.

By the time I began working on my Masters Degree, I was able to overcome my fear of casting and began to explore some familiar seaforms through carving and molding wax. Using wax and the lost wax technique of casting I was able to develop more organic, flowing shapes and a variety of new textures. I spent a year experimenting with these seaforms before deciding to concentrate on this area as my thesis.

As I started actively looking for new ideas in this area through books and photographs, I found that the shapes and textures I had been using were common to many species of sea life. The forms I had developed were the result of a continuous growth of ideas representing a great variety of sea life. Seeing these similarities I began to look for characteristics that all seaforms had in common. I decided to ignore fish and most sea shells, and concentrate on the more unusual seaforms.

One outstanding characteristic that all my favorite seaforms held in common was the strong feeling that they had all evolved to be natural containers, protectors, or nurturers. These characteristics became my unifying theme - developing seaforms into objects: boxes that are containers and protectors for precious items; and jewelry which enhances and protects precious stones.

II. Sea Anemones

Sea anemones (ill. 1), one of the sea's most beautiful and flamboyant plant-like animals, were the first seaform developed within this theme.

> The sea anemone is simply a large polyp, similar to the smaller polyps that make up coral reefs. Each polyp consists of a stout, muscular stalk, from 1 to several centimeters long. At the foot end of the stalk is the disk by which the anemone attaches itself firmly to the rock. At the mouth end, where the stalk flares slightly, like the bell of a trumpet, are situated the numerous hollow tentacles that cause the sea anemone to resemble the flower whose name it bears. Most sea anemones are only 1 to 3 centimeters in diameter at the mouth end, although the warm, sun-drenched waters of the Great Barrier Reef of Austrialia nurture anemones measuring as much as 1 meter in diameter at the mouth end.
>
> The brilliant white, green, blue, orange, red, and varied combinations of these colors that suffuse the body of the anemone, especially its tentacles, make it appear even more like a vivid blossom. But these colorful tentacles form no delicate flower; instead they are part of an efficient, often deadly feeding apparatus.
>
> At low tide the sea anemone is unable to feed and so draws its tentacles down into the stalk and shrinks into a rubbery mass. At high tide, when it stretches its body, unfurls its tentacles, and moves them sinuously about its mouth, the anemone resembles the mythological Gorgon, Medusa. Now the tentacles, armed with paralyzing darts - nematocysts become a snare to trap unwary fishes and small invertebrates. Should a small fish blunder into the anemone, it is quickly stunned by the nematocysts. Numb and helpless, it is then borne by the anemone's tentacles into the gastrovascular cavity and digested (3, 62-67)

To transform these deadly animals into benign metalforms was a simple task. The beauty of the anemone lies in how its sinuous tentacles form a visually protective field around its mouth. In a piece of jewelry, the tentacles can be manipulated to produce this protective ring around a precious stone. The interweaving of many tentacles produces a pleasing texture as it surrounds a stone. This spacing forms a protective barrier to objects which might scratch, crack, or catch on and loosen the setting. The negative areas between the frame of tentacles allows exposure to light which enhances the stone.

To make the two pairs of earrings in this set, the lost wax casting technique was used. In this technique a wax model is built, encased in a type of plaster called investment, and heated to melt out the wax. Molten metal is injected into the cavity formed by the lost wax. This process is a one-time-only process and the plaster molds cannot be reused.

For Anemone Earrings I (ill .2), in 18k gold with tanzanites, each wax was fabricated by hand. Short pieces of blue wax wires were carved to a taper with a scalpel, and heat polished with the tip of a soldering pen. Each piece was then curved and welded onto a sheet wax base. After casting, the prongs for the stone settings were applied by filing gold wires to a taper, inserting them through holes drilled in the face of the anemone, and soldering. Earposts were also soldered on at this time. The earrings were then shotblasted to produce a satiny texture. They were heat treated to raise a layer of fine gold to the surface, and tumble polished for many hours to highlight the tip of each tentacle.

After the earrings were polished, notches were burred into the prongs to seat the stones. The actual setting proved difficult as the tentacles had been arranged to protect the stones so well that it was difficult to get access to them with the setting tools. The settings were made to blend in with the tentacles, so that the final effect is that of a brilliant stone floating among a protective mass of golden tentacles, rather than one of a stone being firmly anchored down.

Anemone Earrings II (ill. 3), in 18k gold with pink sapphires, were produced using a slightly different technique. The first pair had become so popular that finding a way to mass produce them became necessary.

Rubbermolding objects with so many convolutions and undercuts is virtually impossible, so the anemone form had to be modified. A new model was built from wax; a base with one row of tentacles sticking straight

out. From this model a two piece rubber mold was produced which could be used over and over to generate many identical waxes. Each wax must then be heated in hot water to soften it so that its tentacles can be curved in the appropriate directions. At this point, a second and even third layer of wax tentacles may be welded on to the model with a soldering pen, cutting production time in half. Prong settings could also be added on in wax, eliminating the need to later fabricate and solder them on.

The effect of these earrings is much the same as the first pair, with the exception of the lighter, more delicate look that was produced by using fewer tentacles.

Anemones can also communicate a protective feeling in the form of a box. As a box, the tentacles may spread out in all directions, protecting the body of the anemone as well as its face. This extension shows a sinuous quality of movement, and produces a psychological barrier as well as a physical one. The anemone appears to be reaching out to create space around itself - warding off threats and attackers with its poisoned nematocyst tipped tentacles.

