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Cold Connections as Used by the Metalsmith and Sculptor

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COLD CONNECTIONS AS USED BY THE

METALSMITH AND SCULPTOR

(TITLE)

BY

Deborah A. Rohr

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Arts

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1977
YEAR

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COLD CONNECTIONS AS USED BY THE SCULPTOR AND METALSMITH

BY

DEBORAH A. ROHR

B. S. in Ed., Eastern Illinois University, 1971

ABSTRACT OF A THESIS

Submitted in partial fulfillment of the requirements for the degree of Master of Arts at the Graduate School of Eastern Illinois University

CHARLESTON, ILLINOIS
1977

Metal may be joined to metal and non-metal materials by many techniques. It is my intent to discuss one group of such techniques--that of cold connections, and illustrate them with art works. Although there are many types of cold connections, this study will concentrate on the use of rivets, screws, bolts, adhesives, nails and wire as cold connectors.

A proper definition for cold connection is attachment of one piece of material to another piece of material without use of heat.

Historical reference of the uses of cold connections by prehistoric man, early civilizations of man, through modern times is included in the preface. Truly, cold connections have aided man in the conquest of his environment, providing a means for disassembly, with a possibility of reassembly for any movement of the connected objects.

As the methods of cold connection are sometimes underappreciated and overlooked for a myriad of reasons, a philosophy and a list of reasons to use cold connections is included in the introduction. One should be mindful that use of cold connections may become an end in itself--reducing the piece to possible showmanship only.

Each type of cold connection has been researched as to varieties available, historical use, advantages and disadvantages and manners of correct use in a section preceding

examples of my work (text and illustrations). Observations as to the effectiveness of the chosen cold connection and other techniques used in each piece are listed at the end of each text.

I chose to investigate a limited number of cold connections. Knowing a little about several types of cold connections has been more advantageous than knowing a great deal about one type of cold connection. Resultant frustration, boredom, the lack of creative approaches to my work, and the lack of enthusiasm have not influenced my research because I have limited knowledge of each type of cold connection I chose. The ideas were plentiful and the pieces were more than just satisfactorily completed.

One could develop quite an extensive discussion on any one type of cold connection successfully. The information is easy to obtain and is quite interesting.

As technology provides new materials for mankind to join together, and new techniques and materials for joining, one will either use the existing types of cold connections, re-design them, or will develop new types to fit his needs. The extent of an investigation of the uses of cold connections by a sculptor and metalsmith appears interminable.

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I am deeply grateful to Mr. Cary Knoop for his continued help, encouragement, and personal interest throughout the many years I have studied and worked under his guidance.

I would like to extend my appreciation to the other members of my committee, Mr. Garret DeRuiter and Dr. Lynn Trank, for all the time and assistance they have given me. I also wish to thank Dr. June Krutza for her help during the early stages of my writing.

A special thanks goes to my parents whose patience, love and confidence in me have helped me through all the long nights throughout my work on this thesis.

Preface

Mankind has been connecting objects since prehistoric times to make tools for his survival and ornaments for his body and home. His first devices used to attach one object to another were the tether, wooden pins or simple animal glues.[1] As prehistoric man was primarily nomadic in nature, these types of cold connections were very practical, offering a secure attachment of the objects to each other, a means of disassembly, with a possibility of reassembly, for their many journeys. Throughout the passing of thousands of years, these forms of connection have not changed in concept, though they have been broadened in use and function significantly by technology. (Figure 1)

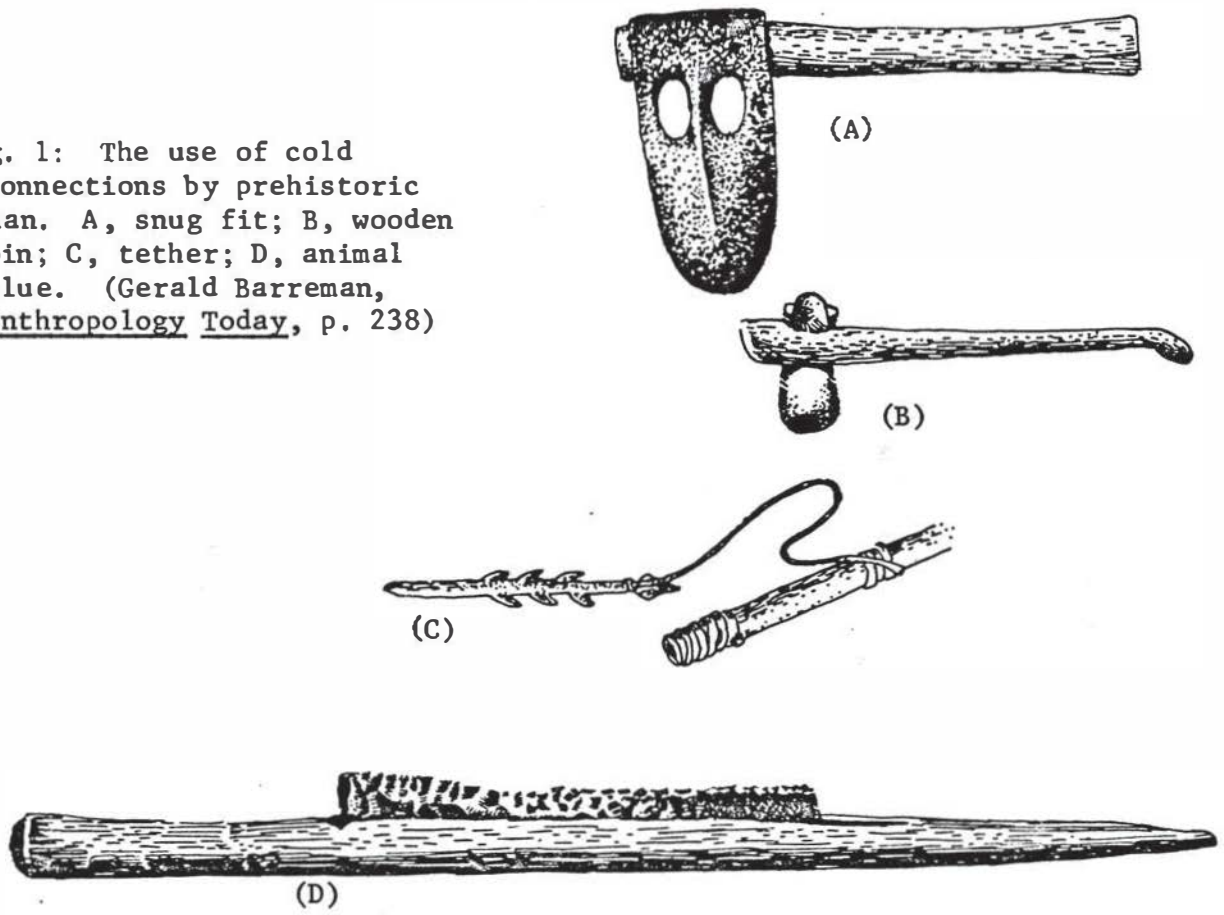

Fig. 1: The use of cold connections by prehistoric man. A, snug fit; B, wooden pin; C, tether; D, animal glue. (Gerald Barreman, Anthropology Today, p. 238)

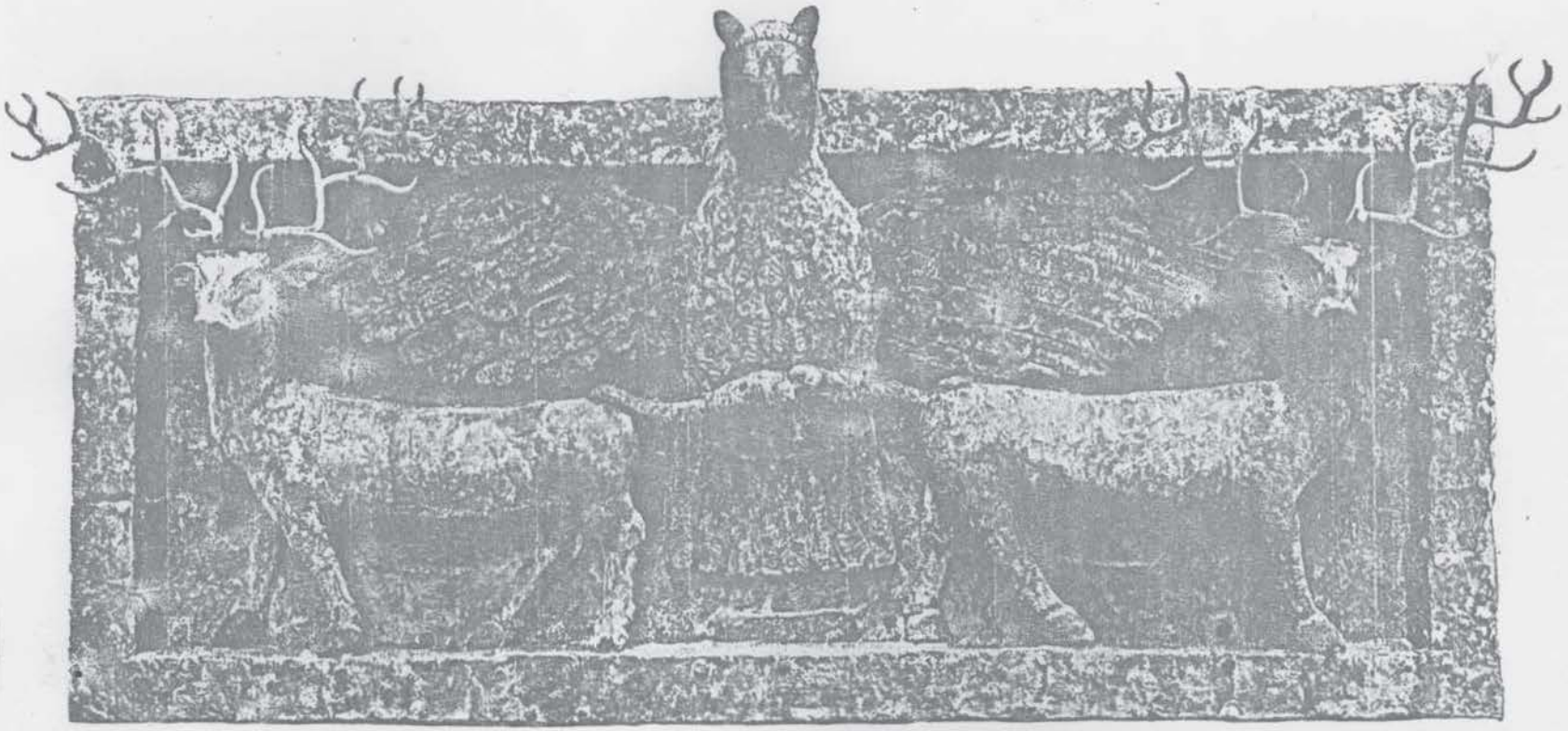

Figure 2: The frieze of Im-dugud, found on the site of the settlement of Al'Ubaid and dating from the first dynastic period of Ur, ca. 2700 B.C. The whole frieze is covered with copper, the metal having first been hammered into sheet and afterwards beaten to fit closely on a carved, wooden foundation which was surrounded by a copper frame. The copper sheets were secured in position on the wood with copper nails. The complete panel is 7 feet 9½ inches long and 3 feet 6 inches in height. (Leslie Aitchison, History of Metals, p. 25)

Over the years climatic conditions permitted settlement of prehistoric man. It was during this period, known as the Neolithic Age, that man developed skills in agriculture, pottery, weaving and metalworking.[2] The metalworking skills of forging and casting provided the means to produce superior tools of survival and more permanent ornaments. Although copper nails were being produced, their use was as scarce as the metal itself. The prime means of connections were still cold, though heat was being used to produce the objects they connected.[3] (Figure 2)

As man learned more about metals and as metals became more available, the need for improved joining mechanisms had to be met. Soldering was developed by the Egyptians, but not all objects could be soldered to others (such as shells to metal). By 2330 B.C. they were using rivets to hold sheets of metal together, though examples from this far back are rare.[4] (Figure 3) The Egyptians were using wire to hold their necklaces together, to string their stones and cast objects, by 2040 B.C.[5]

Although Archimedes is credited with being the first to experiment with screws (ca. 270 B.C.), it has been suggested that the use of the screw as a connecting device goes even further back in history to Archytas of Tarentum (400 B.C.).[6]

Apart from the origin and history of screws is the problem of how the early screws were made. The earliest screws were doubtless of wood, the lathe having been invented around the seventh century B.C.[7] Screws of metal were also made in antiquity.

