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# Treatise on combined metalworking techniques: forged elements and chased raised shapes

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# TREATISE ON COMBINED METALWORKING TECHNIQUES:
# FORGED ELEMENTS AND CHASED RAISED SHAPES

# TREATISE ON COMBINED METALWORKING TECHNIQUES: FORGED ELEMENTS AND CHASED RAISED SHAPES

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## DEDICATION

FORM MUST GIVE FORTH THE SPIRIT
FORM IS THE MANNER IN WHICH THE SPIRIT IS EXPRESSED

ELIEL SAARINAN

IN MEMORY OF MY FATHER, WHO LONGED FOR HIS CHILDREN TO HAVE THE OPPORTUNITY TO HAVE THE EDUCATION HE NEVER HAD THE FORTUNE TO OBTAIN.

# PREFACE

Although the processes of raising, forging, and chasing of metal have been covered in most technical books, to date there is no major source which deals with the functional and aesthetic requirements of combining these various techniques in depth. My goal in writing this thesis is to compile a reference manual for both the student and the advanced craftsman, based on my explorations and research.

In conjunction with the written text, I have included photographs whenever possible to give a clearer understanding of the metalworking process. This should be especially helpful to the artist, who tends to be visually perceptive.

I would like to acknowledge the guidance and information I received from Hans Christensen, which in many cases was information unobtainable in any book. If some areas are not covered in depth, it is because of the scope of that particular topic and the possibility of future students to develop it into other theses.

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# PART I.: INTRODUCTION

## INTRODUCTION

By combining forging, raising, and chasing in metalwork, the possibilities of form and decoration are unlimited. Though there are extreme differences between the techniques employed, all three processes basically are involved in forming the metal.

The key word to remember is form. Each technique has its own method of forming. How do these different techniques change the metal from its original form? The end goal is to use these techniques to create a unified form.

Forging is the process of working thick metals with intermittent sharp blows from a hammer to move the metal and shape it. For raising, a hammer is also used but, in raising, the process of making a hollow form starts from a fairly thin, flat sheet. This process is accomplished by bringing the sides up gradually in stages of hammering metal on an anvil or a wooden stake. Chasing differs from the two methods mentioned above in that it is a decorative process involving surface modeling of

metals from the front with the aid of various shaped punches and a hammer.

This treatise also considers two types of metalwork within these three areas of forging, raising, and chasing. Michael D'Grando said: "My reason for doing both hollow ware and jewelry is that I think of both as a sculptural medium. One can be very dependent or influential on the other. In both these mediums, the artist-craftsman applies to tradition (or in some cases, non traditional) materials the same concepts and forms that are embodied in the art of sculpture. However, within the realm of hollow-ware and sculptural adornment, one must meet certain functional requirements."[1]

As an art form, metalwork should adhere to the principles of communicating a statement. Through the use of raising, one can achieve a maximum of three-dimensional message in metal. Forging offers functional and visual strength to a design. It additionally gives the artist an option to emphasize linear design.

Chasing can be used as a decorative surface embellishment which creates a visual contrast to bare surfaces usually created by forging and raising. It provides depth on an otherwise flat surface. By

re-establishing and following outlines as they merge into the surrounding background, a soft and organic effect is obtained. The most successful result of fine chasing leaves the unmistakeable impression of hand tooling. One of the reasons I tend to choose a raised form to chase on is that one of the primary things to avoid with chasing or any decorative technique is the effect or ornamentation which has been made from a different piece of metal and appears incoherent. A design should be unified. The advantage of using chasing is the ability to achieve various tilt surfaces and use the play of light on the metal surface to bring out the richness of the metal surface.[2]

With all three processes the plastic quality of the metal can be utilized to its fullest extent. Written explanation can only begin to indicate to the student the possibilities of the material. The behavior of the metal is the best instructor, and chasing especially lends itself well to the spontaneous artist.

# PART II.: THE WORKING PROCESS

# THE SEQUENCE OF STEPS IN DEVELOPING A PIECE WITH FORGED ELEMENTS AND RAISED CHASED SHAPES

## I. PRELIMINARIES

### Choose a Design Incorporating all three techniques

With a raised form it is necessary to have the design finalized on paper in order to figure out the amount of metal needed. The detail of design needed for forging is about the same. In chasing, however, it is best to figure out the general form, but allow the details to develop out of the metal as you work.

### Selecting the Metal

#### Raising

In order to achieve any great amount of movement the metal must be stretched quite a bit. For this reason, a substantial stock or 18 or 19 gauge is desirable. Thicker gauge is too difficult to move and thinner is easily punctured.

#### Forging

In cold forging one can use as thin as 7 gauge metal. In most cases, square or round stock is used. Square of round stock ranges between anything from 12 gauge to 3 inch stock or even thicker. The most commonly used stocks range between 12 gauge and 3/4 inch stock.

Chasing

In order to achieve deep relief the metal must stretch quite a bit. For this purpose, 18-20 gauge allows for a substantial amount of movement.

If fine or low relief work is desired, 20 gauge is usually recommended. Thinner gauges (22-26 gauge) are easier to manipulate, but one must be careful not to puncture thinner metals with the sharper chasing tools.

Transferring the Design to the Metal

If one is preparing to make a raised form it is easiest to make a life size drawing of the piece (Fig. 1). When starting to raise from a cone shape, the size of the metal is determined by making the drawing of the piece a part of a circle and making the cone shape three times the width of the piece, and about one-quarter inch extra on top and bottom (Fig. 2). Then one can cut out a paper pattern and rubber cement it on the metal.(Fig. 3).

For the chased design carbon paper or a smooth round stylus gives an accurate transfer for relatively flat surfaces. However, on a raised form, the chased design must be drawn in free hand with lead or grease pencil.