In Anemone Box I: Life Cycle; High Tide (ill. 4) the body of the box was fabricated first, so that a wax model of the lid could later be fitted to it. The box was constructed from a rectangular shaped sheet of 20 gauge sterling silver. It was soldered into a rough tube shape and planished round. Using a wide faced raising hammer over a specially shaped wooden stake, the metal in the center of the tube was compressed and both ends flared out. After the raising process was completed the piece was annealed and filled with pitch, a hard tar-like substance. This procedure enables the sides of the box to be chased without caving them in. Flutes were hammered into the sides and a lineal texture was applied over the entire surface with a sharp edged tool.

Next, a rim was soldered to the top edge of the box to support the lid. To accomplish this step a square piece of sheet silver was cut slightly larger than the uneven top edge. In the center of this, a hole was cut, slightly smaller than the size of the final opening in the box. This piece of metal was tack soldered onto the highpoints of the top edge of the box. Next, the rim was lightly tapped down with a hammer to meet the top edge of the box, and soldered again. This process was repeated one more time in order to get a perfect fit. The opening in the center of the rim was filed to the exact size and shape needed and a silver band was soldered inside of it to create a feeling of volume and thickness. Afterwards a flat bottom was soldered on and every seam filed flush, sanded, and polished.

The lid of the box was formed in much the same way as the anemone earrings; built of wax and cast in sterling silver. Important differences occurred because of the large size of the wax. Its tentacles were much larger and were built from sticky red sprue wax rather than the firmer blue wire wax. Using this softer wax allowed the tentacles to be tapered by rolling one side of them as one would roll out a clay worm. However, because the wax was soft and sticky, it was impossible to achieve as fine a finish as on the earrings. This finish worked well, producing a natural texture of anemone skin. The anemone's face was also much larger than on the earrings, so waves of texture were applied to its surface with a soldering pen. This texture is similar to the color-texture on real anemones.

The finished effect of the box is that of the aggressive, feeding anemone at high tide, with trunk and tentacles fully extended. This box creates an impression of inviolable space around itself, and also a feeling of defended space inside the reach of its tentacles.

Anemone Box II: Life Cycle; Low Tide (ill. 5) repeats the feeling of a defended space. It shows the anemone contracted into a ball, with all it's

tentacles drawn inside. During low tide when the anemone cannot feed, it draws its tentacles in to protect itself (ill. 6). The box illustrates the defensive qualities of anemones that exist at this extreme of the daily life cycle. By using this characteristic in a box, the feeling of protection is transferred from that of an anemone protecting itself, to that of a box protecting its contents.

The box was constructed of fabricated sterling silver and cast 14k gold. The tentacles were cast in gold both to contrast with the silver of the body of the box, and to draw a comparison to the anemone earrings. A wax was produced from the rubber mold made for the second pair of anemone earrings. The mold was able to quickly produce a wax anemone which was shaped to have all its tentacles curled in towards the center. Next, the body of the anemone was fabricated from sterling sheet. A tube was formed in the same manner as the first box, but the edges were compressed over a dapping tool, rather than flared out. This raising produced an ovoid form based on the sea urchin shell. After forming, a planished texture was applied to the box. The top opening of the box was filed smooth, a ring of sheet metal was fitted into the hole and soldered on. The rim was soldered with its edge raised above the level of the box and a faceted texture was hammered into it. An inner ring made from a length of thick square wire was soldered inside of the first ring, providing a base for the lid to rest on. Following this procedure the bottom was fitted to the box and soldered in place.

To form the lid, a ring of square wire was fit loosely into the opening in the top of the box. The ring was then soldered to a flat sheet and the edges trimmed flush, leaving a disk with a raised edge. The gold tentacles were placed in the center of the disk and soldered into place. A dapped silver dome with a hole cut into its' center was carefully fitted to the rim of the disk. The hole in the dome was filed until the gold tentacles were exposed to the appropriate point. A faceted texture, matching the one on the box's rim,

was applied to the edge of the hole in the dome. At this point the dome was fastened to the disk and tentacles with binding wire, soldered down, and filed clean.

The lid was fitted into the rim, and spots were marked for the placement of the hinge. The marked area on the faceted rim around the opening of the box was filed out, and a small piece of silver tubing soldered into place. Two notches were filed into the tubing, at two fifths and four fifths down its length, creating three positive and two negative sections of equal length. Two small sections of tubing were cut to fit in the filed spaces.

To prepare the second half of the hinge for soldering, the three positive sections of tubing and the area around them were coated with White-Out Liquid Paper to prevent solder from flowing onto them. The two small pieces of tubing were slipped into place and an old drill bit pushed through all five sections to hold them in place. The lid was fitted into place, and small globs of flux and chips of solder were carefully placed between the two loose sections of tubing and the lid. Heating carefully to avoid accidentally fusing the hinge shut, the two sections of tubing were soldered onto the lid. After soldering, the drill bit was slipped out and the piece was pickled.

A friction catch was soldered to the inside of the box's lid and a pull tab added onto the outside. The tab was fabricated out of gold wire and shaped to match the tentacles, but curled out rather than in, so that it can be gripped to open the box. Next, the box was cleaned up and a satin finish applied. A gold hinge pin was inserted and riveted into place.