> A sheet of soft metal in the form of a right-angled triangle was wound round the cylinder so that one arm of the right-angle was parallel to the axis. The hypotenuse would then trace a spiral on the surface of the cylinder. This metal spiral was used as a guide to the file, chisel, or gouge cutting the spiral groove.

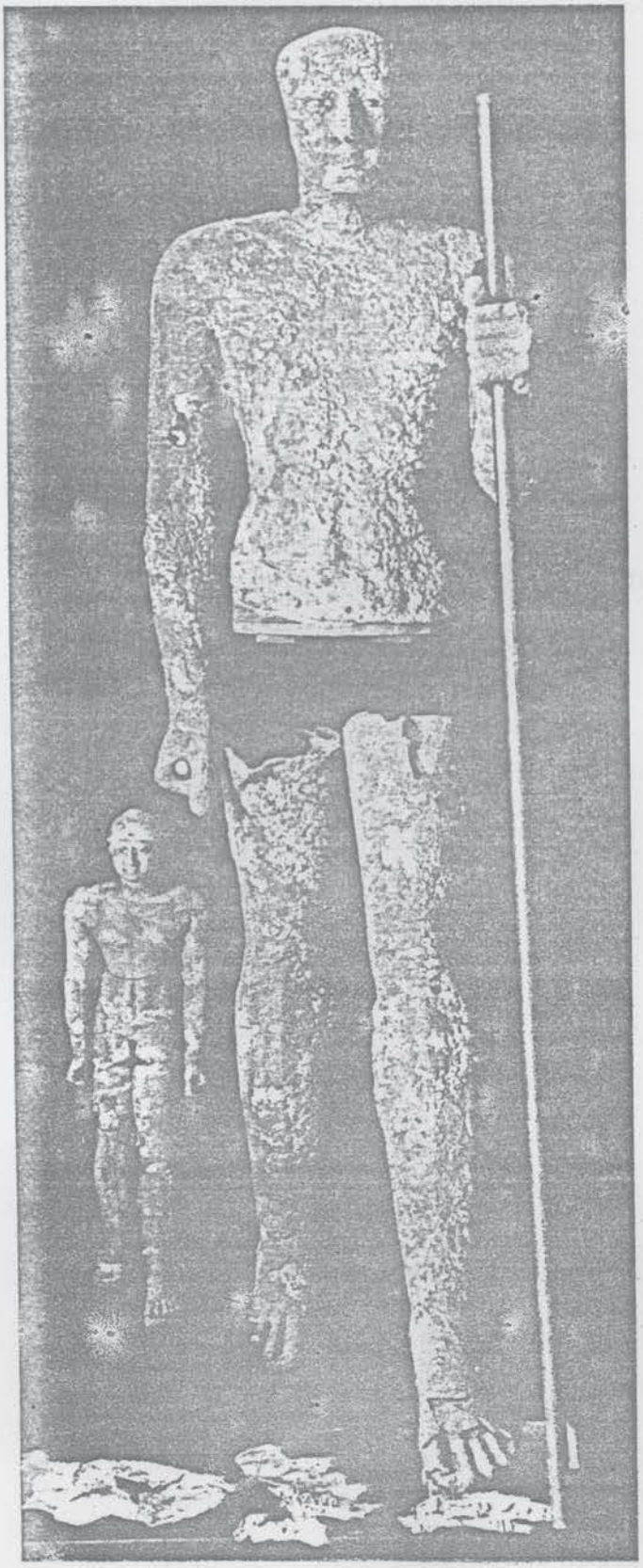

Figure 3: A life-size Egyptian statue, ca. 2330 B.C., of the pharaoh Pepi I; behind, a smaller statue of Pepi's son, who reigned later as Pepi II. The statue of Pepi I consists entirely of almost pure copper. The trunk and the limbs were made of hammered sheets which were beaten to shape and then riveted together; the face, the hands and the feet were copper castings which may have been made by the lost-wax process, a difficult procedure to carry out with unalloyed copper. No other statues of this kind, which could have been made during the subsequent thousand years, have been discovered. (Leslie Aitchison, History of Metals, p. 69)

LIST OF ILLUSTRATIONS

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INTRODUCTION

Metal may be joined to metal and non-metal materials by many techniques. It is my intent to discuss one group of such techniques--that of cold connections, and illustrate them with art works. Although there are many types of cold connections, this study will concentrate on the use of rivets, screws, bolts, adhesives, nails and wire as cold connectors.

What are cold connections?

A proper definition for cold connection is attachment of one piece of material to another piece of material without the use of heat.

A Philosophy

Quite often ideas of proper and improper means of joining metal to metal and non-metal materials has dictated technique, and sometimes, the finished product. The methods of cold connection are sometimes underappreciated and overlooked for a myriad of reasons. Whether these reasons are valid or not, they include the following among their numbers: a) by being relatively simple, the technique of joining may not make the product look "difficult" to a possible patron who already feels he might be able to do the same piece at home for less cost; b) the technique may become an end in itself--reducing the piece to possible showmanship only.[11]

In actuality, many of the techniques of joining materials with cold connections provide opportunities that hot, more time consuming and difficult methods do not. Some reasons to use cold connections rather than those that are hot (such as soldering) are:

1. To connect metal to objects that cannot be joined by heat because

such action would destroy areas previously joined by heat (such as with multiple solder joints).

2. To connect metal to objects that can be destroyed by heat (such as metal joined to plastic).
3. For use in a situation where equipment is limited and/or heat is dangerous to those in that particular environment.
4. To decorate the objects as well as connect it to another object as in the use of rivets, nails, bolts and screws.
5. With the advent of research, new adhesives have been developed that not only connect for an indefinite time but also are easy to use, available at numerous curing temperatures, and provide numerous functions besides that of connection, such as protection against water damage.
6. By using cold connections to join polished surfaces one can avoid discoloration of the surfaces which occurs often with soldering.
7. Unlimited types of cold connections are found in most hardware stores, making them easy to obtain.
8. The young student is often denied use of welding and soldering equipment because of age and lack of experience; he could use most, if not all, methods of cold connections.
9. The use of cold connections in art projects demands few tools; most of the necessary tools can be found at home, in the classroom or in a hardware store.
10. As many school art rooms do not provide for the use of heat to connect metal to metal or other materials, use of cold connections becomes the obvious means of attachment.

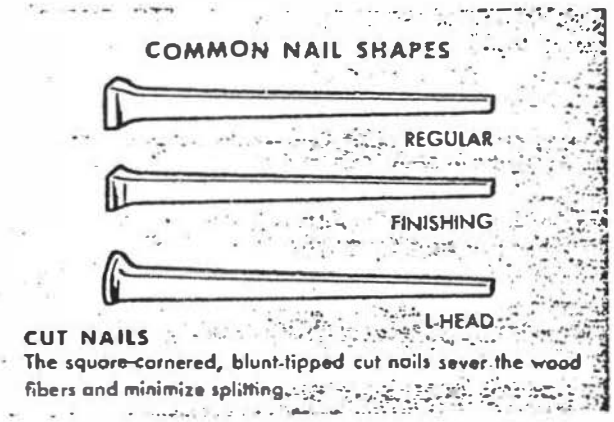


Figure 4

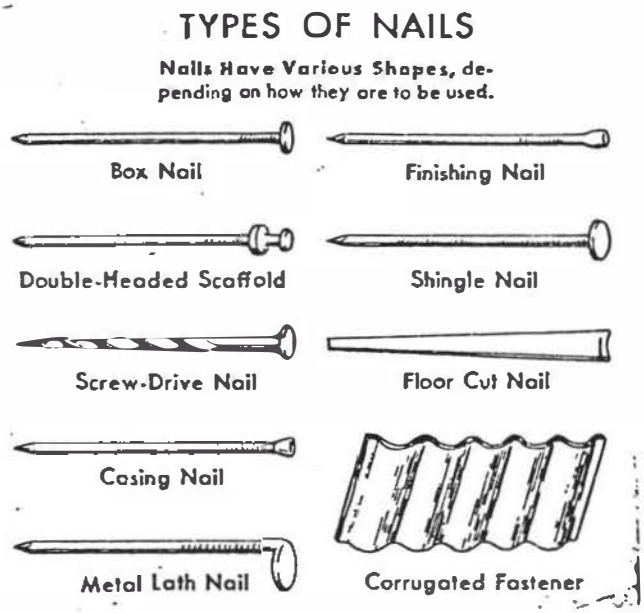


Figure 5

Figure 6

NAILS

One of the oldest forms of cold connections is the nail. Dating back to the Neolithic Age, the nail, made of copper or bronze, has changed little in shape and function throughout the centuries. By the time of the Roman Empire most nails were commonly made of forged iron.[12]

Although one is more familiar with the mass produced cylindrical nails, the first metal nails were four-sided, tapered in shape. The nails are known as cut nails (Figure 4). One end if beveled to a point while the other is cold-forged into a head. The advantage of the square corners of the cut nail is that they chisel through the fiber by separating the fibers, reducing the tendency to split the material (wood) into which they are being driven.

Modern nails are classified as to use and to the shape of the nail head. Nails are usually made of steel or aluminum. The size of nails range from the needle nail (95,000 to a pound) to that of the boat nail (two pounds each). The length of the nail body as well as the diameter varies also with the type of nail. (Figure 5) A recent advance in nail design is the threaded nail which provides for easier driving, reduced splitting and a holding strength comparable to that of screws. (Figure 6)

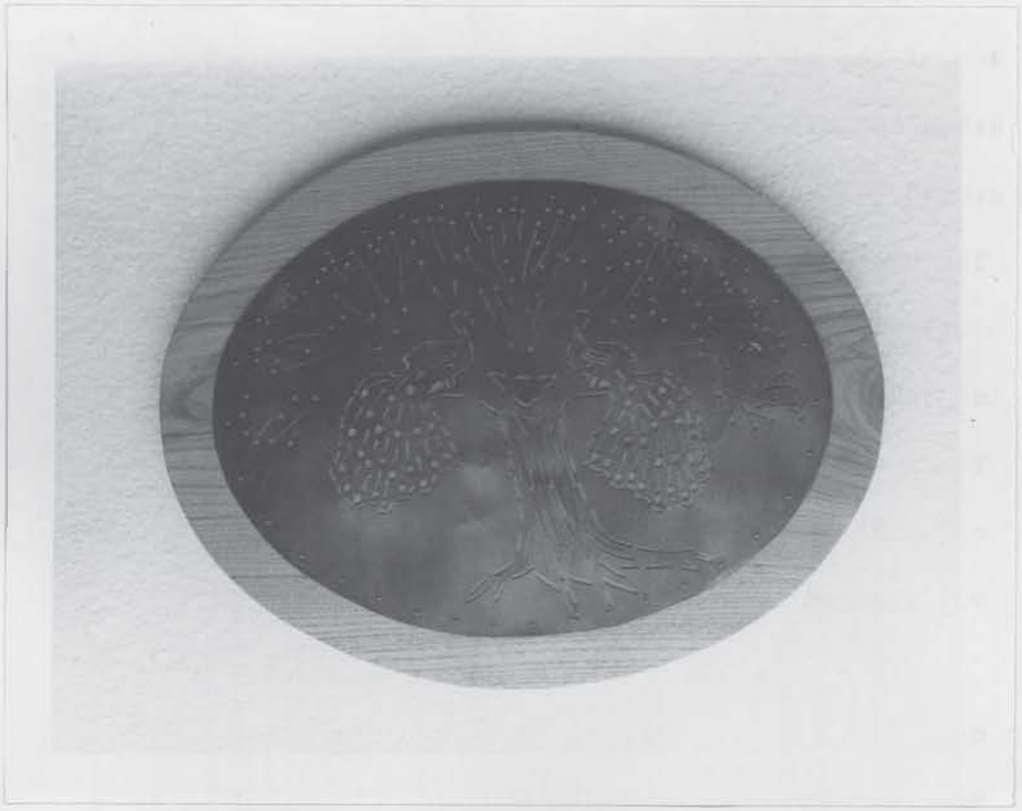
Selection of nail type and size depends on the thickness and types of materials being joined. For the sake of craftsmanship, drilling of holes in both the base material and the material to cover the former make the appearance of the finished product better and also allows for easier hammering. One should not drill the channel to more than one-half the length of the nail body to allow the nail to have holding power--deeper will lessen the

effectiveness of the nail. Most carpenters believe that nails driven at an angle will hold the materials more securely than if driven straight.

Although not often considered, holding nails in the mouth prior to driving them lubricates the nail body allowing it to be driven in more easily. This is not to be recommended for use with small nails as the danger of swallowing would far outweigh the benefits of lubrication.