Fig. 1

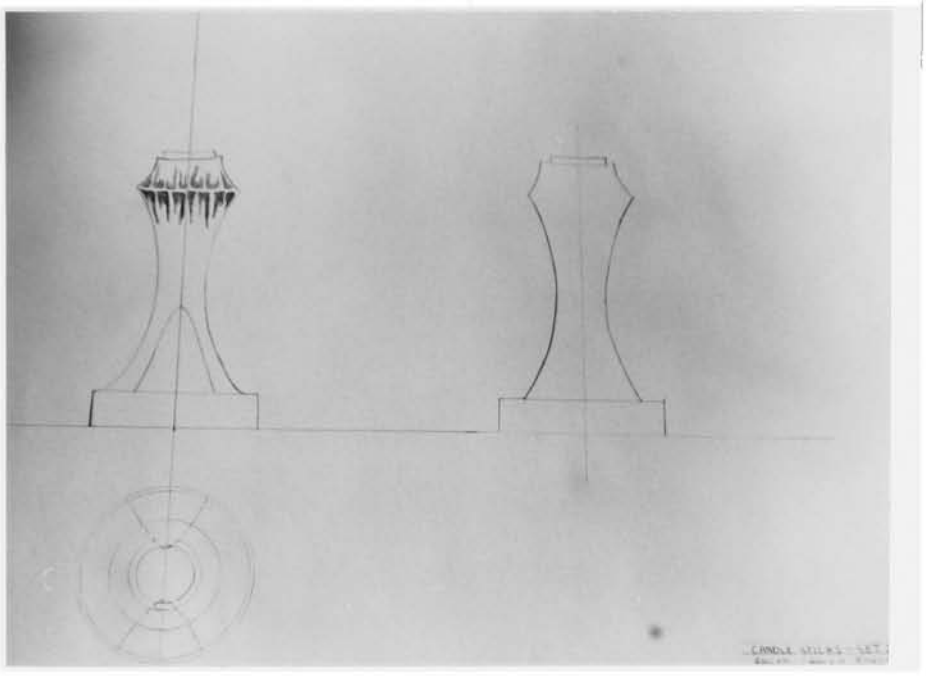


Fig. 2

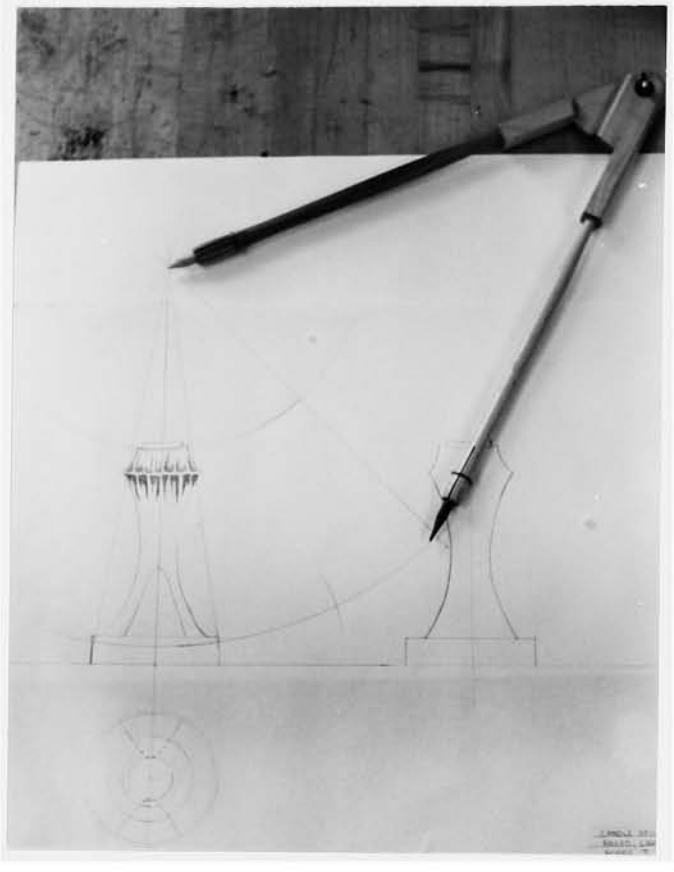


Fig. 1. Drawing of Design

Fig. 2. Determining Size of Metal


Fig. 3


Fig. 4

Fig. 3. Pattern Placed on Metal

Fig. 4. Bench Shears - for long, straight cuts

Cutting out the Metal

After transferring the design to the metal, there are several methods of cutting out the design. If it is a long straight edge, the bench shears are most accurate (Fig. 4). If it is a circular form, the round bench shears work well (Fig. 5). Hand shears are usually used for harder to reach areas (Fig. 6), and a jeweler's saw is used for more intricate work (Fig. 7). It is good practice to file the edges after sawing to free them of snags which possibly could be worked into the metal and cause cracking.

Annealing the Metal

After cutting out the design, it is necessary to anneal the metal before working with it. When most metal comes from the foundry, it is in a work-hardened, springy state which has been induced by rolling the metal down to desired gauges. Annealing the metal changes it from the work-hardened state to a soft, easily manipulated state. This malleable state is highly desirable for forging, chasing, and raising. Through working, metals undergo a crystalline, or molecular, structural change. If this condition is not remedied at the proper time, further working will cause the metal to crack.[4] If this does happen, the cracks should be repaired at once. (See page 46)

Fig. 5

Fig. 5. Circular Shears - for curve cuts

Fig. 6. Hand Shears - for odd angles

Fig. 6

Fig. 7

Fig. 7. Jeweler's Saw - for intricate cutting

Fig. 8. Set up for annealing small pieces on asbestos

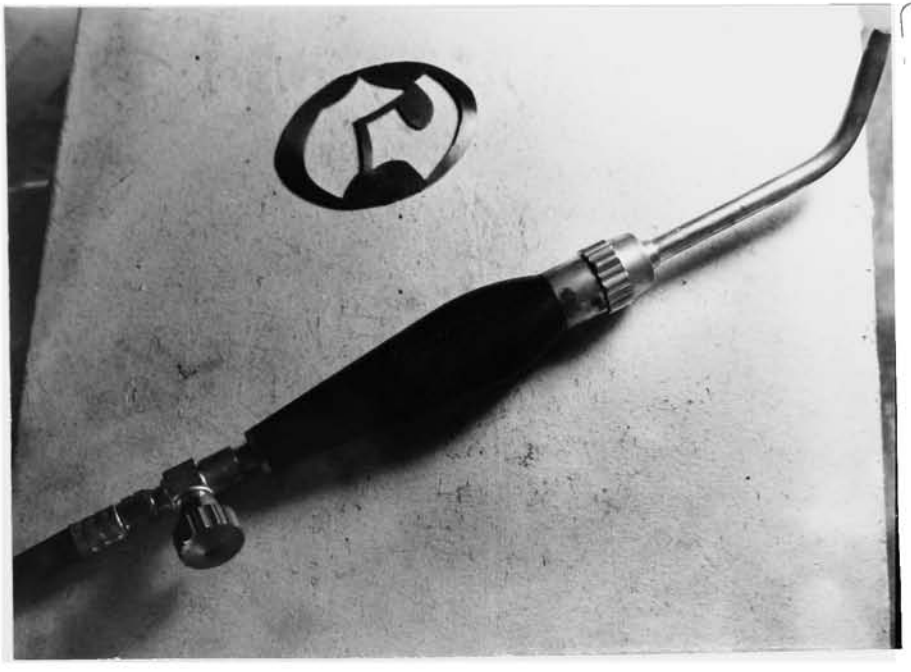


Fig. 8

Before annealing, the metal should be cleaned with an abrasive such as pumice powder or fine emery to remove all scratches from the surface. Then place the metal on an asbestos pad if it is small or thin, or a pan filled with rock pumice if it is an average piece. The reason for placing a piece of metal on the asbestos pad is that it draws heat from the metal and keeps small pieces from becoming overheated (Fig. 8). However, with larger pieces of metal, such as forged elements or large sheets it is best to place them directly on the stones so that there is as little head loss as possible (Fig. 9).

A large, soft reducing or non-oxidizing flame is usually best. An oxidizing flame has a high content of oxygen, is bluish in color, and usually comes to a sharp point. A reducing flame is more yellowish in color and is more feathery and loose. The metal should be heated to a dull cherry red. Sterling silver may be safely heated to 1100 degrees - 1200 degrees, gold to 1200 degrees, and copper to 700 degrees - 1200 degrees F.[5] The easiest way to detect when the metal has reached the proper color is to anneal in a dark room or poorly lit area. Overheating the metal may result in melting, destruction of the working quality, and a heavy firecoat.

Fig. 9

Fig. 10

**Fig. 9. Set up for annealing large pieces on pumice stones**

**Fig. 10. Pickling the metal**

Pickling the Metal (Fig. 10)

The pickle bath is made up of sulphuric acid and water in proportions of one part acid to six or eight parts water. Sparex is a commercially produced substitute for sulphuric acid, and it is safer for general use. If the pickle bath is heated until it begins to steam, the chemical reaction will occur more quickly (Fig. 11). This is especially handy for jewelry work.

When the red hot non-ferrous metals are plunged in water or other cooling liquids, the sudden cooling or "quenching" makes it 25% softer than if it were allowed to cool down by air. With a pair of copper or brass tongs, remove the annealed metal from the annealing pan and quench immediately in water. This removes the oxides and dirt. If one puts a warm piece of the metal directly into the acid the chemical reaction will also be sped up.

However, in final stages of planishing, putting a hot piece of metal into the acid can cause warpage. Also, in seamed cylinders, putting the hot metal directly into the acid causes the acid to react more strongly, especially on the seam, which has a higher copper content. This can be detrimental because if much raising is to be done, it can cause cracking.

Fig. 11

Fig. 11. Hot Pickle

Fig. 12. Washing the Metal after pickling

Fig. 12

Never put steel into the pickling solution. This causes the copper ions in solution to plate on the piece. Thus, it is best to avoid placing pieces in the acid with pliers or tweezers. It is important to remove all binding wire used to hold pieces together for soldering before placing the metal into the pickle.

After pickling the metal for about ten minutes or more, remove it from the pickle with copper tongs and rinse with water and dry the metal (Fig. 12).