Differing greatly from the first two boxes, Anemone Box III: Pink-tipped Anemone (ill. 7) is a representation of another species of anemone: the pink-tipped anemone (ill. 8). Although the species is called pink-tipped it's tips may actually come in a wide range of colors. (4, 377)

This box illustrates the poisonous quality of sea anemones. Each tentacle in the box is tipped with either an amethyst or a diamond. The cold bright quality of these stones, as well as their bulbish tips and more angular tentacle stalks, project a repelling quality. These stalks have a more individual quality to them than the tentacles of the other boxes. Each tentacles' stance shows that it is protecting itself, as well as the entire entity. The shape of the body of the box is less inviting; its bulbish quality has less elegance than the finer, more tapered look of the other boxes. Its shape gives the piece a strong, bullish, indelicate appearance.

The body of this box was formed in the same manner as the other boxes, constructed from sheet silver and raised. The opening for the lid was completed by thickening the metal rim with a hammer, and then the bottom of the box was added on.

Pink sheet wax was molded to fit over the top surface of the box, forming a base for the lid. A rim of half-round blue wax wire was shaped, textured and welded onto this base. Tentacles were then individually carved from red sprue wax and welded to the base. Each tentacle stalk was tapered in the middle and a thickened bulb built up on the end.

After casting, an inner rim of sheet silver was sized to fit snugly into the opening of the box, soldered onto the bottom side of the lid, thus completing the friction fit lid. The lid was shot blasted to clean up inaccessible spaces between the tentacles and tumble polished.

Holes were drilled into the center point of each tentacle tip approximately three fourths the size of the stone that would be set. Each tip was burred out to the exact stone size, and the edges filed down. The stones, amethysts and diamonds, were placed in the settings and the edges pushed over with a burnisher. All the tips were cleaned up and polished with a buff.

The designs of the first four pieces of this series successfully form a set which illustrate some of the interesting qualities of sea anemones.

Each pair of earrings show the delicate sinuous beauty of the anemone and the protective qualities of its tentacles. They also hint at the infinite variety of color and appearance possible throughout the species.

Boxes I and II are able to illustrate a more anatomical direction, showing the two extremes possible in a single anemone during the daily tidal cycle. The changes an anemone can go through may be used to project a wide variety of emotional statements: the aggressive protection of the fully active anemone at high tide; or the more nurturing protective role of the contracted anemone of low tide.

The last piece of the series, Anemone Box III: Pink-tipped Anemone does not fit in with the rest of the series, but successfully highlights the agrressive/defensive abilities of the sea anemone's poisonous nematocyst stingers. This more deadly version stands out in contrast by focusing attention on each individual tentacle, rather than on the cumulative effect of the tenticular mass.

III. Reef Coral

Another series of seaforms were based on a distant relation of the sea anemone: the reef coral (ill. 9 & 10). Despite the relationship, the appearances of the two types of polyps are quite different to the naked eye. A coral reef is not one individual creature, but a colony of many tiny polyps, built up on the skeletons of previous generations. (3, 106)

An actual coral polyp is almost too small to see. Its beauty lies in the cumulative effect of texture built up by the skeletons of many individuals. There are over 6,000 species of coral throughout the world and each one is different. (3, 200) The type of coral depicted here is an amalgamation of several reef corals, which grow in shallow tropical seas. (3, 106)

A coral colony's complicated life cycle makes it a natural container, protector, and nurturer throughout the changing aspects of its existence. Each individual coral polyp becomes a container as it builds itself a protective structure of calcium and minerals. It is a nurturer in its symbiosis with the zooxanthellae:

> In the tissue of each coral polyp there are microscopic green plants called zooxanthellae. The relationship between the plant and the polyp is an example of symbiosis - a living arrangement advantageous to both organisms. The polyp provides the plant with a place to live. The plant provides the polyp with food. (3, 110)

The zooxanthellae also provides the polyp with oxygen to breath. (3, 107)

As a coral colony grows into a large mass, the size of its body helps it protect itself as a species. A coral colony's protective qualities are extended

to anything around it. Sunken ships, for example, may be protected by becoming totally encased within a coral colony. (3, 106)

If a colony reaches reef size it may come to nurture an entire undersea environment as a habitat for other ocean creatures. A barrier reef or fringe reef may come to protect an entire island or coastline from the ravages of the ocean (ill. 11).

As jewelry, coral's protective qualities can be utilized in the setting of stones. In the two coral jewelry pieces, the stones are set within a framework of coral texture. In a stone setting of this type, two of the properties of coral are combined and altered to produce a protective visual effect. The stone may be looked at as though it were something that the coral has begun to grow over and entrapped, or it may be seen as an enlarged detail section of the coral mass. The stone then becomes a representation of the actual coral polyp, living inside its gold setting as the creature lives within its calcium shell.

To achieve the natural feeling of coral, all the pieces in the series - the ring, bracelet and box - were cast using the lost wax technique. The basic form of each piece was first carved from file-a-wax, and the stone settings roughed out. Coral texture is then applied by drilling a variety of small sized, closely spaced holes through the wax model. After the holes are drilled, a hot soldering pen is used to stipple the surface of the model, creating tiny craters among the holes. The final effect of this texture closely resembles the built-up mass of a coral colony.

The Coral Ring (ill. 12), in 18k gold with green tourmaline, was carved and cast first. After casting and polishing, the last step to be completed was the stone setting. The setting was burred to an exact fit, the stone glued in place so that it wouldn't move, and the edges of the setting tapped over with a brass tool. The glue was removed and the setting

tightened. As the setting tool had flattened out the raised texture surrounding the stone, the texture was re-applied with a chasing/stippling tool and hammer. Fortunately, the slight difference of texture in this area only helped to emphasize and frame the stone.