Pages six through sixteen contain illustrations, my work, of the decorative and functional applications of nails.

PIATE I



PEACOCK PIECE

Title: Peacock Plate (serving board)

Size: 13½" H by 17½" W

Materials: Yellow oak, mild steel sheet, brass escutcheon pins

Process: An 11 inch by 14 3/4 inch oval was cut from a piece of mild steel sheet (18 gauge). The steel was then pierced by using a jeweler's saw and finished by rubbing the pierced metal with a piece of medium grit emery cloth until the surface was smooth but still showed the circular motions of sanding. The outer edge of the piercing was textured with the small end of a riveting hammer. Stove blacking was applied to the surface of the piercing by heat to protect the metal from oxidation and to darken the piece so that it would be in contrast with the yellow oak background.

The background of yellow oak was finished by sanding the board, which was cut larger than the pierced steel sheet, coating it with shellac and backing the board with black felt.

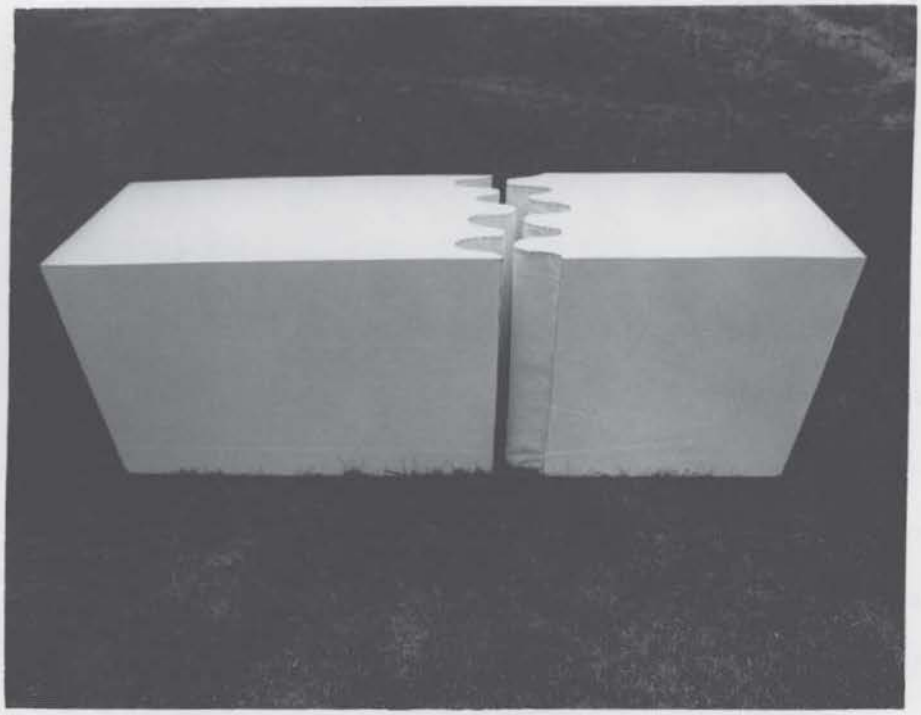
Three-eighths inch brass escutcheon pins were used to connect the pierced metal to the wood. The angle of hammering the pins into the wood was changed every fourth pin to further secure the metal to the wood.

Observations:

1. The heat used when applying the stove blacking on the metal caused the metal to warp making the means of attachment do extra work--that of straightening as well as connecting. With this in mind, the piece would have been more secure with longer pins or nails or with the use of screws (of the two, screws would have been the most secure).

2. The piercing design is not strong. What saved the piece is the size of the piercing, the strong contrast between the foreground and the background and the shape of the finished piece.

PLATE II



EARTHQUAKE

Title: Earthquake

Size: 24" H by 18" W by 5'6" L

Materials: Particle board, brass escutcheon pins, fiberglass screen, matt medium

Process: Earthquake is composed of three units: two wood and fabric constructed pieces and the space between them.

The substantial pieces were made of one-half inch particle board. The tops and bottoms were cut in the parallel snaked curve by using a band saw. The sides were cut to fit the tops and bottoms and have mitered corners which were glued and nailed together. The ends are of one-half inch particle board and were butt-jointed to the sides, tops and bottoms of the two sections with glue and nails. The sections were then sanded and painted white.

The fabric that is used was made by placing fiberglass screen on a smooth sheet of plastic (Visqueen), coating the screen with twenty thin coats of matt medium and four coats of white acrylic paint. When the resultant fabric dried, it was pulled from the Visqueen, cut to fit the curves, then nailed into place with three-eighth inch brass escutcheon pins. The escutcheon pins are the only visible metal in this piece (nails in the edges being invisible) and perform in two ways: as a form of cold connection and as a decorative border.

The space is mentioned as an important part of the sculpture because the amount of closure determines the mood and the success or failure of the two substantial pieces. Placed too far apart, the sculpture appears disjointed and the substantial pieces become separate sculptures. Positioned too close together, the reason for separation

is reduced in importance. The space between the pieces seems to work best if held to between six and nine inches.

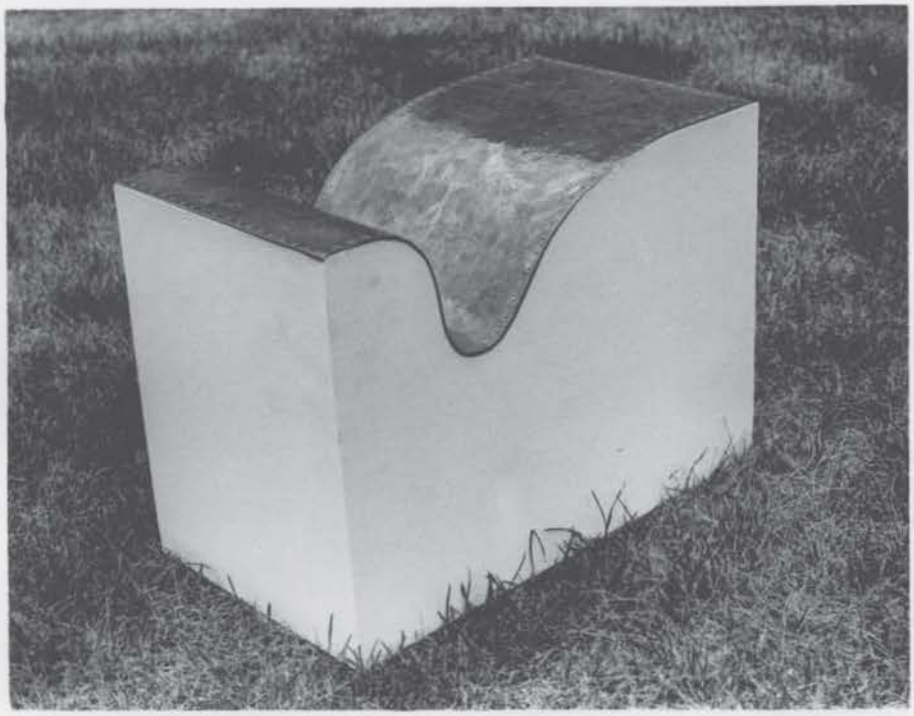
Observations:

1. Because the space between the two substantial pieces is important, to display this piece it is necessary to enclose instructions to those who wish to display the piece as it was conceived. One could vary the piece by up-ending it or stacking the pieces or placing them back-to-back to make the piece more versatile.
2. Although there is little use of metal in this piece, the method of construction brought about the ideas for the following pieces (included in this thesis):

   Watch for the Dip in the Road, page 12

   Monument to the Back 40, page 15

PLATE III



WATCH FOR THE DIP IN THE ROAD

Title: Watch for the Dip in the Road

Size: 10" H by 12½" D by 17½" L

Materials: Particle board, copper sheet, brass escutcheon pins

Process: The four walls of this piece was made of one-half inch particle board, two sides of which were cut together with a band saw to get the "dip." The corners are butt jointed, glued and nailed in place. A bottom was added to make the piece sturdy and heavier as well as to make the piece appear (or feel) "finished." The wood base was then sanded and painted white.

The top was covered with 20 gauge copper sheet which had been textured by hammering the sheet on concrete inbedded with rocks.

Three-eighth inch brass escutcheon pins were hammered one-half inch apart, one-fourth inch from the copper sheet edge to secure the copper to the wood base. Holes had been drilled in the edge to make this process easier. The edges of the sheet were then burnished to the wood base.

The copper sheet was allowed to tarnish slightly before a plastic spray was applied to the surface.

Observations:

1. The texture on the copper sheet complicated the shaping of the sheet in the "dip" area. Several times the pins had to be removed and the copper sheet annealed and re-shaped to get it on the base straight.
2. A series of similar pieces could have been started from simple variations on this basic piece (such as: polishing the copper, using more complicated curves with a thinner gauge metal, a multi-unit piece, et cetera). Monument to the Back 40 is one such variation (page 15).

3. Artistically the piece is very squat, as it is limited to placement on some other object to brint it to a comfortable viewing height. It could have been made higher or lower (which would have made it more acceptable to being placed on a table top).

PLATE IV

MONUMENT TO THE BACK 40

Title: Monument to the Back 40

Size: 37½" H by 12" W by 9" D

Materials: Particle board, copper sheet, escutcheon pins, epoxy glue

Process: Monument to the Back 40 is composed of two units: the sculpted upper area and the two part pedestal.

The four sides and bottom of the uppermost unit were made of one-half inch thick particle board. Two sides were cut simultaneously with a band saw to produce the "dips." All edges were mitered, glued and nailed together forming a box measuring eight and three-quarter inches high by twelve inches wide by nine inches deep.

The pedestal was made in two parts: a small, spacer box and a large box used as a base. The large box is the same width and depth as the upper unit but has a heighth of twenty-seven inches. Its top and sides were made of one-half inch thick particle board and constructed in the same manner as the uppermost unit.

The small, spacer box located in the center of the two larger boxes measures one and three-quarter inches high by nine and one-quarter inches wide by six and one-quarter inches deep. It, too, is made of one-half inch thick particle board, with mitered, glued and nailed edges.

The three parts were joined by centering the spacer box between the two larger parts, glueing and nailing. After all joints were sanded, the wooden parts were painted white with acrylic paint.

A 20 gauge copper sheet was cut to fit the length of the "dips" and the depth of the upper unit. The surface was textured in the same manner as the copper in Watch for the Dip in the Road, page 12. Holes were drilled about the perimeter to allow for the escutcheon pins to be

nailed to the wooden edge, thus attaching metal to wood. These holes were drilled one-quarter inches apart and one-quarter inch from the edge of the copper. After hammering the escutcheon pins in, the copper was coated with liver of sulphur to hasten tarnishing. The surface was then rubbed with steel wool (00) to highlight the copper.

To add more color and unity to the piece, strips of 36 gauge copper were cut and glued to the sides of the spacer box. This metal was attached with epoxy glue and has been allowed to tarnish naturally.

Observations:

1. There is a sense of monumentality about this piece as PLATE IV indicates. The piece is well proportioned and is structurally sound. I believe the piece could be reproduced proportionately smaller or larger and still be as highly effective.
2. The copper in the piece contrasts well with the white painted wood, however, the craftsmanship is poor. The copper on the spacer box was so thin that it buckled when cut and glued to the box. This might have been avoided had the copper been one piece (rather than four pieces) and perhaps thicker. The textured copper sheet changed in dimension when the texture was produced and was difficult to measure for a correct fit before the holes were drilled. This might have been avoided had the sheet not been textured so unevenly.
3. Many people have commented both favorably and unfavorably about the starkness of the white paint in this and in the sculptures named Earthquake and Watch for the Dip in the Road. I chose white to satisfy a personal preferance, although I must concede that many other colors would also compliment the rich copper color.

WIRE

Wire can best be described as a long, flexible rod of metal that has a uniform cross section. Ductile metals, or metals that can easily be drawn out, are the only metals that can be used for making wire. Some of these are: copper, brass, iron, silver, gold, platinum and aluminum.[13]

Wiremaking dates back to the end of the Neolithic Ages. It was used frequently in the jewelry of the Egyptians. This early wire was made by hammering metal into thin sheets which were then cut into strips. The strips were rounded by further hammering the edges. Wire of this type was quite brittle after forming and had to be annealed before it could be used.[14]

In the 1300's A.D., crude drawplates were developed for the manufacture of wire. A drawplate consists of progressively smaller tapered openings in a wood or metal plate through which wire can be pulled. Wire is annealed several times during the process of "drawing down." Wire that has been drawn is more uniform in cross section than that of the Egyptians but usually requires annealing prior to use.[15]

Machine-drawn wire was first developed in England around the middle of the 1800's. Small ingots of metal were heated and run through rollers which pressed them into smaller and longer shapes. The rods were then tapered and run through a die. As soon as the end passed through the die, it was caught by a pair of pincers and drawn far enough to be attached to a drum. This drum was then rotated, pulling the rest of the rod through and wrapping the wire around the drum. Fine wire may pass through a number of progressively smaller dies before being wrapped about the drum. Because the wire becomes brittle as it passes through the dies, the wire may pass through

areas in which hot air heats it to reduce the brittleness. For wire that is to be drawn very fine, the drawplate may be made of diamonds.[16]

Annealed wire can be twisted, tied, woven, wrapped and used as thread for sewing or embroidery.[17]

Pages nineteen through twenty-four contain illustrations, my work, of the decorative and functional uses of wire.