## II. RAISING

### Preparing the Metal for an Overlapping Seam

After annealing the metal, the two edges to be joined are scraped on the front and back surfaces (Fig. 13). Then one edge on the front side has to be filed at a 60 degree angle and the other edge the backside has to be filed at the same angle. Often it is helpful to place the edge parallel with the top of the work bench and C clamp it down so the metal does not move while filing (Fig. 14). When the filing is completed each edge is bent at approximately a 90 degree angle. One edge is bent toward the other. The easiest method for accomplishing this bend is to put about ½" to 1" in the top edge of a drawer and push down (Fig. 15, Fig. 16). Then one cuts two small flaps about 1/4" to 3/16" wide and deep into each end of the inner edge of the cone of cylinder (Fig. 17). Now the edges of the seam are pushed together and past each other. The flaps are then raised and the upper edge snapped into place (Fig. 18). The flaps are then planished gently into place, and light planishing right next to the seam on the side that goes underneath causes the metal edges to move together (Fig. 19). Lightly planish the seam line and the seam should become tight. It is now ready to solder.

Fig. 13

Fig. 13. Scraping edges

Fig. 14. Filing edges for over-lapping seam - set up on bench with C clamp

Fig. 14

Fig. 15

Fig. 15. Bending edges

Fig. 16

Fig. 16. Edges bent

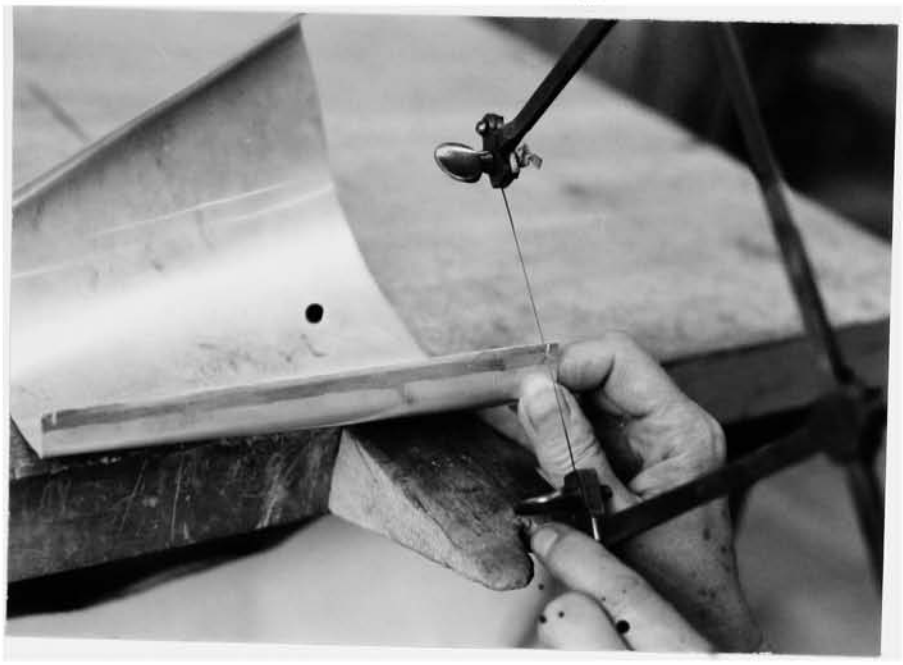


Fig. 17

Fig. 17. Cutting Flaps

Fig. 18. Snapping edges in place

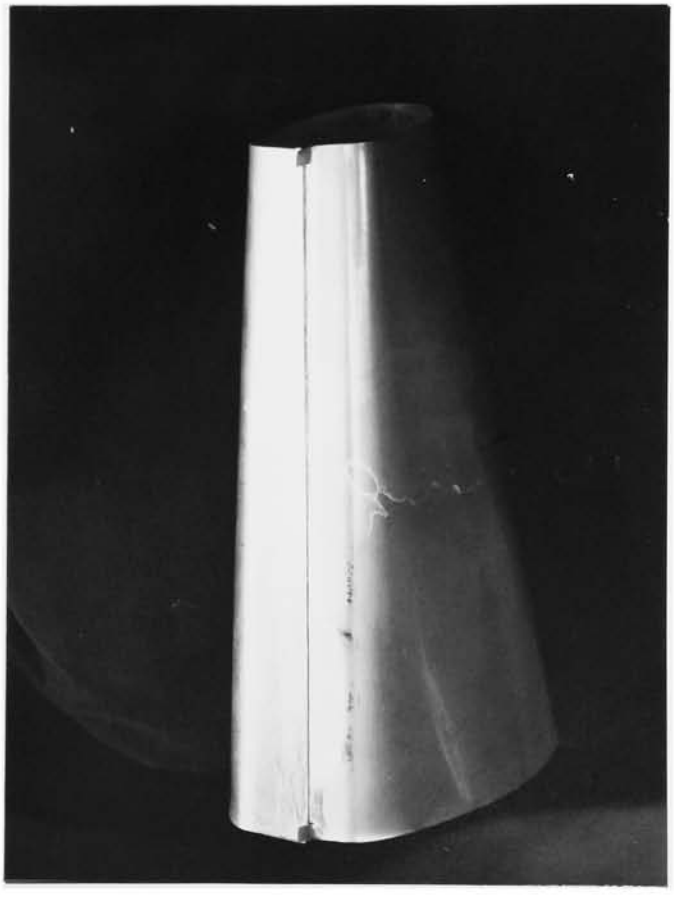


Fig. 18

Fig. 19

Fig. 19. Planishing edge to close seam

Fig. 20. Set up for soldering seam and heating flux

Fig. 20

Soldering an Overlapping Seam

Flux should be generously applied to both the inside and the outside of the seam. Place the cone, seam down, in the pumice stone in an annealing pan and place pieces of heat bricks on either side of the cone (Fig. 20). Heat the cone gently with a soft flame until the flux has at least turned white and stopped bubbling. Then one can placè the pieces of twisted hard solder on the edge of the seam on the inside of the cone. The solder should be about 3/18" long and placed between 1/8" to 1/4" apart (Fig. 21). By placing each piece of solder in the flux before placing it on the seam, it will stick where one puts it and keep the solder from oxidizing.

After all the solder is in place, the heating process is continued but with a stronger flame. Both sides of the cone should be evenly heated to prevent solder from flowing all to one side. Also, the entire cone should be heated and one should not concentrate the heat on the seam until the solder is ready to flow or the flux can be burnt off and the heat will run to the rest of the piece trying to equalize the temperature in the metal. One can tell the solder is about to flow by the color of the metal, which is at an annealing stage and by the consistency of the flux

Fig. 21

Fig. 21. Solder placed on seam and ready to heat

Fig. 22. Placing cone in hot water to clean and check seam

Fig. 22

which becomes first sticky (at this point, some solder may move and must be adjusted with solder pick) and finally a clear liquid state. At this point, your flame should become a neutral flame and directed along the edge of the seam where the solder is placed. The point of the flame should be at about a 45 degree to 60 degree angle with the solder and not at a 90 degree angle. Remember the solder flows toward the hottest spot and running the flame along the edge of the seam causes the solder to follow this path.

After the soldering is completed the piece should be allowed to cool. Then place the cone in hot water to clean off the flux and check the seam (Fig. 22). The cone should not be placed in the pickle until you have achieved a perfect seam. If an area of the seam does not have enough solder reflux, add solder and reheat. If the seam is solid (Fig. 23), place it in the pickle.

Cleaning an Overlapping Seam (Fig. 24)

After the cone is pickled, remove it from the acid, wash in water and dry. Then file off any excess solder and sharp edges, and emery the seam so that there are no scratches (Fig. 25).

Hammering seam together and rounding cone

After the seam is completely clean, a heavy hammer

Fig. 23

Fig. 23. Placing cone in pickle

Fig. 24. Filing off excess solder

Fig. 24

is used on the flatter side of the raising stake to make the seam smooth (Fig. 26). Then the piece is annealed, pickled, and planished on the seam. Anneal and pickle once more. Then, gently round the cone with a rawhide mallet until it is round (Fig. 27). One is then ready to raise the desired shape (Fig. 28).