Setting the blue-flash moonstones in the Coral Bracelet (ill. 14) was handled in a different manner. Large holes were burred into the surface of the bracelet and commercial bezel settings fitted into them. These were soldered inplace and the bracelet repolished. The bezels were trimmed to the proper height and the moonstones set into them. The settings were tapped closed with the brass setting tool and the polish touched up with a buff.

The last piece, the Coral Box (ill. 13), was carved in the sea urchin shape with no bottom or top rim. These parts were fabricated and added on in the manner used on Anemone Box II. The lid of the Coral Box was constructed differently, being made as a bezel setting. A slice from an agate geode was chosen for the lid because of its visual and textural similarities to the box. The agate was cut to fit the bezel and then set into place on the hinged lid.

The basic forms chosen for the coral pieces were designed in a simple and classical manner, in order to emphasize the textural qualities in the metal and highlight the visual properties of the stones. All the stones were chosen because of their similarities in color, texture, or luminance, to coral and its environment.

In the Coral Ring, the green tourmaline's unusual color and watery cut makes it appear to be a part of some shallow south sea lagoon. It could also be compared to the translucent body of a tiny coral polyp. The moonstones in the bracelet are even more similar in color and in their glasslike quality to

the polyps. They also appear to be little air bubbles or water droplets clinging to the sides of the coral mass. On the Coral Box, the fractural lines towards the center of the agate, and the color variations, from white to yellow, are similar to a real piece of coral. Opening the box, the illusion is reinforced as the back of the stone is revealed. The crystalline center of the agate geode is revealed, looking like a clump of tiny living polyps amid a mass of dead coral.

These stones and the forms that they are set in, work together to produce a feeling of the ocean, as well as a feeling of actual coral. The bright colors of the metals and stones interact to produce an effect of the pieces being dripping wet, just brought up from the ocean floor.

IV. Knobbed Zoanthidians

Knobbed Zoanthidians (ill. 15), belong to the same class of sea life, Anthozoa, as both sea anemones and corals. (4, 338) They..."are small, anemone-like polyps without a skeleton...They are either solitary or colonial." (4, 338-9)

Although zoanthidians have no skeletons their body tissue is hard and woody, unlike the softer sea anemone. This tissue is stronger and stiffer than an anemone, but despite this, zoanthidians are still able to expand or contract into a ball like their softer cousins. Zoanthidians often form colonies like corals, growing in the same areas, and even over dead coral skeletons.(4, 371)

In appearance, the zoanthidian is a long irregular shaped hollow tube with small knobby ribs radiating from its top edge. This structural formation makes it possible to turn zoanthidians into protective containers with only slight modifications. The hollow tube-like body of the creature forms the container and the knobbed top becomes a decorative lid. These knobs can be manipulated to form a frame around the container, protecting the contents of the box, and highlighting any stones set within its lid.

In this way, the knobs are able to create a protective barrier around the box in the same manner as a sea anemone. While the protective theme of the two species remains the same, the visual impact is quite different. The short stumpy knobs of the zoanthidian give these boxes a bristly quality as compared to the anemones flowing, inviting appearance.

The Zoanthidian Ring (ill. 17), in 18k gold with a black pearl, and Zoanthidian Boxes I, II, & III (ill. 16), in sterling silver with baroque pearls, were all made to emphasize these protective qualities.

The ring was designed as a way of protecting the delicate surface of a pearl while at the same time showing off as much of its surface as possible. To produce this effect, the pearl is set down into a large hollow cavity in the ring which represents the zoanthidians body. Knobs surround the pearl on all sides, pushing it out from the walls of the cavity, and holding it in place visually as prongs would. Spaces, formed by these knobs, between the walls of the zoanthidian and the pearl are designed to reveal as much of the pearl as possible. They emphasize the pearls curved, spherical surface and reflect light off of it, while protecting it from being knocked or scratched.

To make this ring, a model was carved from wax and cast. The casting was then filed, tumble polished, and buffed. A stippled texture was applied to the rings sides with a chasing tool, leaving a high polish only on the knobs. This effect helps to emphasize the knobs and make them a more effective visual frame for the pearl. It also gives a more organic, skin-like effect to the zoanthidians body.

The three boxes also use pearls within the visual framework of their knobs. The boxes do not form a protective enclosure around the pearls as the ring does. They were designed to emphasize the box as a container, and as such it has a more open framework in order to highlight the space within.

A protective barrier is formed in these boxes by their grouping. Zoanthidians often grow in colonies and their protective characteristics are enhanced by their numbers. Each member of the colony shares space with others. By designing zoanthidian boxes in a group, it is possible to strengthen the defensive and protective qualities by the arrangement of the individual boxes.

The boxes were first carved in wax and the waxes cut in half to separate the lids from the bases. The pieces were then hollowed out and cast in sterling silver. After casting, a sheet of sterling silver was soldered onto the bottom of each tube to form a base. An inner rim of silver was fabricated and fit into the rim of each box and soldered into place on the lids, to make friction fittings. To finish the pieces, an oxidizing agent was applied and the boxes were tumble polished. Pearls were set onto posts on the lid and glued down.

In contrast to the Zoanthidian Ring and boxes, the Zoanthidian Earrings (ill. 18), in 18k gold with indicolite, focus on the properties of zoanthidians in a different way. These earrings show a cross section of a zoanthidians body. They form a pair of irregular circles with slats radiating out from them. These slats are actually the top edge of the knobs and on each earring one knob has been replaced by a stone.