PLATE V

TRIBUTE

Title: Tribute (bas-relief sculpture)

Size: 19" H by 13" W by 2" D

Materials: Clay, copper sheet, copper wire and wooden beads

Process: Tribute was made in three parts: the frame, the face and the copper sheet overlay. The face and frame are made of clay.

The face was made first. Clay was placed inside a plaster mold. While the clay was still wet, holes were bored into the face to later provide channels for the wire used to secure the copper sheets. The holes were made larger than the wire diameter to allow for shrinkage of the clay in the firing processes.

The frame was made to fit the face and was textured by tapping a wire brush on the wet clay surface. The two linear elements at the lower part of the frame were smoothed with a wet sponge.

Both pieces were bisque fired and after applying iron oxide to the frame and face, and glaze to the two linear elements, the pieces were fired in a reduction firing.

The face was then covered with small shaped pieces of 36 gauge copper sheet which were secured with 24 gauge copper wire. The sheets were allowed to buckle and were hand-burnished to the surface.

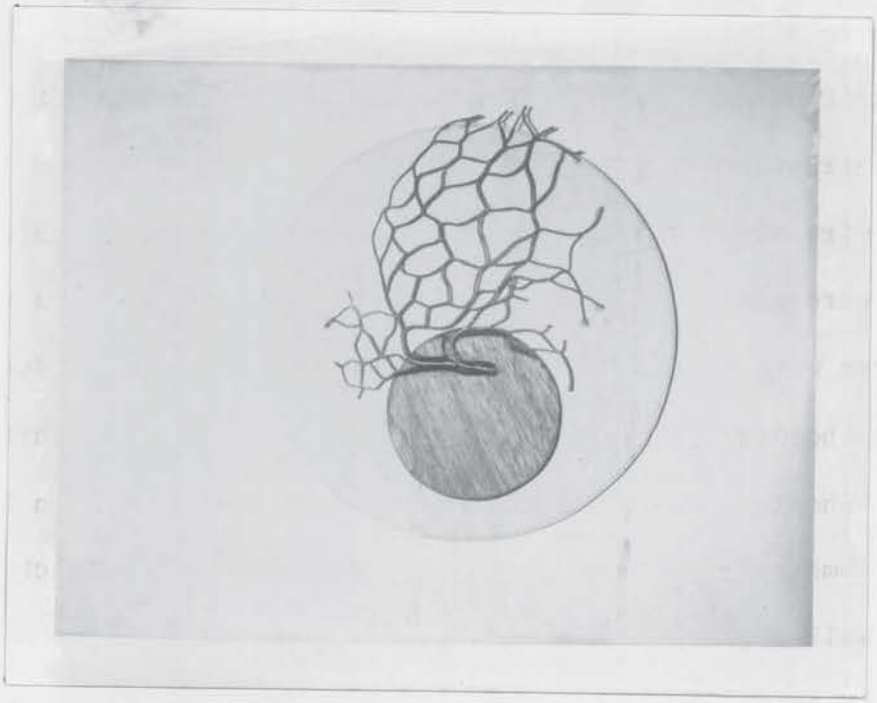
The covered face was treated with liver of sulfur for an antique effect. Areas were selected for highlighting and then buffed, thus creating a greater depth illusion of surface.

The face was attached to the frame by passing 20 gauge copper wire through the hole of a wooden bead and back through holes in the frame and face and a bead on the backside of the face. The wire was then twisted on the backside to lock the pieces together. This process was repeated six times to finish securing the face piece to the frame.

Observations:

1. The wire used to attach the copper sheets to the clay face is decorative as well as functional.
2. The wooden beads, though they function as a holding device, are distracting as not all the beads on the front show.
3. The copper tarnished rapidly but the antique effect has been enhanced rather than lost over the months.
4. Both the ceramic frame and copper-covered face have rugged textures. Though both textures were produced differently, they compliment each other and give the piece artistic unity.
5. The piece was accidently broken. Because of the manner by which it was joined, repair was easy as the piece could be taken apart and reassembled.

PLATE VI



NETWORKS

Title: Networks

Size: 13½ inches in diameter, three-quarter inch thick

Materials: Plywood, mahogany, 24 gauge copper wire, untreated cotton duck, twill tape, epoxy and contact cement

Process: The five and one-half inch diameter, three-quarter inch thick piece of mahogany was found in a wood scrap barrel. It had been "embellished" with a vertical and two horizontal, half-round gouges made by a router and bit. This organic channel, along with the top and sides of the piece, were sanded until smooth, using medium through extra fine Production paper. A hole was drilled to provide a place for the wire structure to "disappear."

The wire structure is made of 24 gauge copper wire. Bundles of the wire were wrapped with the same gauge of wire. As "branches" were made, wires were added into the bundles. The wrapping is done tightly to act as a holding mechanism as well as to give the structure an even texture. Shaping and design were done spontaneously. When the structure was completed, the ends were twisted at the end of each branch and were balled (melted) with an oxy-acetylene torch.

The starting point of the wire structure was inserted into the drilled hole of the mahogany and adhered with epoxy. The wire was allowed to tarnish.

A piece of three-quarter inch plywood was cut in a circle, the diameter of which is 13½ inches. This circle was covered with untreated cotton duck which was stapled onto the back of the plywood. An off-white twill tape, (one inch wide), was glued to the edge of the canvas covered plywood circle with contact cement.

The wire/mahogany structure was then positioned and adhered with epoxy glue to the covered plywood circle. To prevent the wire structure from falling forward, the ends were adhered to the canvas with epoxy glue.

Observations:

1. It is very difficult to determine how much wire one will need to have to make such a structure. Each time one "branches out" less wire is available and sooner or later, more wire must be added . . . to make-up the bundles or be used for wrapping.
2. The epoxy glue stained the canvas where the ends of wire were adhered.
3. The shapes, colors and textures compliment each other. The proportions seem to be correct also.
4. The wire structure is very fragile, but it can easily be re-shaped if it is distorted. Care must be taken in packing the piece for shipping.
5. The cold connection of wire-wrapping offers endless possibilities (metal to metal and non-metal objects).

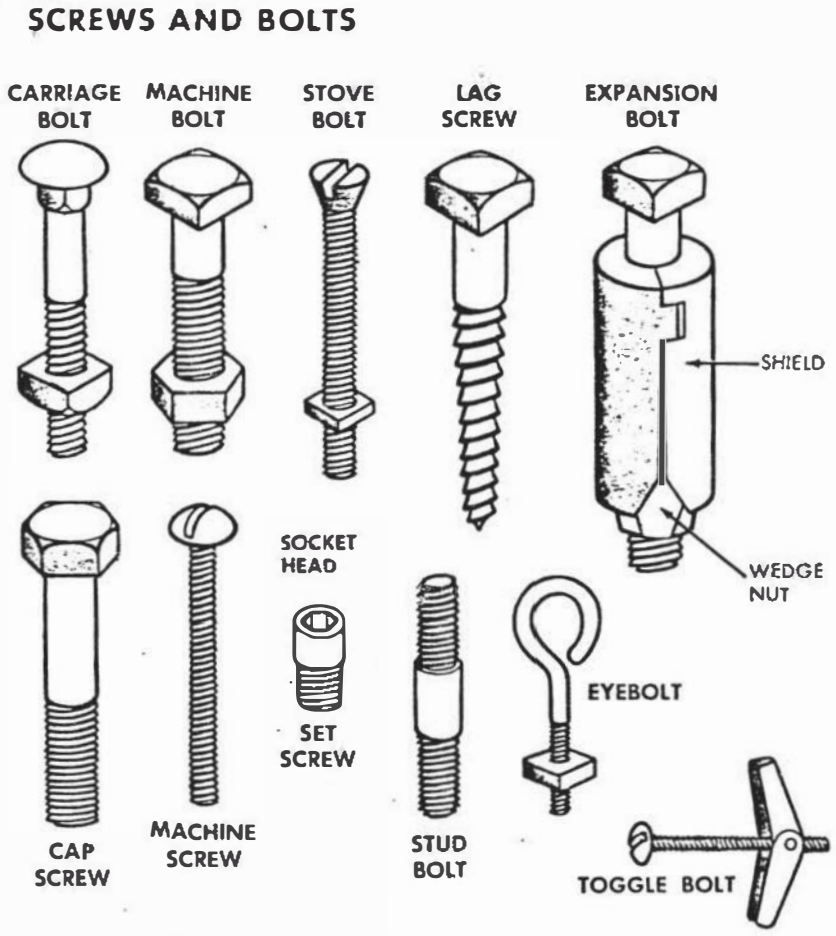

SCREWS AND BOLTS
CARRIAGE BOLT
MACHINE BOLT
STOVE BOLT
LAG SCREW
EXPANSION BOLT
SHIELD
WEDGE NUT
SOCKET HEAD
SET SCREW
EYEBOLT
CAP SCREW
MACHINE SCREW
STUD BOLT
TOGGLE BOLT

FIGURE 7

SCREWS AND BOLTS

Screws and bolts are metallic pins possessing advancing helical threads used to hold objects together. Screws are generally tapered and are turned into relatively soft materials with a tool which engages the slot located on the top of the screw head. Bolts are blunt-ended and are used for connecting several materials together by passage through a drilled or otherwise produced channel in the materials to be joined. The bolt is held in place in the channels by a nut which is a small piece of metal possessing a threaded channel the same diameter as the bolt shaft.

Compared with nails, screws and bolts provide a more secure means of connection by:

1. usually possessing a diameter larger than most nails (nails bend easily);
2. "double securing" the materials by use of threads;
3. having a larger head which permits an easier, more accurate placement (nail heads are somewhat fragile).

Although most people are readily familiar with six or seven types of screws and bolts, the types available are innumerable. The head shapes, length of shafts, angle of thread-diameters, metallic content, thread lengths on the shaft all vary as to the type and size of screw or bolt one may purchase. (Figure 7)

Designed for connective purposes primarily, both the screw and bolt may be used decoratively. Both may also be countersunk within a piece and covered (concealing the means of attachment). An advantage to using screws and bolts is that the objects being joined may also be taken apart and re-

assembled as well as enabling a tighter connection than provided by most cold forms of connection.

Pages twenty-eight through thirty-eight contain illustrations, my work, of the decorative and functional uses of wire.

PIATE VII

MONUMENT TO THE IANDSCAPE

Title: Monument to the Landscape

Size: 22" H by 35" W by 16" D

Materials: Mild steel sheet, particle board, bolts

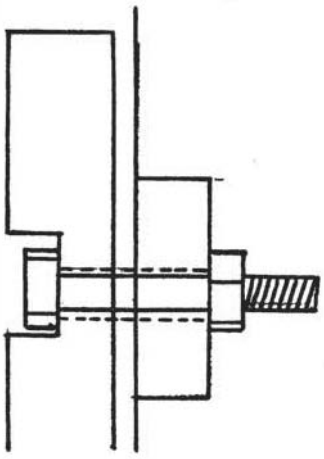
Process: The top of the piece was formed by hammering both the front and the back of a piece of 18 gauge mild steel sheet with several sizes of ball peen hammers. The shape was obtained by placing the sheet over tree trunks, metalsmithing stakes and on the ground to hammer. The texture is derived of hammer blows.

This shaped top was then welded to a rectangle having walls of 18 gauge mild steel sheet into which holes were drilled to provide a channel for attachment to the wood base with bolts. The shaped metal top was then colored by: 1) treating the surface with sulphuric acid in which copper had been boiled--leaving a copper residue on the steel, 2) heating the steel to get fire-scale on the surface, and 3) spraying it with clear gloss plastic spray. The rectangular metal walls were painted with flat black enamel paint.

The base, made of one-half inch particle board, was made to fit the metal top. A groove was cut, one-quarter inch deep, one-half inch wide and one inch from the wood top. In this groove holes were drilled to correspond to the holes in the walls of the metal top. (Figure 8) The corners of this wood base were mitered, glued and nailed together.