Raising

Tools (Fig. 29)

Wooden raising stakes

T stakes - 1 arm flat on top and other circular section

Vice

Raising hammer - 2 faced 1¼" by 1¼", well rounded off

Dapping hammer

Planishing hammer

Torch

Pickle

Raising is the process of making a hollow form from a flat sheet by bringing the sides up gradually in stages of hammering the metal on metal or wooden stakes.[6] There are two basic methods of shaping metals by the use of hammers. One is by compression methods, such as raising and crimping. (The other method is by stretching the metal to form it, which includes blocking a mold, pressing, or sinking.) In raising, the

Fig. 25

Fig. 25. Clean soldered seam

Fig. 26. Flattening seam

Fig. 27. Cones after rounded with mallet

Fig. 26

Fig. 27

Fig. 28

Fig. 28. Cones ready to be raised

Fig. 29. Tools for raising

Fig. 30. Raising

Fig. 29

Fig. 30

blows are directed mainly on the convex surface of the form. Many raised shapes are seamless or made of seamless units joined by soldering. Basically they consist of variations of cylinder, cone, or free form shapes, all capable of holding a volume.

To avoid fatigue when raising a form and to insure maximum efficiency, it is necessary to hold the hammer and metal at the proper angle. The worker can either sit or stand with his body facing the stake (forming tool used in conjunction with the hammer in raising). The metal is held in the left hand (for right handed persons), and the hammer in the right, with the level of the stake at the striking point in line with the level of the elbow. The fingers should grip the hammer handle firmly at the end of the handle for correct balance and maximum leverage (never near the head). When a blow is delivered, the handle is held in line with the forearm and the wrist is stiff, but not rigidly tense. The weight of the blow is directed by the muscles of the forearm, chest, and shoulder.

The angle between the metal and the stake should be maintained if a uniform shape is desired. The metal is continuously rotated as each completed round of blows advances toward the desired point. In the case

of the cone used in Fig. 30, it is raised from the edge toward the center in order to stretch the center portion. It is advisable not to thin the center area out before hand by raising from the center out as one might normally do. This can prevent cracking in later stages.

After completing one course in raising (Fig. 31), the piece must be annealed before repeating the process. Raising will be continued until the shape of the cone is slightly smaller than the actual drawing (Fig. 32). The reason for this is that planishing the metal smooth will cause a certain amount of stretching.

The center portion of the candlestick will not be defined until the outer portions that were raised are almost completely planished (Fig. 33). The logic behind this step is that the area in the center has a fairly sharp edge and if one defined it first, then planished the raised areas, the center portion could become off center and changing a sharp edge once it is defined is extremely difficult. Defining in the center portion, also, only has to be roughly planished because it will be chased.

Planishing is done after the piece is finally shaped with a light half-pound planish hammer, which

has a highly polished, slightly convex face, and a spring handle. The piece must be held as flat as possible against the stake. Planishing should be done slowly and steadily with rhythmic blows starting from the bottom line and working towards the edge. Each planish mark should slightly overlap the previous one as the piece is slowly rotated (Fig. 34). In this process the metal will, also, become work-hardened after each course, and annealing will be necessary. A cardboard template will also be handy in determining how symmetrical the shape is, and what areas need to be brought in or out (Fig. 35).

Fig. 31

Fig. 32

Fig. 33

Fig. 31. First course in raising
Fig. 32. Completion of raising
Fig. 33. Illustration of planished candlesticks before area to be raised is perfected

Fig. 34

Fig. 34. Planishing

Fig. 35. Template

Fig. 35

Fig. 36

Fig. 36. Use of height gauge to determine area to be raised in

Fig. 37. Raising in area to be chased

Fig. 37

Fig. 38

Fig. 38. Piece totally raised

Fig. 39. Stake made for perfecting center portion

Fig. 39

## III. CHASING

### Preparing the Metal - Placing on hardground surfaces

In order to raise a pattern on the surface of the metal, the work must be placed on a substance that gives some resistance and yet allows each blow on the metal to change the immediate surface and at the same time support the metal near by.[7] The support material should be in continuous contact with the surface of the metal.

Pitch is the most commonly used substance and can be placed in a cast iron pitch bowl (Fig. 41) for jewelry or actually poured into the piece itself for hollow ware forms (Fig. 45).

To place flat sheet metal in a pitch bowl and have it adhere properly there are several guide lines to follow. If it is a rectangular piece of metal, the four corners should be bent at about a 30 degree angle before trying to place it in the pitch. Secondly, it is helpful to warm the pitch several times with a soft flame until it melts and becomes plastic and is level with the bowl before laying the metal on the pitch surface. If the flame is too hot, it burns and becomes brittle and loses

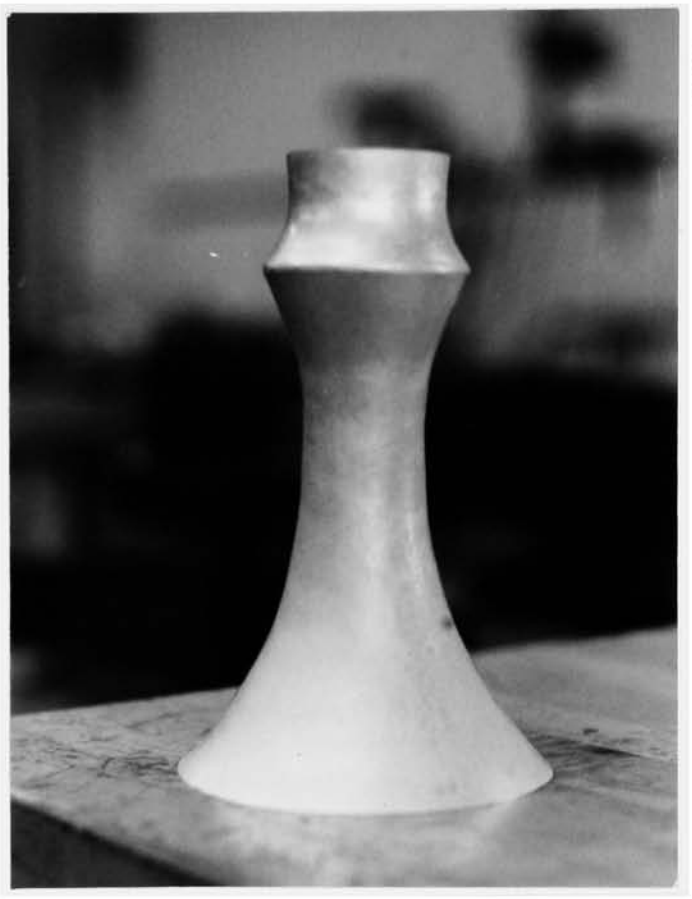


Fig. 40

Fig. 40. Planished candlestick ready to chase

Fig. 41. Pitch Bowl

Fig. 41

its adhesiveness.[8] To insure perfect adhesion the metal and pitch should both be warmed (Fig. 46). After placing the metal on the pitch, wiggle it sidewards while pushing down gently on the metal to remove any possible air bubbles underneath the metal and secure its position. Excess pitch may be wiped off with a rag dipped in hot parafin, alcohol, benzol, or kerosene, or if it is cold, it may be chipped off. Also, rubbing a little vaseline on the surface of the metal that comes in direct contact with the pitch will make removal easier.[9]

When beginning with a dapped form, it is necessary to pour pitch into the form before placing it in the bowl and allowing it to cool enough to return to a solid state. Then the pitch bowl is warmed in the same manner as mentioned above. This time after placing the dapped form in the pitch bowl, warm the whole unit slightly and allow it to cool.

In order for the pitch to serve as a resilient backing it must be allowed to cool before any work is attempted. The best method is to allow it to cool slowly and evenly. One can run it under cold water or place it next to a window in the winter,

Fig. 42

Fig. 43

Fig. 44

Fig. 42. Candlesticks prepared for pitch, and stick used to support piece

Fig. 43. A filled form-placing wood in position

Fig. 44. Filling the remainder of candlesticks

but the chance for the pitch to become brittle and crack is greater.