By emphasizing only one part of the creature, the Zoanthidian Earrings differ from the rest of the pieces in this series which are shown as protectors and containers. While the earrings do show the defensive characteristics of zoanthidians, they are different in that they don't actually protect anything.

The stones in these earrings are a part of the protective element of the piece rather then the focus of the protection. Using the stones in this way emphasizes the zoanthidian's protective qualities by highlighting one section of the knobs. This forces the knobs to be seen as individual elements rather than as a textural mass. The knobs then become the focus of the piece, rather than the frame for the focus.

The earrings were fabricated in wax and then cast in gold. Channels for the stone settings were burred into place on each earring and gold sheet was soldered to the ends of the settings for extra support. Earposts were

soldered on and the earrings buffed to a high polish. The stones were slid into the channel settings and the open edges of the settings were pushed closed.

In this series, three different aspects of zoanthidians were illustrated. The zoanthidian was shown as an individual in the ring and emphasis was placed on its individual protective qualities. In the three boxes, the aspect of the colony was shown with each box supporting the others. Finally, in the earrings, the form was abstracted to highlight the protective mechanism itself.

V. Barnacles

The sea contains many other families of animals besides the polyp groups. Crustations are one such group, including within itself a variety of different animals such as crabs, lobsters, shrimp, beach fleas, searoaches, and barnacles. (4, 586) All crustations have an exoskeleton, which is a ridged outside covering composed mainly of chitin, a substance which is secreted by the animal's cells. (4, 764)

One group of crustations, the barnacles (ill. 19 & 20), have many superficial similarities to coral polyps. A barnacle starts its life as a free floating animal, but soon attaches itself to a hard surface such as a rock or a ship, and proceeds to grow its exoskeleton. (1, 455) Barnacles may live as corals do, either singly or in colonies. (1, 454) Unlike coral polyps, a barnacle is large enough to make an interesting object on its own as well as in a large mass.

Individual barnacles are emphasized in the two jewelry pieces of this series, the Barnacle Brooch and Barnacle Earrings (ill. 21), both made in 14k gold with button biwa pearls, diamonds and amethyst. To construct these pieces, as well as all the barnacles made in this series, individual barnacle chitins were modeled in wax, and rubber molds were made from them. Barnacles were then cast in wax and assembled into small clusters to form the earrings and brooch. These waxes were cast in gold, and stone settings and findings were fabricated and soldered on. The pieces were then cleaned up, buffed, and the stones and pearls set in place.

The stone settings on these jewelry pieces were designed to emphasisze the protective qualities of the barnacles. button biwa pearls were chosen and set recessed within the chitin to duplicate the manner in which the actual barnacle animal resides within its chitin. The settings of the diamonds and amethyst protrude from the chitin in the feeding position.

These settings illustrate two phases of the barnacles life cycle. The recessed settings of the pearls emphasize the barnacles defensive characteristics by protecting the vulnerable pearls from any physical contact with the harsh environment which may damage them. The tougher diamonds and amethyst are set in a more exposed position which enhances their appearance as well as illustrates the feeding end of the barnacle life cycle.

The jewelry pieces are also designed to mimic the manner in which barnacles encrust an object. A barnacle encrustation naturally follows the shape of the object it is growing on. In the Barnacle Earrings, the large barnacle with the pearl setting is designed to rest on the largest part of the lobe, while the smaller barnacle sits up higher where the lobe thins to join the curve of the ear, following the shape of the body. The Barnacle Brooch is also designed to follow the curves of the body, and may be worn either at the neckline or over the curve of the breast.

Two boxes were also made within the barnacle series: Barnacle Box I (ill. 23), in copper and sterling silver, and Barnacle Box II (ill. 22), in sterling silver and 14k gold. They are similar in shape and design, but are of differing size and material.

Each box was formed in the shape of the sea urchin shell, the larger out of copper and the smaller in sterling silver. They were raised and constructed in the same manner as Anemone Box III and hinged lids like that of the Coral Box were constructed and attached.

After construction of the box forms were completed, wax barnacle clusters were molded and fit to the curved sides of each box. The waxes were arranged to encircle the lids of the boxes, highlighting these areas with maximum encrustation. These areas are the places in which a natural barnacle encrustation would occur. Compared with the smooth sides of the boxes, the raised edge near the lid gives the best surface for attachment of a barnacle chitin. Wax barnacles were also formed to fit the sides of the boxes, thinning out in the natural progression of a barnacle colony. This tapering off of barnacles both follows nature and enhances the design by making a gradual transition from the encrustation to a smooth surface. The barnacles for the copper box were cast in sterling silver and those for the silver box were cast in 14k gold. After casting, the barnacles were cleaned up and soldered to the appropriate box.

Mother-of-pearl was set into the lid of each finished box. A plain piece of white mother-of-pearl was used on the silver and gold box, emphasizing the subtle pastel shades of the box. A selection of different colors, shapes, and sizes of mother-of-pearl were cut and fitted to the larger box duplicating the visual texture of a barnacle. These pieces of mother-of-pearl were all cut to follow the pattern of the ridges along the chitin of the barnacle and illustrate it in two dimensions.

After the colored mother-of-pearl had been selected, the larger box was oxidized. An oxidizing agent was applied by stippling the surface with a paint brush forming an irregular dotted patina. The patined color of the box blended well with the colored mother-of-pearl and the texture reproduced that of the barnacles. The barnacles themselves were also oxidized to a more natural greyish hue, the total effect being that of an object left under water long enough for real barnacles to have encrusted it.