Figure 8

Figure 9

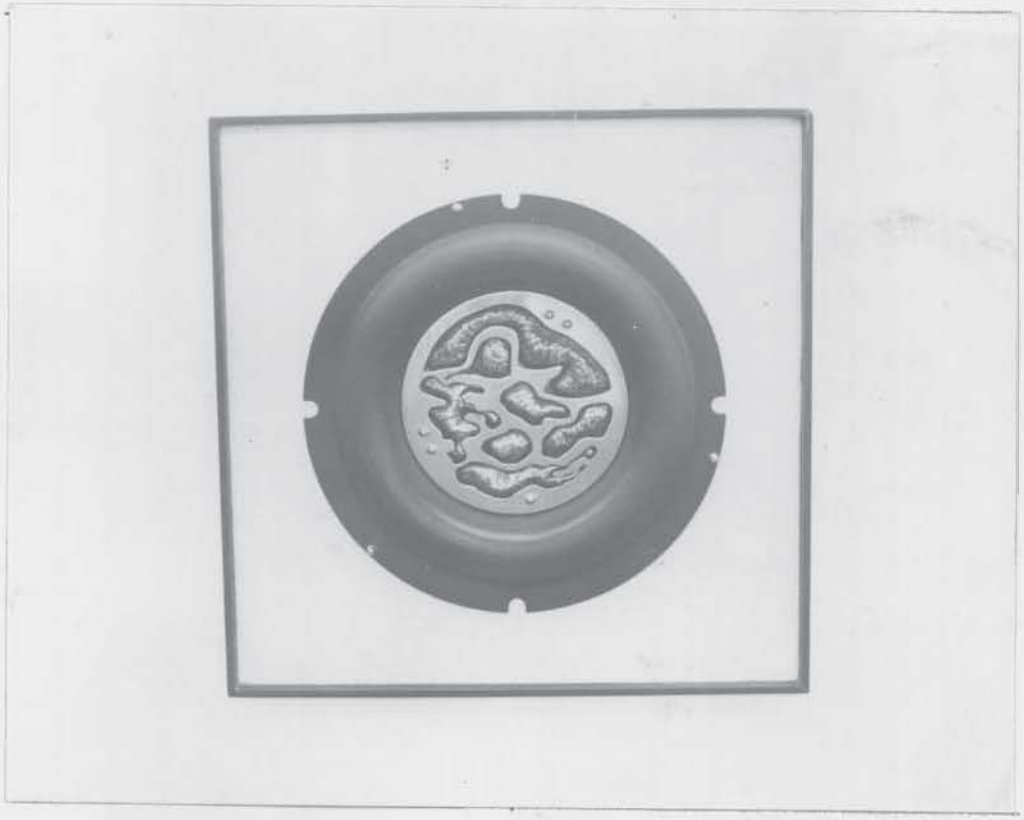


Small nuts and bolts were used to connect the metal to the wood base. The bolt shaft was passed through the base, the metal box and through a piece of wood (which was used for added support and security) located inside the metal box. After the bolts were tightened, the groove was filled with spackling, the base sanded and painted white. (Figure 9)

Observations:

1. Though the use of the wood pieces on the inside of the metal box had been planned prior to the joining of the pieces of wood and metal, they became more necessary after the metal sides were joined to the metal top. During the welding, the sides of the rectangle warped. This made the attachment of the top to the base more difficult. As a result, one side of the wood base is warped. This could have been remedied (or avoided) by using thicker metal sheets for the sides of top and/or thicker particle board. Had the sides been arc-welded rather than oxy-acetylene welded, the metal also may not have warped.
2. The coloration is at best the result of chance. The results worked well with this piece but one might have difficulty duplicating this method of coloration.
3. The surface texture is interesting in that it enhances the idea of rolling plains visible in landscapes. The surface contrasts nicely with the base.

PLATE VIII



MEDALLION

Title: Medallion

Size: 20½" H by 20½" W by 2" D

Materials: Particle board, lattice board, muslin, a steel collar, copper sheet, cold-rolled steel sheet, brass bolts, steel cap-nuts

Process: A nine and one-quarter inch diameter opening was cut in the center of a three-quarter inch thick piece of particle board, twenty inches square. Three 3/16 inch holes were drilled into the board to correspond to holes in the steel collar. The edges of the opening, as well as the outer edges of the board, were slightly beveled to prevent the wood from splintering and the cloth from tearing when it was stretched onto the board. The board was then covered with the off-white muslin, nailing it to the edges of the particle board.

The frame was made with one-quarter inch by one and three-quarter inch lattice board. The corners were mitered. The frame was cut to fit the covered particle board, painted with flat black enamel paint, and attached by nailing the frame so that one-quarter inch extended from the back of the covered board and one-half inch extended from the front.

The steel collar was found at a junkyard. It was in good condition and required only cleaning with soap and water and spraying with flat black enamel paint to finish it. The collar was attached to the covered particle board by three 3/16 inch diameter, one and one-quarter inch long brass stove bolts being pushed through the holes (from the back) in the covered board, through the muslin, and out the holes in the edge of the collar. Steel cap-nuts were twisted onto the exposed ends of the bolts, making the connection tight.

An 18 gauge steel sheet was cut into a circle eight inches in diameter. A non-objective design was drawn on the circle and then areas

were pierced from the circle design. A 20 gauge copper sheet was chased and repoussed into high relief to fit as well as to extend beyond the pierced areas in the steel sheet. Five holes 3/16 inch in diameter were drilled into the steel and the copper sheets simultaneously to avoid mis-matching and poor fit when they were assembled by the bolts.

The pierced sheet was then finished by rubbing it vertically with a piece of coarse grit emery cloth until the surface was lightly textured and shiny. It was then sprayed with clear plastic spray to retard corrosion.

A patina was produced on the copper by soaking the copper in liver of sulfur, rubbed with steel wool (00) to highlight the tops of the reliefs, and sprayed with clear acrylic spray to retain the finish.

The remaining five brass bolts were cut to one-half inch lengths and the center section was assembled as in figure 10 below.

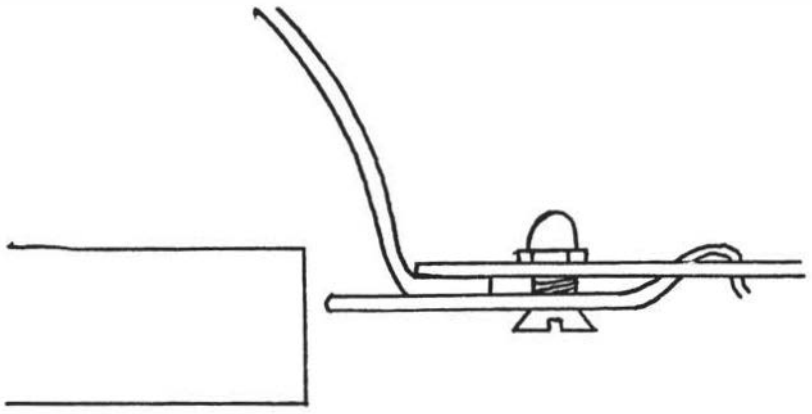
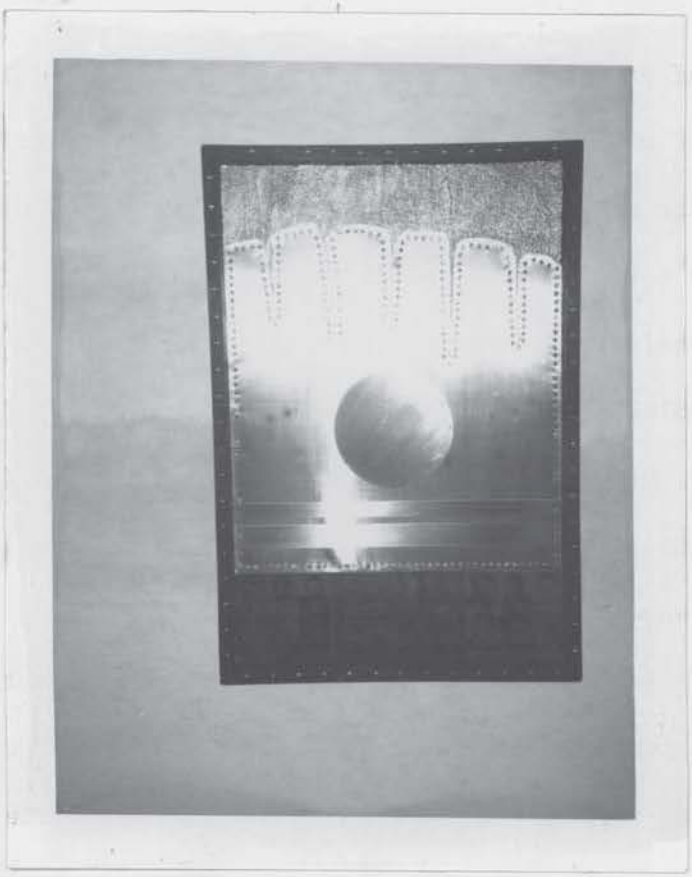


Figure 10

Observations:

1. The Value Pattern is consistant, pleasant, and successful.
2. The design within the center of the collar is balanced and the pierced areas and the reliefs compliment each other well. The reliefs are quite pleasing. They are quite high, and have a uniform organic texture and quality. They seem to draw attention to themselves through their own merits (complimented by the pierced steel).
3. Although the collar is fairly large, it seems small due to the value pattern, the powerful design and the execution of the pierced and relief work in the center.
4. The piece is easily disassembled for cleaning and working the center areas when they tarnish beyond necessity. Reassembly is completed with the same ease.
5. The nuts work both as a means to assemble and also as a decoration (fitting in with the value pattern at the same time).

PLATE IX



NEW HORIZONS--COMMENCEMENT 1957

Title: New Horizons--Commencement 1957

Size: 25½" H by 17½" W by 1½" D

Materials: Plywood, pine, brass sheet, copper sheet, stainless steel sheet, brass screws, contact cement, epoxy glue

Process: A piece of one-half inch thick plywood was cut sixteen inches by twenty-four inches. An eight inch by sixteen inch sheet of 36 gauge copper was adhered to the top of this board with contact cement. After the cement had set, a blunt nail was used to texture the copper. No attempt has been made to prevent the copper from tarnishing.

A sheet of 24 gauge stainless steel was textured by rubbing it with a piece of medium grit emery cloth both horizontally and vertically. Shears were used to cut the sheet into the finished shape: hand shears for the top, a power sheet metal shear for the sides and bottom. Masking tape was placed over the edges of the sheet to protect the finish while holes were drilled three-eighths of an inch apart around the perimeter. Brass screws one-quarter inch long were screwed through these holes into the plywood, leaving four and one-half inches at the bottom of the wood for use later.

A six inch in diameter circle was cut from a sheet of 20 gauge copper and was textured by rubbing it with a piece of coarse emery cloth in one direction. This circle was adhered to the stainless steel with epoxy glue so that the texture was on a diagonal.

At this point it was noticed that the stainless steel area looked odd with nothing on the bottom area to balance the shapes at the top. Pieces of 20 gauge brass and copper were cut into strips sixteen inches long and one and one-quarter inches and three-quarter inches wide respectfully. Holes were drilled into the edges to match the spacing of

the holes in the stainless steel. The strips were then textured by rubbing them with coarse emery cloth. They were then connected to the steel by removing existing screws and re-screwing the pieces together, now with new metals on top.

The bottom of the piece was covered with photo-etched pieces of 16 gauge copper. These pieces were cut from plates once used to print the Eastern Illinois University yearbook. They were adhered to the board with epoxy glue.

The frame was made with five-eighth inch by one and one-half inch white pine. The edges were cut to fit the mounted plywood, the corners were mitered. The frame was painted with flat black acrylic paint and attached to the mounted plywood by nailing it to the edges, flush with the back. Where it was nailed to the edge, paint was applied to hide the nail heads.

To further embellish the piece, more brass screws of the same length used in the piece were screwed one and one-quarter inch apart in the center of each top edge of the painted frame running the entire length of each edge.

Observations:

1. If the texture on the stainless steel would become damaged, the copper circle would not permit the surface to be re-textured in the same manner.
2. The use of screws both decoratively and functionally is highly successful. The use of screws on the frame is very handsome; they add to the piece visually without taking the attention from the piece they surround.

3. The contrasts of textures, shapes, size, light and dark are very effective. Each element is interesting on its own merit and is of such a nature that each also works well with all other elements.
4. The top of the stainless steel should have been cut with a jeweler's saw and blade to make the edges smoother than what the hand shears did. This would improve the appearance of this vital part.