Lead, tin, zinc, linoleum, wood, or microcrystalline wax are also used as backings for metal, but they can be found to be unsuitable for some work because of the hollow forms in designs.

To prepare a hollow form for pitch, the smaller end must be plugged. Paper toweling over the end and taped to the sides works well. Next a hard wood board must be selected to place in the pitch. This board will be used to place the piece in the vice at various angles for chasing. It must reach at least halfway into the hollow form, and not touch any side of the hollow form. Also, it is advisable to get the thickest piece of wood possible for the size of the form because the thicker the wood, the less vibration while chasing. After selecting the wood, hammer one nail on each side of the wood at the point where the wood comes out of the piece when placed half way into the hollow form (Fig. 42). Meanwhile, the pitch should be heating until it reaches a liquid state, at about three quarters full with pitch. The wooden board is then put into place, making sure that it does not touch any side, and the pitch can then continue to be poured until the form

is full (Fig. 43, Fig. 44). At this point, the form filled with pitch must be left setting for several hours while it cools (Fig. 45).

Form for Chasing

Chasing is any relief work done from the front. The worker should sit directly in front and sufficiently above the work to look down upon it. The chasing punch is held firmly, but not tightly, in the left hand (if right handed). The placement of the fingers on the punch is extremely important for maximum control. Place the first three fingers on the side of the tool farthest from the worker, rest or cushion the third finger on the metal, hold the fourth finger out from the third finger and place the thumb on the side of the tool nearest the worker (Fig. 49). Then, place the tool on the line to be traced, tipping the tool back slightly from the direction it is to move. For small curves, tip the tool back at a greater angle.[10] The reason for this positioning of the hand is that it allows the tool to spring up after it has been hit.

Next, pick up the chasing hammer and hold the rounded pear-shaped end of the hammer in the palm of the hand. Place the first finger on top of the handle, the thumb on the side, and curve the other three

Fig. 45

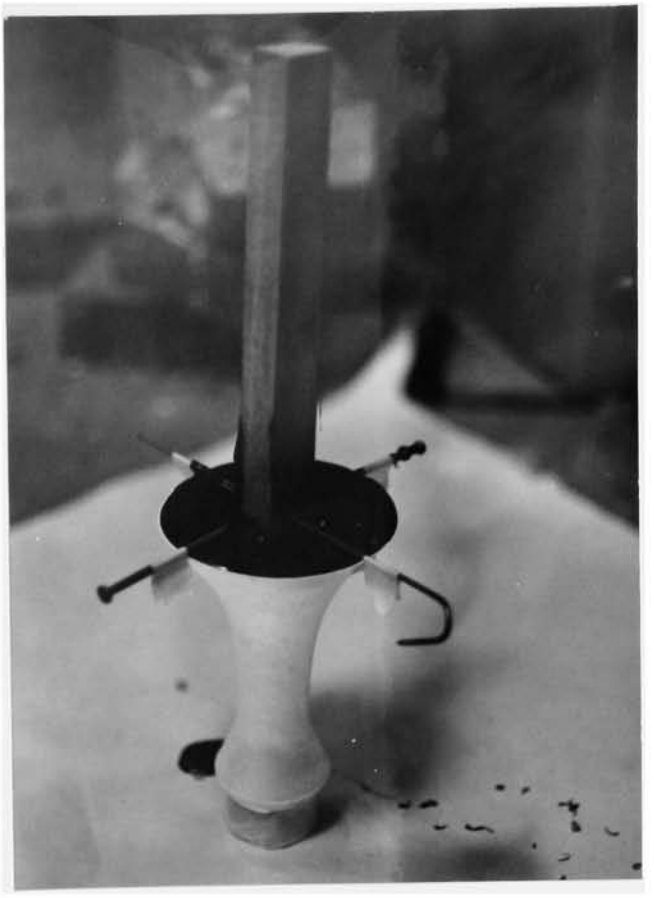


Fig. 45. Candlesticks filled with pitch and cooling

Fig. 46. Warming pitch

Fig. 46

Fig. 47

Fig. 47. Drawing design on piece

Fig. 48. Position of wood in vise for chasing

Fig. 48

Fig. 49

Fig. 49. Form for chasing-hand position

fingers around the thick end. The face of the hammer is held in a normal relationship to the axis of the tool. A chasing hammer or ball peen will both function for hammers, but a chasing hammer with an emery finish is preferable because of its large face (Fig. 50).

First Step

The first course of chasing should block out the masses by pushing down the relief areas from the front. The design has already been traced on the metal with carbon paper or free hand (Fig. 47). The areas to be raised and depressed have been determined. One begins working with smooth, rounded punches to push down areas which are to remain the lowest. As the tool moves toward the worker with each blow of the hammer, a smooth groove should be left on the surface of the metal. While making repeated blows on the tool, keep the eye on the line of the design and not the end of the tool.[11] Don't expect to do too much refining on the total desired depth in the first stage. After the lowest areas have become work-hardened, remove the metal from the pitch, clean it, anneal it, pickle it and dry it before replacing it in the pitch (refer to p. 37).

Patching Holes

If the metal is pushed too far during the first course, after the metal becomes work-hardened the surface becomes uneven, thinner in the sections, and in this state the metal can easily be punctured with the chasing tools. If the metal is punctured, the best procedure is to repair the damage immediately and prevent any possible increase in damage.

The best way to patch a hole is to drill or file out the hole slightly larger than it is. Insert a wedge or piece of wire of slightly smaller dimension, so that it fits snugly. The wire or rod should be of the same material as the original piece. Cut off the wire and leave it protruding on the outside. Clean and flux the crack and the pin through the joint. Capillary action will draw the solder into place. Clean the soldered piece in the pickle and file off the excess solder and the protruding pin.[12] The joint will show slightly, but textured surface of chasing makes the imperfection only noticeable to the trained eye.

Removing the Metal from the Pitch

The most common way of loosening the metal from the pitch is to warm the metal and lift it off the pitch with a pair of old tweezers (Fig. 51a) and

Fig. 51a.

Fig. 51. Use of pitch

Fig. 51a. Removing piece from pitch bowl (Same form used for placing piece in bowl)

allow excess pitch to drip off into the bowl. The metal should not be heated over the pitch bowl. If it is, ashes may fall in the pitch which will contaminate it and cause soft spots in the pitch which are detrimental to a chaser.

If one is removing pitch from a hollow form the piece must be securely hung above the pitch pan with binding wire (Fig. 51b). Then, the piece must be gently heated with a soft flame from the bottom until the pitch all drips out. It is extremely important not to heat the container at the center or top or the pitch will expand and can cause an explosion which is extremely dangerous.

Burning off Pitch

This operation should be carried out in a well ventilated area that is isolated from the regular working areas because of the mess and the possibility of contamination.

An old asbestos pad is more satisfactory than pumice stones for setting the metal on because excess pitch does usually run off the piece and causes the stones to stick together. If using a pad, place the metal on it face up and begin heating with a soft flame. The pitch will begin to bubble and smoke. Continue to heat until all the pitch turns to white

Fig. 50


Fig. 51

Fig. 50. Chasing hammers and ball peen hammer

Fig. 51b. Removing pitch from hollow form

Fig. 52. Heating excess pitch until it turns to white ash

Fig. 52

ash (Fig. 52). Then anneal the piece.

Quenching, Washing, and Drying

After annealing the metal it is not advisable to place it directly into the pickle because the white ash contaminates the pickling solution. First, one should wash the metal in hot water to remove the ashes. (A brush may be helpful in this step.) Place the metal in the pickle for ten minutes. Remove from the pickle, clean with water and dry throughly, and the piece is ready to be replaced in the pitch.