The overall emphasis in this series is on highlighting the most interesting characteristics of barnacles. Individual barnacles make a uniquely beautiful protective framework for precious stones, especially the delicate biwa pearls which resemble luminous living creatures.

Gold and silver barnacles shaped to the contours of a box or body become integrated to that form as they would in nature. Their textural qualities as individuals or groups contrast with either the smooth skin, cloth or metal surface beneath them, emphasizing the surfaces as well as covering them.

VI. Pen Shells

Another family of sea creatures with a protective shell are the bivalves, a class of mollusks. Bivalves are common and familiar to most people as the family includes clams, oysters, mussels, cockles, and scallops. (4, 457)

The pen shell (ill. 24) is also a member of the mollusk family, and it has a very interesting background.

> The legendary cloth-of-gold from antiquity came not from underground mines but was spun by marine bivalves known as pen shells. These molluscs secreted byssus fiber, a milky substance that hardens into bronze threads that the animal uses to anchor itself. Byssus was first woven into cloth in the Kingdom of Colchis on the black sea. Jason and the Argonauts called the elusive golden fleece "Colchis," giving rise to the modern theory that the fleece was made from byssus. (2, 372)

While byssus is of historical interest, other aspects of the pen shell can also be used in metalwork.

The surface of a pen shell is composed of rows of expanding ribs with small textural ridges running across them. On the top of each rib is a series of evenly spaced flutes. These flutes increase in size and height from the base of the shell to its tip. The textural quality of this shell makes an excellent surface design for jewelry. The low areas between the shell's ribs are an ideal place for stone settings. The ribs both protect the stone and frame it visually, leading the eye to the focal points where the stones are placed.

The similarities in form between the actual pen shell and the pieces in this series are not as strong as in the previous works, but the important aspects of the shells are represented. The shell's ribs and flutes are utilized in a protective manner as they would be in life.

The first piece in this series, the Pen Shell Ring (ll. 25), was cast in 18K gold from a carved model. The basic form was carved in wax and a seat for the stone cut into it. After the stone was in place a framework of ribs,ridges and flutes were built up around the stone to protect it. These ribs, ridges, and flutes all flow towards and around the stone emphasizing the similarities between the facet lines in the stone and the natural patterns of the shell.

The ridge forms were slightly modified from the original shell; their lines are straighter than in nature and blend in to match with the facet lines of the stone. The flutes are also modified, arranged at the corners of the stone they mimic the appearance and placement of prong settings, but not their function.

The second piece in the series, the Pen Shell Box (ill. 26), was designed to emphasize the same aspects of the pen shell as the ring does. The box's form is different enough so that the idea may be expressed in another manner.

The shape of this box is based on the sea urchin form. As the urchin is a spherical form, the ribs and ridges on the box were arranged in the manner of longitude and latitude lines on a globe. The flutes on the box radiate up the length of the ribs increasing in size from the base to the lid. The large surface of the box provides an opportunity to emphasize and exaggerate the textural qualities of the shell. The ribs, ridges, and flutes are all enlarged, rising higher and cutting deeper into the surface of the box.

The box was constructed from a wax carving cast in sterling silver. Its lid was fabricated as a large bezel setting for a faceted stone. Hinge and catch mechanisms were fabricated and attached in the same manner as those earlier described. After the metal construction was completed, an amethyst was cut to fit the lid of the box. The box was built with six ribs each having three

flutes. The amethyst in its lid was cut to match it, with six main facets and eighteen secondary ones.

The third piece in the series, the Pen Shell Bracelet (ill. 27), cast in sterling silver with amethysts, contains aspects of each of the two previous pieces in the series. The bracelet uses the heavy texture of the box, but its format is more like that of the ring.

Designed with a rectangular stone set in its center between two large ribs the bracelet differs from the ring in that its ribs run across the circumference of the band and the ridges run across the width, rather than the opposite ways as on the ring. The bracelet also utilizes six small round amethysts, set randomly across its surface. These stones break up the surface of the bracelet and represent blemishes that might occur naturally on a shell.

All three pieces of this series were designed to show how the flutes of the pen shell work to protect the surface of the shell from abrasion. In nature these flutes have two functions. One is to help the byssus strands anchor the pen shell to the ocean floor, and the other is to provide a buffer zone around the shell. In the metal pieces, the flute and the ribs they are attached to are arranged around the stone in a manner that provides at least a token amount of physical protection. Their arrangement's main purpose is to provide a visual framework and focus around their stones.

VII. Kelp

The great kelp forests of the oceans have a very special role in the undersea world. These forests are the habitat of a whole range of sea life. In this manner, kelp projects a nurturing quality equal to that of a coral reef.

> The giant kelps *(Macrocystis)* are important members of the group of aleae, commonly called seaweeds, that flourish in coastal waters in many parts of the world. Small gas-filled bladders help keep the kelp's fronds at or near the water surface, where they can benefit from the sun's energy. (3, 40)

> There are several varieties of plants in the kelp forests, including *Laminaria, Nereocystis,* and *Alaria.* But the giant of them all is *Macrocystis pyrifera,* which may reach more than 30 to 35 meters from its root-like holdfast on the ocean floor to the tip of its frond, which functions like the leaves of earthbound plants in making food by photosynthesis. Joining the holdfast and the fronds is the stipe, which might be likened to the trunk of a tree. *Macrocystis* specimens of up to 300 meters long have been reported along the California and Baja California coasts. (3, 40)

The kelp series does not directly portray the environmental aspects of its species. Instead, it concentrates on the individual beauty of a kelp frond. (ill.28)

The idea for this series came out of the development of computer chasing on 24k gold and fine silver foil. In this technique an image or textural pattern is developed as a computer program, and then embossed in metal by running gold or silver foil through a high quality dot-matrix printer. This method was perfect for duplicating the complex, organic texture of a kelp frond in a reasonable period of time.