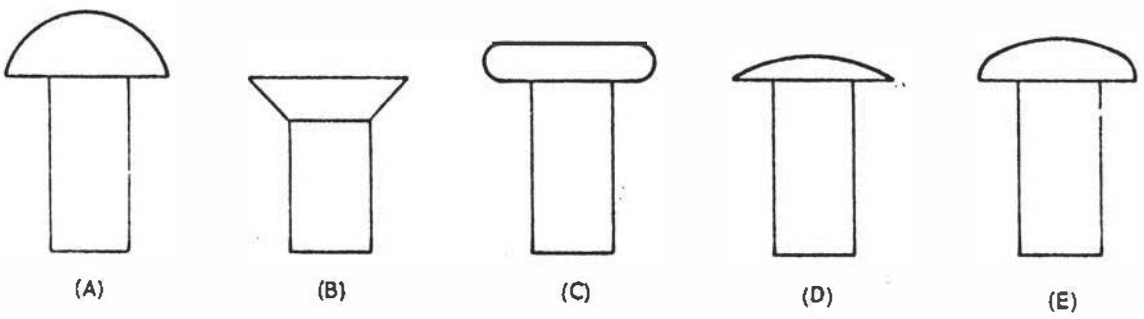
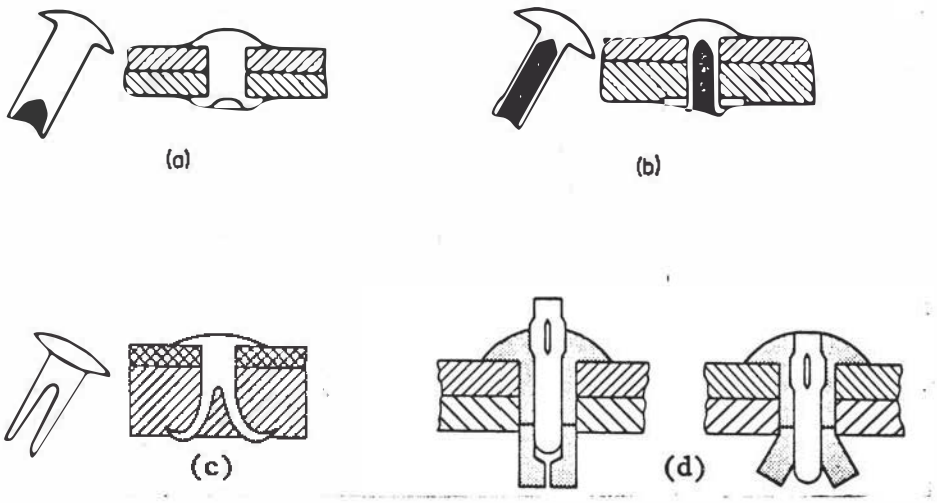


Figure 11: Rivet head styles: (A) Button head. (B) Countersunk head. (C) Flat head. (D) Truss head. (E) Pan head. (a) semi-tubular; (b) tubular; (c) split; and (d) drive-pin.



RIVETS

A rivet may be described as a short metallic pin passing through a hole, keeping two or more pieces of material together at the junction of the materials. The connection is made possible by hammering the pin broad after insertion so as to keep the materials closely bound and tight. It is one of the oldest and easiest methods of cold connection. It provides for joining as well as simple decoration of the materials on which it is used.

Rivets are made of malleable metals of all types and come in a variety of shapes. Tubular, solid and split rivets are available at most hardware stores or can be made of tubing, sheet or wire stock by the craftsman. The most commonly used rivets are the snap head and the countersunk rivets. (Figure 11)

To choose the type of rivet for a connection it is necessary to consider the use of the materials to be joined, the location of the rivet on the materials, and the appearance of the final piece. Since rivets come in a number of designs, a rivet can be easily selected that will not mar the surface. They also may provide a decorative pattern to the pieces being joined.

To set a rivet it is necessary for the materials to be held static for both the drilling of the rivet channel and for the securing of the rivet. The rivet channel should be drilled rather than punched as a drilled hole forms a cleaner and more accurate channel to accept the rivet. The channel should allow the rivet stem to fit tightly.

To select the correct size, the rivet should have a diameter three times the thickness of the materials being riveted. The length of the rivet depends on the shape of the rivet head and the thickness of the materials

being joined. If the rivet is too long, the stem of the rivet will bend, and if the rivet is too short, it will not form the head at the opposite end from the force.[18]

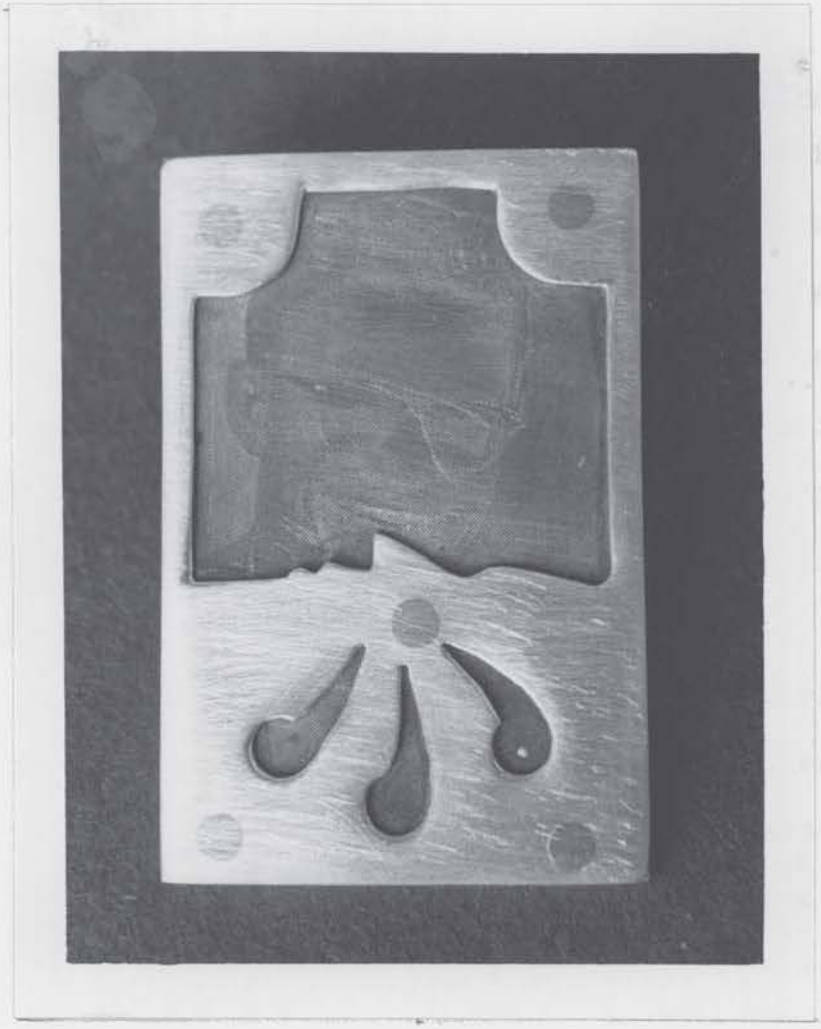
The rivet should be annealed prior to setting to make it more malleable for setting purposes.

Once the rivet has been chosen, and the length and size matched to the drilled channel, the next step is to secure the rivet. Care should be taken to support the pre-formed head of the rivet in a depression that fits its size and shape. A few taps to the end of the rivet will cause it to bulge, locking the materials together. Care should be taken to tap the rivet end in a circular pattern, shaping the rivet head. After the rivet is set, the rivet head may be further shaped with a repousse or dapping tool. If properly set there will be no movement of the materials between the rivet heads unless movement is intentional.[19]

An advantage of using rivets is that their use is not limited to connecting small scale objects; they can also be used for connecting large scale objects (i.e. use in architecture).

Pages forty-two through fifty contain illustrations, my work, of the decorative and functional uses of wire.

PLATE X



SMILING MAN

Title: Smiling Man (pin)

Size: 2" H by 1 5/16" W

Materials: Brass rivets, copper and sterling silver sheets

Process: The background piece is 16 gauge copper sheet. The image of the man was photo-etched on the sheet (once used to print an Eastern Illinois University yearbook). The size of the image determined the size of the finished piece.

The foreground consists of a 20 gauge sterling silver sheet which has been pierced in a decorative way. The sheet is cut to the same size as the copper background.

The two pieces were finished in the same manner: the back of the copper sheet and the front of the silver sheet were both rubbed with a piece of coarse emery cloth, moving vertically across and back. A commercial pin finding was soldered to the copper sheet backing to save time in the completion of the piece.

Brass rivets (five) were obtained from cutting a piece of 8 gauge brass brazing rod. A rivet head was formed by sanding the stem smaller than the head. The brass rivets function as both a cold connection and as a decorative element. The brass rivets add contrast to the silver foreground and compliment the copper background.

Setting of the rivets was done as described on page 41. Added support was necessary to prevent damage to the pin finding. The rivets were countersunk.

The pin was then buffed to complete the piece.

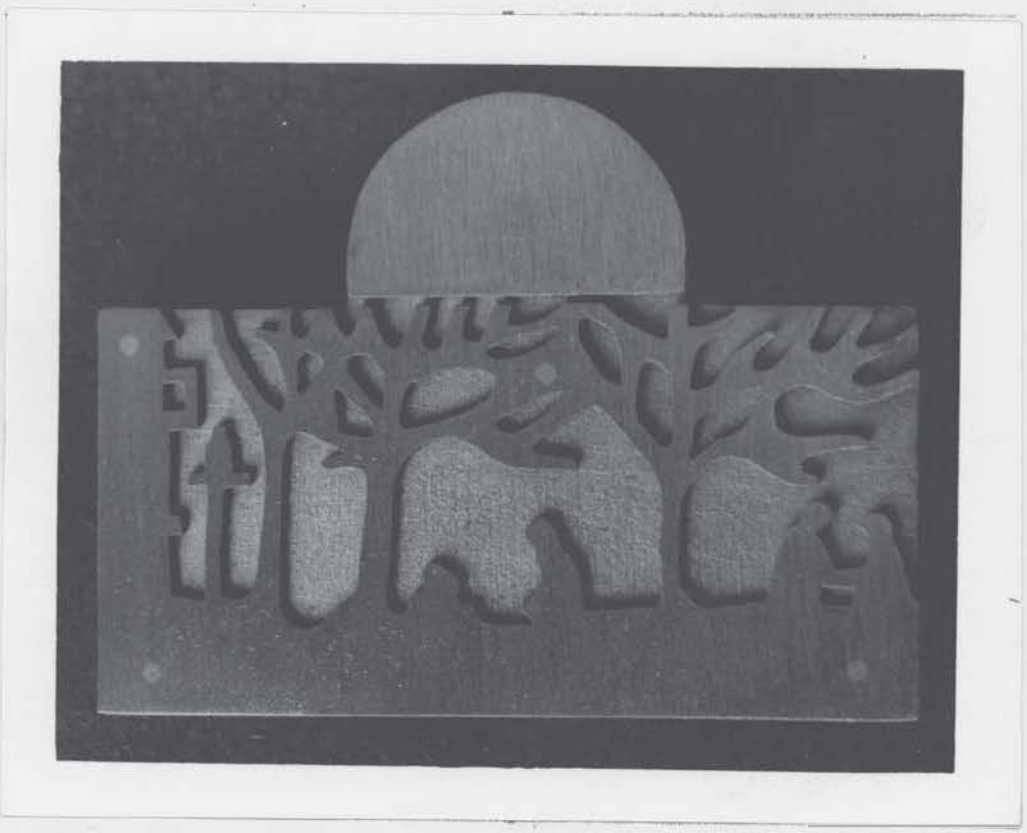
Observations:

1. It is very difficult to maintain a luster on the pin since copper

tarnishes rapidly. Some plastic sprays are effective in preventing or retarding the tarnishing process.

2. The use of the sterling silver sheet is effective when viewed from the front, but, because it is thin, its three-dimensionality is lost. A thicker piece of sterling silver sheet might have solved this problem but might have made the piece too heavy. One might also have cut the silver sheet larger than necessary and wrapped the edges over the copper sheet, burnishing it to the surface.

PLATE XI



EVENING IN THE PARK

Title: Evening in the Park (pin)

Size: 1 3/4" H by 2 1/4" W

Materials: Brass and silver rivets, brass, copper and mild steel sheet

Process: The background section was cut from 20 gauge copper sheet. Wax crayon was rubbed on both the front and the back in a random manner. The piece of copper was then dropped into a weak solution of hydrochloric acid for five minutes. After removing the sheet from the acid, the wax crayon was removed to reveal the etched texture and the piece buffed.