Planishing

When the surface of the chased metal is examined, lumps of areas with ridges will probably be found, undesirable marks to be removed. These areas can be refined by planishing. There are several methods used for planishing chased metal. One method is to planish the metal over dapping tools that are used like miniature stakes. (A regular planishing hammer may be too large and heavy for this type of work, but the flat end of a medium weight riveting hammer is a good substitute.) Another method is to fill the hollow areas with pitch and then place the metal in the pitch bowl and allow it to cool. It can be planished next.

Second Step (Fig. 53)

In this step the craftsman begins to define and refine his chased form with linear tools. If a visible outline is desired around a particular shape, curved or straight lines are best to define the outline.[13] As a chaser perfects his style the outlines are crisp and clear, instead of heavy and wavering like a beginner.

Texturing

Texturing is used on areas in which a covering of closely placed tool marks are desired to create an overall effect. To increase speed for this effect it is helpful to hold the tool in the same manner as described in the beginning of this section, but keep the little finger on the surface of the metal while the tool is held slightly above the surface of the metal and is returned to this position after every blow with the hammer. This technique increases the rapidity with which one can chase, since it eliminates the additional motions of placing the tool in a new position for every stroke. This method allows flexible movement of the tool over the surface and permits the tool to rotate between the fingers in order to create varying effects.[14]

Matting tools are made specifically with textures

on the faces. By using these tools a broader surface may be textured in a shorter amount of time. However, one must be cautious in using them because if great control is not used the pattern can become sloppy in appearance.

Fig. 53

Fig. 54

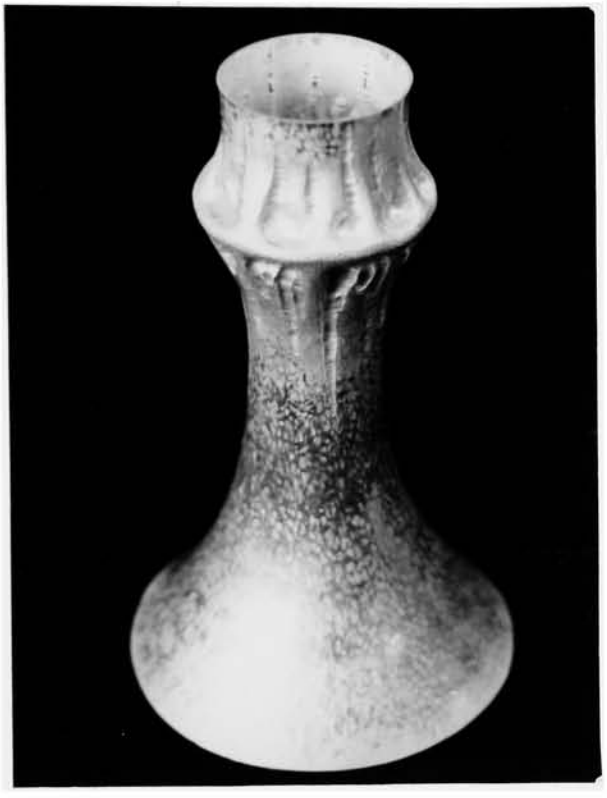


Fig. 53. Defining the form

Fig. 54. Hollow form that can't be done by repousse'

Fig. 55. Butt seam for top of candleholder

Fig. 55

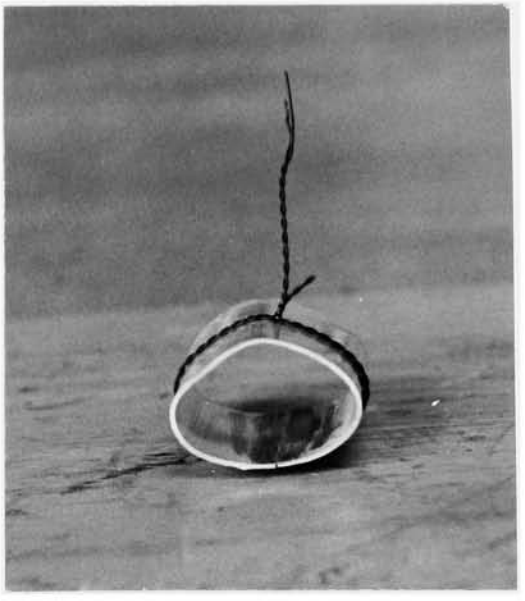


Fig. 56

Fig. 56. Detail of construction of candleholder
Fig. 57. Detail of construction of candleholder
Fig. 58. Detail of construction of candleholder

Fig. 57

Fig. 58

## IV. REPOUSSE'

Strictly speaking repousse' is that part of ornamental work produced by modeling sheet metal with a hammer and punches which is done from the reverse side of the metal. It is the bossing up of lines or patterns from the back. However, in modern times all relief work done on the back or front and chasing is defined in these terms as touching up and finishing of cast work hand held punches.[15]

There are three main divisions of chasing and repousse'. Flat chasing, worked on one side-- the front-- mainly with tracers. Backgrounds may be textured. Embossing, the raising of forms from the back.

In repousse' there are usually three stages: outlining with tracers, reversing the metal on pitch and giving it texture, the metal is once more turned over, bringing the front uppermost. Extreme depth can be achieved by sinking the background and modeling the parts left standing.

Because of the embossed effect often attempted in repousse' there are several things one must remember. In raising bosses of any height avoid straining the metal by inclining the tool and working outwards, toward the edges of forms. Anneal as soon as the metal

hardens.

For Steps or procedure refer to Chasing

It is usually difficult to reach the full depth in an area on the first course. The deeper the hollow is to be, the farther out from the center one must gather the metal. To push down a deep recess, a broad area is worked down to about half the desired depth. In the second and third stages the final shape and depth is achieved. As in chasing, when attempting to achieve great depth smooth larger round punches or dapping punches are used in the beginning.

Repousse' Tools (Fig. 72)[16]

(Drawings)

Repousse', in many cases, can not be used for hollow ware. The reason being that the design for chasing is often located in an area which can not be reached on the inside with repousse' tools (Fig. 44). For this reason repousse' in the strictest sense is used mainly for jewelry.

## V. FORGING

In this thesis, I refer to cold forging, which is a method of working silver, gold, and non-ferrous metal. The design for forged elements or forms must be based upon experience in the process. The shape can't be arbitrarily imposed on the metal. Instead, the shape must be drawn out of the metal by the action of the forging hammer and the displacing of metal.[17] The end result is that variations of metal thickness are visible.

The anvil is the basic tool or surface on which metals are shaped in conjunction with hammers. On a large anvil the main central part is referred to as the body, and the horn or bick is the pointed rounded end used for forming curves or rings. The hammers used in conjunction with the anvil are forging hammer (about a two pound cross peen sledge hammer), raising hammers, and planishing hammers.

### Forging Operations

Drawing out or forging down is a method of forging in which one uniformly decreases a cross section thickness while increasing the length. Tapering is one variation of drawing down round or flat stock in which one gradually decreases the diameter of a

piece. An example of this technique can be seen in the legs of the Bud Vase in Fig. 73.

Upsetting is the opposite of drawing down by compressing or changing the angle of forging action by 90 degrees. (This is a technique used in making rivets and giving variation in planes in forging.[18])

Other common operations used in forging are twisting and bending.

Working Process

Cold forging compresses the structure of the metal which causes it to become work-hardened. Therefore, before starting to forge and at various stages of working the metal it is necessary to anneal the metal to return it to its highest degree of malleability.

Determining the amount of material needed to start with is often difficult. For the average forged neckpiece or pendant you should start with about two-thirds of the actual length desired. If starting with heavy sheet it is best to cut a pattern of the design out of paper and make the actual piece only slightly smaller because in this case one is probably interested in achieving more of a directional movement than a plane or linear movement. An example of the latter can be seen in the base of the Chalice (Fig. 60).