To construct Kelp Brooch I & Kelp Brooch II (ill. 29), a sterling silver framework similar to an irreguarly shaped bezel was built in the shape of a

kelp frond. Bezel settings were also constructed for the rainbow moonstones which would represent the kelp's air bladders. One end of each small bezel was soldered to the base of a kelp frond framework and stipes shaped from silver wire were soldered on to the other end of each bezel. A final soldering was done to attach pin findings.

After the frameworks were completed, gold foil was computer embossed with the kelp texture and cut to fit into the forms. A layer of epoxy was spread over the back of each piece of foil to support it. After the epoxy had set, but while it was still flexible, the gold pieces were fit into the frameworks. The edges of the bezel settings were then upset with the sharp edge of a riveting hammer leaving a textured edge.

The rainbow moonstones were then set into their bezels and the emeralds and diamond were attached. The settings for these stones were built as modified tube rivets with 18k gold settings, forming a head on one end of a sterling silver tube. After the stone settings were completed, they were inserted through holes drilled into the surface of each pin, and the edges of the tubes were flared out to hold them in place.

The Kelp Box (ill. 29) was constructed in copper in the same manner as the barnacle boxes. Kelp frond frameworks were formed in copper to fit the contours of the box. Both the box and the kelp frameworks were patined blue by fuming them in ammonia vapors. Fine silver foil was printed with the kelp texture and set into these frameworks. Large freshwater pearls were used as the air bladders for these fronds. The fronds were attached to the box with tube rivets, and an agate was set into the lid of the box.

The materials for the pins and box were chosen to idealize the appearance of sea kelp and to project an image of it that emphasizes its value to the environment through a transformation into precious materials.

Gold and silver were used for the fronds in order to draw attention to the sinuous textural quality of their surfaces. A green patina on the box reflects the natural colors of the kelp and the emeralds on the pins are used for the same purpose. Silver used in the pieces reflects the natural white color on parts of the plants. The moonstones and fresh water pearls help illustrate this quality. The shape and color of the gems also give the appearance of actual air bubbles. The small diamond on the larger pin duplicates this effect as well as adding structural support as a rivet. The patterns and colors on the agate which forms the lid of the box bring in the textures and patterns of the waves, giving a hint of the environmental aspects of a kelp forest.

VIII. Conclusion

The creatures which live within the ocean depths have many varying forms, textures and colors. Like all life forms they have evolved in certain directions in order to meet the demands of their environment.

Many creatures of land, sea, and sky develop fight or flight responses in order to survive. Other, slower, or stationary creatures evolve with protective armor and weapons. The protective characteristics of these creatures may be manipulated into jewelry objects.

Like living creatures, metalwork can be considered as an evolving form. One direction which it may take is that which combines the beauty of precious materials within a framework which protects and preserves. The metalwork of this thesis has shown such a direction. Seaforms which are able to protect soft vulnerable living creatures from the ravages of the ocean can also form an ideal framework, both beautiful and practical, for delicate gems and keepsakes.

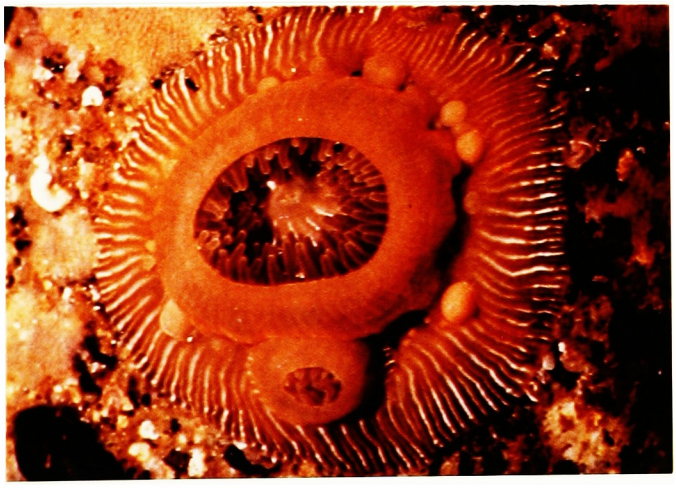
ill. 1. "Sea Anemone" (5, 84)

ill. 2. Anemone Earrings I

ill. 3. Anemone Earrings II

ill. 4. Anemone Box I: Life Cycle; High Tide

ill. 5. Anemone Box II: Life Cycle; Low Tide



ill. 6. "Proliferating Anemone" (4, plate 197)

ill. 7. Anemone Box III: Pink-tipped Anemone

ill. 8. Pink-tipped Anemone (2, 123)

ill. 9. A Reef Coral (2, 309)

ill. 10. "Leather Coral" (5, 65)

ill. 11. Barrior Reef off Bora Bora in French Polynesia
(3, 128-9)

ill. 12. Coral Ring

ill. 13. Coral Box

ill. 14. Coral Bracelet

ill. 15. "Knobbed Zoanthidians" (4, plate 8)