A commercial pin finding was soldered to the copper sheet backing to save time in the completion of the piece.

The lower foreground is made of 18 gauge mild steel sheet. The steel foreground was pierced to form the silhouette of the trees, people, street light and building. The steel foreground was finished by rubbing the piercing up and down with a piece of coarse emery cloth.

The brass half circle was made of 18 gauge brass sheet. It was finished in the same manner as the pierced steel.

Four sterling silver rivets were made from 16 gauge sterling silver rod. The heads were formed by sanding down the stem. Silver was chosen for a contrast to the steel.

One brass rivet was made for the brass half circle from an 8 gauge brazing rod. The rivet head was formed by sanding the stem smaller than the resultant head.

All five rivets were countersunk into their respective places and set. The pin finding required added support for the setting of the rivets.

The piece was finished by buffing both front and back and then spraying the piece with plastic spray.

Observations:

1. This piece was more successful than the Smiling Man pin because:
   a) the gauge of the metal sheets were more satisfactory;
   b) the piercing is more detailed;
   c) the choice of metals provided more color;
   d) the piece is not rectangular which makes it more interesting.
2. The sterling silver rivets should have been heavier in gauge as they were difficult to set. The choice of the small gauge seemed necessary at the time because the areas of the steel piercing appeared quite small; however, a larger gauge would have fit.

PLATE XII

TEXTURES

:tle: Textures (pin)

:ze: 1 1/2" H by 2 1/4" W

:terials: Brass rivets, brass and copper sheets

:ocess: The background piece is made of 20 gauge copper sheet. Before cutting the resultant shape, the sheet was textured by using the rolling mill as a press and embossing the texture of two wire screens laid on top of each other.

The back of the printed side of the copper sheet was textured (by etching) in the same manner as the copper sheet in the pin Evening in the Park, page 46.

A commercial pin finding was soldered to the copper sheet after the sheet had been cut to the desired shape.

The foreground is an 18 gauge brass sheet which was printed from a copper matrix in the rolling mill. The circular textures on the matrix (of 20 gauge copper) were made by dapping hemispheres, then smashing them flat. The textures immediately surrounding them were made with chasing and repousse tools. The completed matrix was then used to emboss the brass sheet.

Four rivets were cut from an 8 gauge brazing rod. The heads were formed by sanding the stem smaller than the resultant head. Again careful counter-sinking and setting of the rivets was necessary to protect the pin finding.

After setting the rivets, the piece was finished by using a dapping tool to further texture the brass sheet; texturing the upper edge of the copper background; buffing the piece; and spraying it with liquid plastic.

Observations:

1. As this piece relies on texture for its embellishment, a different matrix material should have been used. The matrix for the printing should have been made of a metal with a hardness greater than that of the brass printed sheet. The copper matrix did not possess this quality and much of the texture it contained was crushed by the tremendous pressure placed upon it and the brass sheet when it was rolled or printed. The result was a less pronounced texture. The texture on the copper sheet worked well (no matrix was used by the screens were made of a harder metal--steel).
2. The plastic spray worked well to protect this piece from tarnishing; however, one could easily re-finish the piece should it tarnish beyond desirable quality.
3. The different textures and the contrast of the metals worked very well in this piece. The use of the rolling mill as a means to print textures could provide the artist with many new avenues to explore.

ADHESIVES

An adhesive can be described as a substance that is capable of holding materials together by surface attachment. The common names for adhesives are glue, cement, mucilage and paste. Often these terms are used synonymously but this is incorrect as each term is indicative of the manner of manufacture.[20]

Glue refers only to the gelatinous material found in animal hides, bones, cartilage and in fish. Glue has been used for over 5000 years by primitive and highly civilized cultures alike.[21] It bonds without the use of heat, is not moisture resistant, and is the most common of household adhesives. Some examples of glue are the white glues sold in plastic squeeze bottles. These glues are used to bond wood, paper, cloth, leather, cork, and other materials providing one surface is porous.

Cement refers to those adhesives that are, in essence a mixture of the silicates and aluminates of calcium, and is one of the most important of the silicon-bearing products. Rubber cement and contact cement are two familiar types of this adhesive. A characteristic of the cements is that they bond surfaces instantly on contact. Cements may be used to laminate plastic, plywood, and hardwood, leather or plastic to wood or metal and as a general purpose household adhesive.

Mucilage is an adhesive prepared from any of various gummy secretion substances present in plants and water. It has a low bonding strength. The resulting bond is due to evaporation of the water. The exact ingredients of mucilage vary with the use to which the adhesive is to be used. Glycerin or sugar may be added to keep mucilage moist until it is used. One example of

consumer use of mucilage is the adhesive on the back of postage stamps which is made by dissolving dextrin in cold water.

Pastes are adhesives that are made from starch, latex or dextrin. The bond is caused by evaporation. Though strong when dry, pastes are not resistant to moisture. Their use is usually limited to adhering paper to paper.

Metal adherents are a recent development of modern technology. Adhesives used to bond similar materials do not function in the bonding of metal to metal or other materials due to the character of the metal surface.

Modern technology has provided mankind with adhesives for three types of constructions involving metal:

1. Straight metal assembly--all metal construction. The adhesives needed for bonding include both structural (those joints where stress is present) adhesives such as vinyl and epoxy (the stronger) glues and non-structural (little stress) adhesives such as polysulfide, neoprene and/or nitrile rubber base, room temperature curing adhesives, pressure sensitive adhesive tapes and ethyl cellulose cements.

2. Specific mixed metal assemblies--metal and non-metal materials. Often when adhering metal to non-metallic materials a secure bond is not easily accomplished. The reasons for this problem are: differences in the surface compositions and differing expansion rates for the materials being bonded. Because the bond requires the use of heat, the manner of connection is no longer a cold connection and will not be discussed in this thesis.

3. General purpose metal assemblies--those assemblies not requiring strong bonds. These adhesives include acrylic, cellulosic, rubber and vinyl materials, all of which can not be subjected to moist or high temperature climates.[22]

Adhesive bonding has many advantages to offer. No other method of attachment is as satisfactory for many applications. When all the applications of adhesives are taken into account, adhesive bonding must be considered as the most widely used method of holding materials together.

Mechanical fasteners are, by their nature, discontinuous and thus cause stress concentrations. Even welds, which are considered to be the best method of attaching metals, furnish only edge attachment. The adhesively

bonded joint furnishes a full film of adhesive over the bonded parts, which results in a more uniform stress distribution.[23]

The greatest disadvantage of adhesive bonding is its uncertainty; there is presently no means to test the adhesive bond without destruction of the joint and no means to test how long a bond will last.

SURFACE PREPARATION PROCEDURES FOR ADHESIVE BONDING

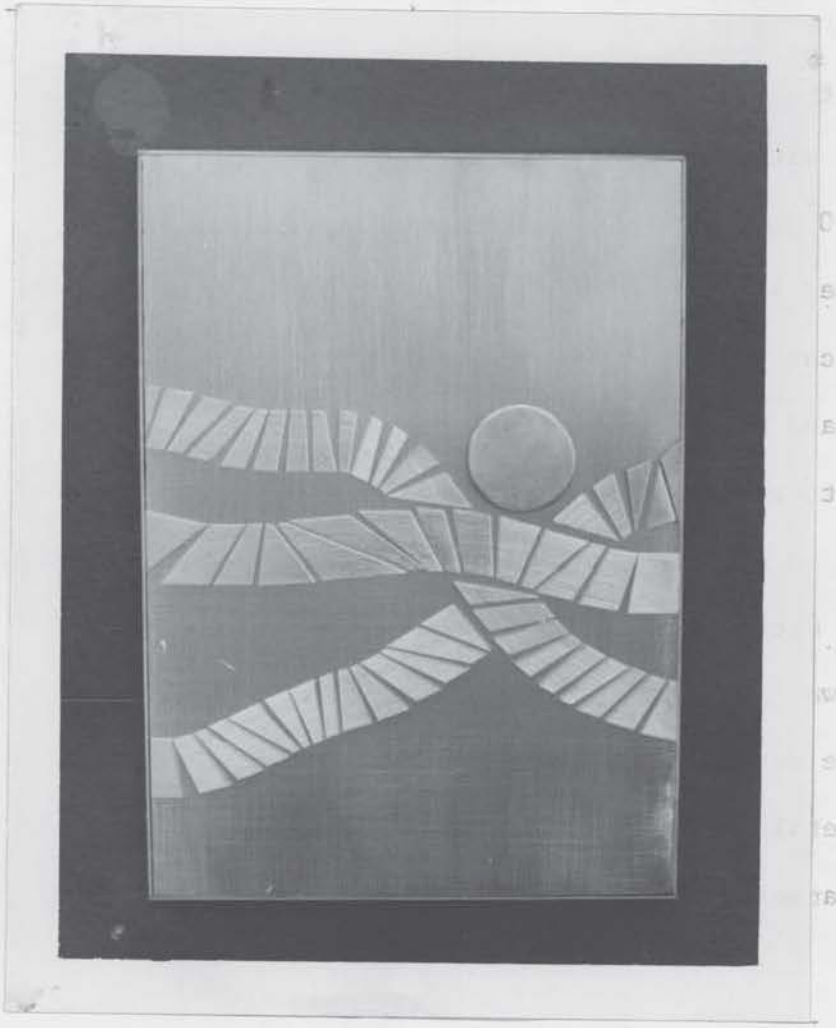
The total force holding two materials together is proportional to the bond area. The best results for adhesion occurs when the surfaces are smooth but not polished. It is a misconception that adhesion occurs best when the surfaces are roughened; that this roughening provides for better interlocking of the surfaces to be bonded. In reality, with roughened surfaces, the adherent can not be spread evenly, thusly assuring a proper bonding of the materials.

Since most surfaces are contaminated by dust, oil, grease and oxides, it is necessary to clean the surfaces prior to bonding. If this is not done, the resulting bond will most likely be incomplete and, with stress, the joint will break.

The procedure for cleaning a surface to be bonded depends on the materials to be bonded but, usually solvents, vapors, sanding or etching is required. It should be noted that the cleansing of the surfaces in these ways are only effective when performed correctly. It should be further noted that after the surfaces are properly cleaned they should not be touched with bare hands or exposed to any environment which could re-contaminate the surface prior to bonding.[24]

Pages fifty-four through sixty-three contain illustrations, my work, of the decorative and functional uses of wire.

PLATE XIII



CROSSROADS

Title: Crossroads

Size: 5 inches by 7 inches by one-half inch

Materials: Plywood, brass, stainless steel, and cold-rolled steel sheets, epoxy glue

Process: A piece of 20 gauge stainless steel sheet was cut five inches by seven inches and adhered to the same size piece of plywood (which was one-half inch thick), with epoxy glue. Thus mounted, the metal was given a textured surface by rubbing it, first vertically and then horizontally, with a piece of medium grit emery cloth.

The 20 gauge brass sheet was cut into strips one-half inch wide and textured like the stainless steel. After texturing, the pieces were then cut by a power sheet metal shear. These pieces were cut one at a time and adhered to the stainless steel with epoxy glue. The resultant patterns came about by changing the angle at which the metal was placed in the shear and laying it on the stainless steel to see the success of each cut.

Care was given to handling the metal surfaces so as to avoid tarnishing the surfaces.

The metal disc is of 18 gauge cold-rolled steel and is textured in the same manner as the other metals. It, too, is adhered with epoxy glue.