A helpful hint for the beginner when he is attempt-

Fig. 59. Detail of construction of candleholder
Fig. 60. Chalice
Fig. 61. Drawing down metal

Fig. 59

Fig. 60

Fig. 61

ing to forge a pendant, neckpiece, or circular form, if at all possible solder the form at least temporarily together before starting to forge. This technique can save many hours of frustration for the metalworker. The technical reason for making this joint stems from the fact that when one starts to forge on one side of a pendant or other circular form, the curve expands. When one solders the piece together this movement is inhibited and allows symmetry to be attained with greater ease.

If soldering is not desired or needed, anneal, pickle, wash and dry the metal as the first step in forging. When starting with a stock that is approximately the appropriate length to begin with general shape is hammered out on the anvil with a rawhide mallet, (a technique especially used on thinner stock). The general planes are determined in this step. The best way to stretch wire stock and thin it at the same time is to forge across the length of the wire (vertically - Fig. 61). After getting a particular area to the desired size and shape one uses the flat side of the forging hammer to remove the forging marks and in later steps a planishing hammer to smooth the surface.

A tapered shape, on the other hand, is tapered

first and then bent with rawhide mallets into shape. This process can be quickened by taking one's annealed stock and rolling it down to various thicknesses.

After annealing the metal, variations in thickness are hammered out in stake shown in Fig. 62 by constantly turning the stock working on eliminating the edges first and the metal is then planished smooth, filed and emeried.

On the other hand, if one wants to increase the width of an area on a forged piece the cross peen is used horizontally on the metal which pushes the metal sideways instead of lengthwise (Fig. 63). Another variation of forging is to hit the metal vertically on one edge which will cause the outside edge to be lengthened while the inside length is not. The end result is that it causes the metal to curve (Fig. 64).

All of these techniques enable the craftsman to create a great variation in movement and planes which creates an optical delight that can't be equalled by any other metalworking technique. The best way for the beginning student to explore this aspect of metalworking is to take several short pieces of stock and experiment to find the limitation and possibilities of the material. He will be able to tell when a piece is work-hardened by the action of the hammer on the

Fig. 62

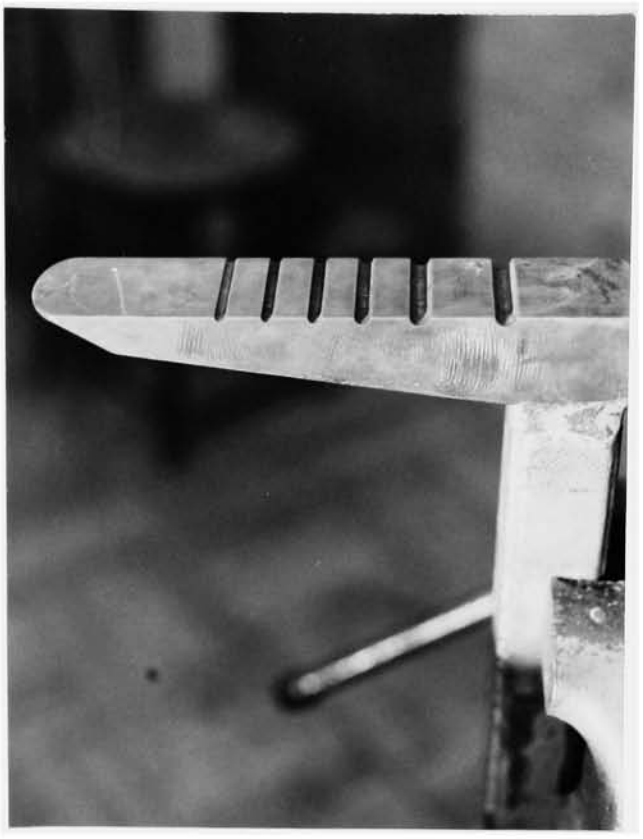


Fig. 62. Stake for tapering
Fig. 63. Widening metal by forging
Fig. 64. Forging curve

Fig. 63

Fig. 64

metal. In the beginning the metal moves readily and gives to the blows of the hammer. (Again the hammer moves basically from a wrist movement and the weight of the hammer does the work.) When the metal becomes work-hardened there will be little movement of metal and the hammer will bounce more off the metal. At this point anneal the metal to prevent cracking. Another important point in starting a forged design is to make sure after one has forged out the desired shape and taken out the forging marks with the rounded side of the hammer that the form is planished as perfectly as possible. This will save hours of filing and perfect the form. In the filing stage, it is best to file as much of one surface at a time as possible and a forward motion (the cutting movement) is most effective.

Finish

One can leave a planished texture on a forged piece, a filed surface, an emeried surface, a polished surface, or a combination of the above. Also, if making a pendant or neckpiece one may not want to anneal the piece after a certain point in order to use the work-hardened state as a natural spring to return a pendant or neckpiece to a particular shape after it has been stretched to place around the neck,

or as a spring mechanism for a pin. In this case it may be necessary to rivet additional elements on the neckpiece, pin, or pendant to maintain the work-hardened state that would be lost in a soldering process.

## VI. FINISHING PROCESS

### Raised Form

For a raised form the final finish can be planished or made completely smooth by filing or stoning the surface, emerying, and buffing. Buffing with tripoli and rough gives the surface a high polish and a crome-like surface. In most cases, after working the metal to a slick surface I prefer to put a scratch brush finish on the metal. Fine wire brushes, 50 gauge to 36 gauge brass, are used with a low speed motor to create a fine surface texture. The spindle speed should not be faster than 1750 RPM and with little pressure on the brush as the tips do the work. The effect is a soft satin finish which softens the form (Fig. 66).

### Forged Forms

Forged forms as I mentioned earlier can be finished with a file texture, emery finish, buffed, or planished. With a file, or emery finish only a scratch brush would be used, but for a high buffed or planished finish the buffing wheels must be used and the scratch brush would be optional.

### Chasing and Repousse'

After the metal is completely formed, a finish is usually applied to the surface to accentuate the forms

and details created in the decorative techniques. To use a regular buffed finish on a chased area would erase and hide many of the beautiful characteristics of a chased area. Subtleties are, also, not apparent with a regular scratch brush finish.

Coloring the Metal

Coloring of the metals should be one of the final steps after all of the buffing or scratch brushing is completed. The effects of chemicals on metals varies according to the existing surface before the patina is applied. The first step to applying a patina is to build up a firescale on the piece which brings the pure silver to the surface. This increases the rapidity of oxidation. Also, one must be sure to have the metal free from grease, oil, or fingerprints which will retard oxidation in the areas where they exist. Boiling the piece in a solution of non-polluting detergent, ammonia and water or cleaning with a fine abrasive such as pumice powder or cleaning in an ultrasonic cleaner can free the metal from these undesirable stains.

Oxidizing

There are many different methods of coloring metal, but one of the most common methods is oxidizing. This can be done with liver of sulfur (potassium sulfide)

or silvox. Liver of sulfur is a powder or rock form of chemical that must be kept in a dark, tightly covered jar to keep it from deteriorating. In preparing the chemical, use about ½" to one quart of water. By making the water as hot as possible, the reaction speed can be heightened. With the liver of sulfur it is best to immerse the whole piece in solution and agitate frequently to insure an even coat. The longer the metal is left in solution, the thicker the oxide; so one must remove the piece periodically to check the color (Fig. 65). (Also, 1% ammonia in the solution tends to change the color from a pure black to a rich blue-purple black.)

After the metal has reached the desired color it is usually scratch brushed for an over all satin finish (Fig. 66).

Silvox is used in place of liver of sulfur if one has a piece in which only a small portion of the piece is to be oxidized while the rest is to remain silver colored. Silvox is also effective in oxidizing gold which can't be achieved with liver of sulfur. With silvox, the solution is highly concentrated and painted on the desired areas with a brush and allowed to dry (Fig. 67).

Fig. 65

Fig. 66

Fig. 65. Use of liver of sulfur

Fig. 66. Scratch brushing metal

Red to Purple Patina

More uncommon, but effective, patina is made from sodium thiosulphite ("hy po"), 75 grams, lead adetate, 50 grams, and water, 1 liter. The solution is made by adding the two salts to the water and the temperature raised to 180 degrees F (82 degrees C). A great range of colors can be obtained from dipping the metal in this solution. In its first stage, the metal is a pale gold shade, then dark orange, brown, crimson, purple, irridescent shades to pale blue and finally to a steel bronze shade. The secret is to watch the piece carefully because of the rapid change of color. When the metal reaches the desired color one must immediately rinse in cold water, allow the surface to dry and finish with wax or transparent lacquer.