ill. 16. Zoanthidian Boxes I, II, & III

ill. 17. Zoanthidian Ring

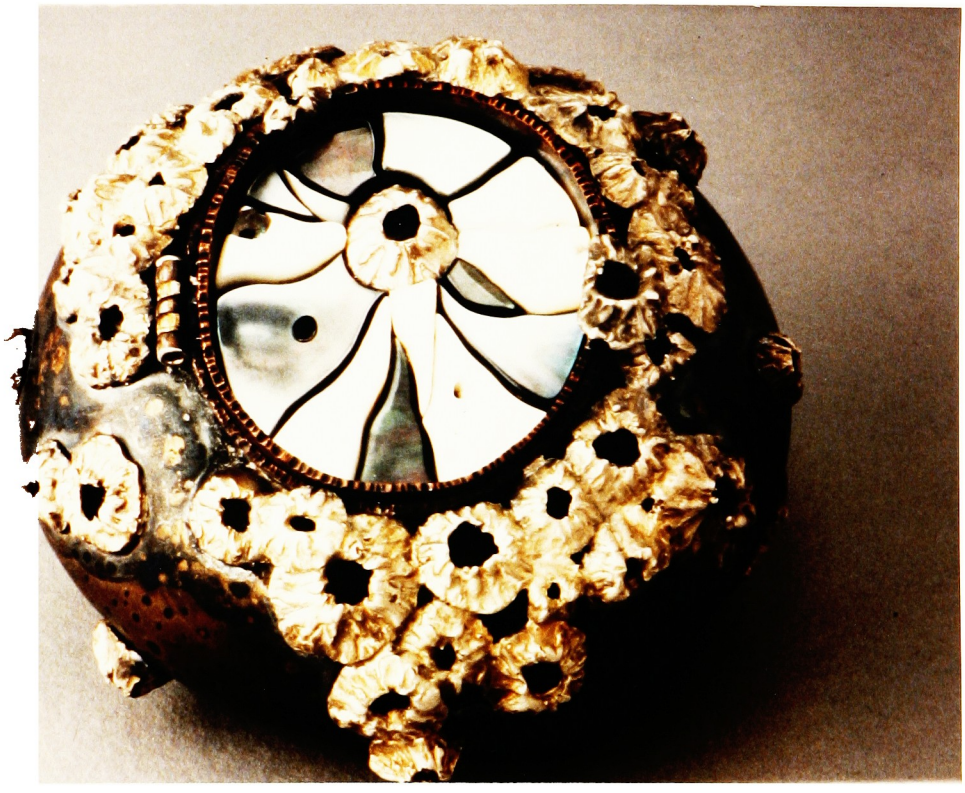
ill. 18. Zoanthidian Earrings

ill. 19. "Little Grey Barnacle" (4, plate 276)

ill. 20. "Thatched Barnacle" (4, plate 281)

ill. 21. Barnacle Earrings & Brooch

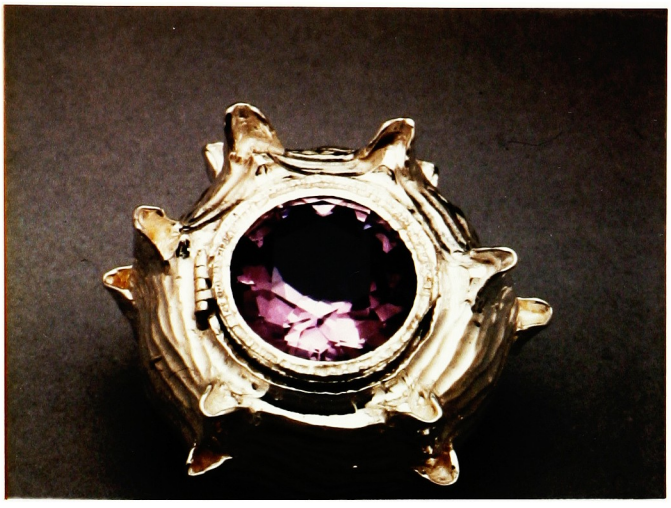
ill. 22. Barnacle Box II



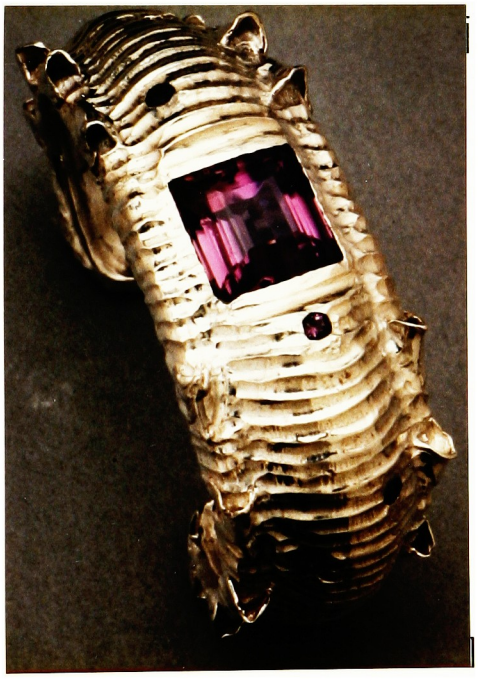
ill. 23. Barnacle Box I

ill. 24. "Saw-toothed Pen Shell" (1, plate 114)

ill. 25. Pen Shell Ring



ill. 26. Pen Shell Box



ill. 27. Pen Shell Bracelet

ill. 28. Giant Kelp *(Macrocystis)* (3, 40)

ill. 29. Kelp Brooches I & II and Kelp Box

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