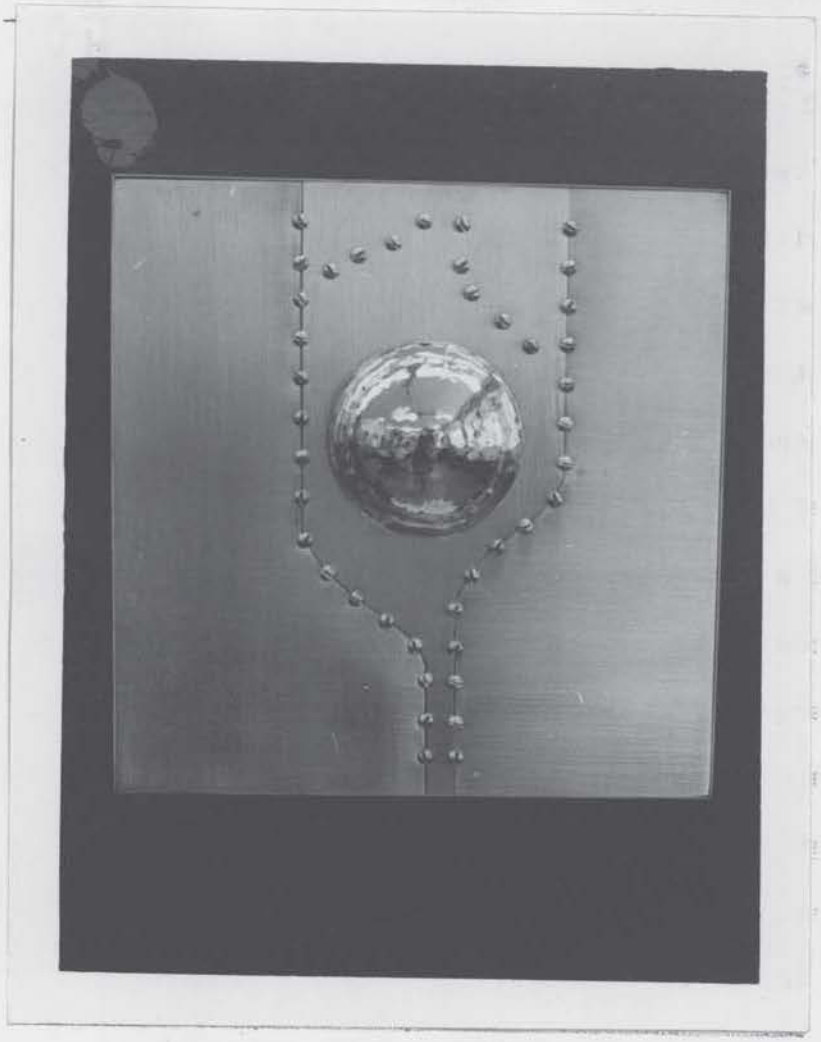
A frame for the piece was made of four pieces of the one-half inch wide brass sheeting. Cut to fit the mounted plywood piece, the edges were also glued with epoxy glue.

Observations:

1. Since the metal tarnishes rapidly, it was sprayed with a clear plastic spray.

2. By using a variety of contrasting metals, one could produce "paintings or graphics" in metal. Subject matter would be endless.
3. The design is somewhat weak. One could improve the idea by: varying the width of the brass strips; changing the placement of the brass pieces; giving the piece more depth through the application of stronger perspective designs creating more levels by laminating several pieces of metal together; et cetera.

PLATE XIV



CONTRASTS

Title: Contrasts

Size: 8" H by 8" W by 1" D

Materials: Plywood, brass sheet, copper sheet, stainless steel sheet, brass screws, epoxy glue

Process: A sheet of 24 gauge stainless steel was lightly textured by rubbing it both vertically and horizontally on a piece of medium grit emery cloth. Two shaped pieces were cut to follow a preconceived design for the low relief sculpture by using a jeweler's saw and blade.

These two pieces were mounted on a half-inch thick piece of plywood, cut eight inches square, with epoxy glue. Care was taken not to touch the metal surfaces as this would stain the surfaces.

A sheet of 20 gauge brass was cut with a jeweler's saw and blade to fit the space left between the stainless steel pieces. This piece was finished by rubbing the sheet vertically on a piece of coarse emery cloth until a uniform texture was obtained. This brass sheet was carefully adhered to the board with epoxy glue, making certain not to touch the metal surfaces and to use only the necessary amount of glue (too much glue and the overflow might damage the metal surfaces).

A slightly domed shape, one inch high, was made from a 20 gauge copper sheet. It was textured on the outside by using a planishing hammer on the surface while the piece was rested on a slightly domed metalsmithing stake. The copper dome was then polished, buffed and glued to the brass surface with epoxy.

To further set-off the design forty-one brass screws, one-quarter inch long were added to the piece. They are a half-inch apart and line the edges between the different metals and form a line within the brass. Holes were drilled to make attachment less difficult.

A frame was made for the mounted board by cutting half-inch strips of 20 gauge brass to fit the edges of the board. They were textured by rubbing them vertically on a piece of coarse emery cloth and adhered with epoxy.

Observations:

1. The metal tarnished rapidly and, because the dome is securely adhered, the surfaces are difficult, if not impossible, to re-texture in the same manner.
2. In cutting the shapes, I forgot to figure for the loss of metal through the sawing action, resulting in gaps between the metals. A tight fit would improve the design execution.
3. The adhering process was successful with the exception that one of the pieces of steel buckled. Apparently the back of the piece was not properly cleaned prior to adhering and it pulled away from the plywood when the screws were tightened. Had the adhesion been strong, the tightening would not have put that much stress on the piece.

PLATE XV

OLD MEMORIES OF SOMEONE

itle: Old Memories of Someone

ize: 18" H by 12" W by 1" D

aterials: Barn wood, steel, iron, brass tacks, copper sheet, epoxy glue, white glue

rocess: The wood for this piece was found in an old barn. All the pieces show the effects of aging, of being exposed to the weather for many years. Several pieces were once painted white, several had been broken off, and many have nail and worm holes in them. No attempt was made to alter the surface textures or colors but the shapes and sizes of some of the pieces were changed as the pieces of the base were assembled.

As various combinations of the wood pieces forming the base were assembled, I noticed that certain combinations of shapes and sizes worked more harmoniously than others. When the base pieces were arranged in the most satisfying combination, work on the areas forming the reliefs began.

I toyed with many combinations of the wood pieces in the relief: changing positions, lengths, widths, textures and colors until the pieces in both the base and the relief complimented each other. As pleasing as the piece was at this point, it lacked an element identifying it with myself. I needed metal in the piece for it to be a more personal expression.

The two metal strips, ten inches long, one-half inch wide and one-eighth inch thick each, were inserted first. The visible edges were ground so that they would draw attention to their use in the piece and also to lighten the area they were located in. These strips were adhered on either side of piece of barn wood already chosen for the piece

with epoxy glue. The base was then glued together, using white glue for the wood to wood sections, epoxy for the metal to wood sections.

Twelve brass tacks were pushed into one of the relief pieces of wood three-quarter inches apart.

A one-half inch wide, nine and one-half inch long strips of 36 gauge copper was burnished between the vertical piece of wood forming the left side of the base and the left ends of the horizontal pieces of wood in the base. It was glued in place with epoxy after shaping.

The iron hook had been attached to a piece of barn wood I had not chosen to use. It and the unidentified metal object were glued with epoxy to the uppermost horizontal piece of wood, the left edge or center located above the copper strip.

The smashed wire cage had been found in an alley. I first thought to use it without metal behind it but it has a similar patterning and color of the wood and became lost on the piece. A four inch circle of 20 gauge copper was adhered to the wood with epoxy where I planned to place the cage. The wires in the cage suggested the size for the circle. The cage was adhered with epoxy to the circle so that the wires could act as a frame for the circle.

No precautions were taken to prevent the metal pieces from tarnishing so that they might better blend with the aged wood.

Observations:

1. The wood (warm) and the metal (cool) do not contrast with each other but rather appear similar. The textures and colors are similar and the shapes are nearly the same.
2. Although one could say the piece is mostly made of wood, the metal pieces make-up a large portion of the visual image. Neither the

wood nor the metal gets applause on its own but rather one sees a marriage of wood, metal, adhesives and design.

3. The visual space is broken-up into many parts, yet none is strong enough to be a strong piece by itself. All the parts contribute the appropriate portion of designed space to make the whole pleasing and stimulating.

CONCLUSION

I chose to investigate a limited number of cold connections. Knowing a little about several types of cold connections has been more advantageous than knowing a great deal about one type of cold connection. Resultant frustration, boredom, the lack of creative approaches to my work, and the lack of enthusiasm have not influened my research because I have limited knowledge of each type of cold connection I chose. The ideas were plentiful and the pieces were more than just satisfactorily completed.

It would be easy to say that this thesis is only a spring board for further investigation of cold connections and their uses by the artist. As is mentioned in the Preface, there are many types of cold connections; the scope of my investigation suggests the uses of cold connections to be nearly endless. One could develop a quite extensive discussion on any one type of cold connection successfully (an example being the section on adhesives). Such a dissertation could include: an account of the author's use of the cold connection artistically as well as functionally (including pictures of the work); how the connections tested under stress or in changing climatic conditions; and the limits, advantages and disadvantages of using the cold connection (even one of these suggestions alone could comprise a sizeable dissertation).

As technology provides new materials for mankind to join together, and new techniques and materials for joining, one will either use the existing types of cold connections, re-design them, or will develop new types to fit his needs. The extent of an investigation of the uses of cold connections by a sculptor and metalsmith appears interminable.

NOTES

[1]Gerald Barreman, Anthropology Today (Del Mar, Cal.: Communications Research Machine, Inc., 1971), p. 238.

[2]E. Adamson Hoebel, Anthropology: The Study of Man (New York: McGraw-Hill, Inc., 1958), p.184.

[3]Leslie Aitchison, History of Metals (New York: Interscience Publishers, Inc., 1960), p. 25.

[4]Ibid., 69.

[5]J. Anderson Black, The Story of Jewelry (New York: William Morrow and Company, Inc., 1974), p. 50.

[6]Charles Singer, et al., A History of Technology (New York: Oxford University Press, 1956), p. 677.

[7]Ibid., 222.

[8]Ibid., 632.

[9]Ibid., 242.

[10]Edward De Bono, Eureka! An Illustrated History of Inventions from the Wheel to the Computer (New York: Holt, Rinehart and Winston, 1974), p. 216.

[11]James J. Kelly, The Sculptural Idea (Minneapolis: Burgess Publishing Company, 1974), p. 60.

[12]Singer, p. 234.

[13]Arline M. Fisch, Textile Techniques in Metal for Jewelers, Sculptors, and Textile Artists (New York: VanNostrand Reinhold Company, 1975), p. 38.

[14]Black, p. 26.

[15]Ibid., 50.

[16]Oppi Untracht, Metal Techniques for Craftsmen (Garden City, New York: Doubleday and Company, Inc., 1968), p. 44.

[17]Fisch, p. 10

[18]Giachino, J. W., Basic Sheet-Metal Practice (Scranton: International Textbook Company, 1952), p. 132.

[19]Ibid.

[20]Charles V. Cagle, Handbook of Adhesive Bonding (St. Louis: McGraw-Hill, Inc., 1973), p. 21.

[21]Barreman, p. 238.

[22]Irving Katz, Adhesive Materials: Their Properties and Usage (Long Beach, California: Foster Publishing Company, 1964), p. 55.

[23]John P. Cook, Construction Sealants and Adhesives (New York: John Wiley and Sons, Inc., 1970), p. 209. (the forge weld should not be included in this meaning of welding).

[24]Katz, p. 414.

BIBLIOGRAPHY

Aitchison, Leslie. History of Metals. New York: Interscience Publishers, Inc., 1960.

Barreman, Gerald. Anthropology Today. Del Mar, California: Communications Research Machine, Inc., 1971.

Black, J. Anderson. The Story of Jewelry. New York: William Morrow and Company, Inc., 1974.

Cagle, Charles V. Handbook of Adhesive Bonding. St. Louis: McGraw-Hill, Inc., 1973.

Cook, John P. Construction Sealants and Adhesives. New York: John Wiley and Sons, Inc., 1970.

De Bono, Edward. Eureka! An Illustrated History of Inventions from the Wheel to the Computer. New York: Holt, Rinehart and Winston, 1974.

Dennis, W. H. A Hundred Years of Metallurgy. Chicago: Aldine Publishing Company, 1963.

Fisch, Arline M. Textile Techniques in Metal for Jewelers, Sculptors, and Textile Artists. New York: VanNostrand Reinhold Company, 1975.

Giachino, J. W. Basic Sheet-Metal Practice. Scranton: International Textbook Company, 1952.

Hoebel, E. Adamson. Anthropology: The Study of Man. New York: McGraw-Hill, Inc., 1958.

Katz, Irving. Adhesive Materials: Their Properties and Usage. Long Beach, Califirnia: Foster Publishing Company, 1964.

Kelly, James J. The Sculptural Idea. Minneapolis: Burgess Publishing Company, 1974.

Mason, Anita. An Illustrated Dictionary of Jewellery. Evanston: Harper and Row, Pub., 1974.

Parr, James Gordon. Man, Metals and Modern Magic. Cleveland: American Society for Metals, 1958.

Rich, Jack C. The Materials and Methods of Sculpture. New York: Oxford University Press, 1963.

Singer, Charles; Holmyard, E. J.; Hall, A. R.; Williams, Trevor. A History of Technology. New York: Oxford University Press, 1956.

Untracht, Oppi. Metal Techniques for Craftsmen. Garden City, New York: Doubleday & Company, Inc., 1968.