Pumicing

After the metal has reached the desired degree of oxidation, pumice powder can be used to bring out highlights on the various subtle tilted surfaces that have been chased. Depending on the amount of oxidation that one wants to remove, the surface can be rubbed with a dampened finger or toothbrush (Fig. 68).

Final finish

At this point the surface can be scratch brushed to give it a soft sheen, or one can burnish the sur-

Fig. 67

Fig. 68

Fig. 69

Fig. 67. Applying silvox

Fig. 68. Pumicing oxidized surface

Fig. 69. Burnishing chased area

face to create a higher luster (Fig. 69). Buffing the surface is not advisable on chasing because polishing compounds tend to wear down the surfaces and obliterate fine lines and crisp textures.

In order to achieve the maximum effect of chasing, it is necessary to bring up the subtle characteristics by color contrast. In jewelry especially one should experiment with the effect of color on the metal as the chased areas are developed because a color change can make a definite change in the balance of the total piece.

# PART III.: TOOLS, MATERIALS, EQUIPMENT

## Tools and Equipment

"The chief beauty,... the quality given by handiwork... if is absent, nothing can make up for the loss."[19]

Man created the tool as well as the product of the tools and many of these have not changed in shape or function since virtually pre-historical times. A great many of our ancient and present day creative craftsmen function efficiently with a small number of tools. A vast number of expensive gadgets are obviously not necessary or indeed not desirable, as they tend to confuse, rather than help, the beginner.[20]

Although most of the tools used for chasing, repousse', raising, or planishing may be purchased on the commercial market, a serious craftsman often makes his own due to the expense and poor quality of commercial products and in order to create tools that better fit his individual needs.

Therefore, a beginner is better off working with tools in a pre-established shop, in order to become acquainted with the process and develop a knowledge of what tools are most valuable to him as an artist. He can begin to make those tools which he desires.

## General Tools used in the Process

### For Sawing and Cutting

1. Bench shears-circular and straight
2. Metal shears-hand
3. Jeweler's saw frame, 5", adjustable
4. Jeweler's saw blades, 1-4
5. Beeswax or silicone spray
6. Bench pin

### For Annealing, Pitch Burning, and Soldering

1. Annealing pads (1 good, 1 old)
2. Torch
3. Annealing pan with pumice stone
4. Tweezers (several pair)
5. Copper tongs
6. Pickle
7. Matches
8. Flux
9. Hard, medium, and soft silver solder
10. Solder pick
11. Nails
12. Old coat hanger for metal clamps
13. Flux brush

For Chasing

1. Pitch
2. Pitch bowl
3. Ring for pitch bowl (rubber on leather)
4. Dapping tools
5. Chasing and Repousse' tools
6. Chasing hammer
7. Nails
8. Board for supporting hollow form for chasing

For Raising

1. Raising hammer
2. Planishing hammer
3. Raising stakes-wooden and metal
4. Leather gloves are handy

For Forging

1. Anvil
2. Forging hammer
3. Planishing hammer

Miscellaneous Tools

1. Vise
2. Binding wire
3. Pliers

## Description of Specific Tools not Described in Explanation of Process

### Hammers

The three hammers that are most used by the craftsman are a raising hammer, a planishing hammer, and a chasing hammer. Raising and planishing hammers should have polished surfaces free from any nicks or marks. Chasing hammers, on the other hand, usually have an emeried face. If one has difficulties with the heads on these hammers being loose, do not keep hammering wedges into the head or the handle will crack. The best method for solving this problem of wood shrinkage is to soak the heads for about an hour in a mixture of gylcerine and alcohol. (The glycerine swells the wood and inhibits shrinkage, and the alcohol is added to allow the flow of the glycerine into the pores of the wood.)

### Chasing Hammer (Fig. 50)

Chasing hammers are made with large flat faces up to 1¼" across, and they have thinly tapered wooden handles about 10 inches long, ending with oval, pistol, or round grip. The face is hardened so that properly used with the tools, they are hit lightly and square-

Miscellaneous Tools, (continued)

4. Wire clippers
5. Ruler
6. Square
7. Calipers
8. Scraper
9. Burnisher
10. Files
11. Buffs; buffing machine
12. Emery paper (emery stick)

ly at the tool end for maximum effect. The tapered wooden handle is designed to give the tool spring, and its weight and form allow the tool to be applied with rapid blows. The broad face of the hammer is designed to provide relatively large striking areas so that this part of the work need not be watched. Vision is concentrated on the metal surface being textured.[21]

Planishing Hammer (Fig. 29)

Hammer with a flat hammer face on one end and a slightly crowned face on the other and weighing about 3/4 pound. One begins with the crowned face and uses this hammer to smooth the surface of metal by beating down the hills and lumps.

Raising Hammer (Fig. 29)

Raising hammers are used on the outside surface of the metals in early forming stages. They are generally wide, rectangular, edge rounded faces which cut the metal less than narrow pointed ones.

## Chasing and Repousse' Tools

### Dapping Punches (Fig. 70)

A dapping punch is a steel shaft with an almost complete ball at one end. They come in a wide range of sizes and are actually designed for a dapping block in which one makes half spheres. As repousse' tools, daps can be used to block out masses, as small stakes for planishing or as texturing tools. Caution must be employed in using the small dapping tools for chasing because of the small area of steel between the ball form and cylinder of the punch; the balls can be broken off if put under undue stress.

### Embossing or Doming Tools (Fig. 71)[22]

Doming tools are used for raising metal, generally from the back. Most are about 5 inches long and are square, rectangular, or round in cross section. If purchasing these tools, the sharp edges should be removed before use to prevent cutting metal.

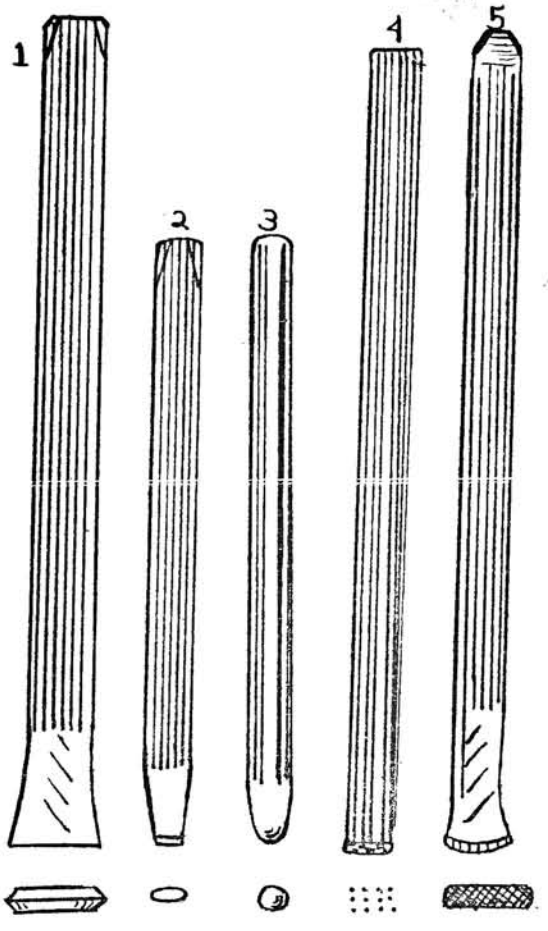
### Tracers (Fig. 71)[22]

Tracers are shaped basically like blunt chisels and have edges that vary from thin to broad depending on the quality of line desired. (Here again it is ad-

Fig. 70

Fig. 70. Dapping punches

Fig. 71. Chasing tools (a form of punch):
1. tracer
2. planisher
3. embosser
4. grounder
5. matting tools




22

Fig. 71

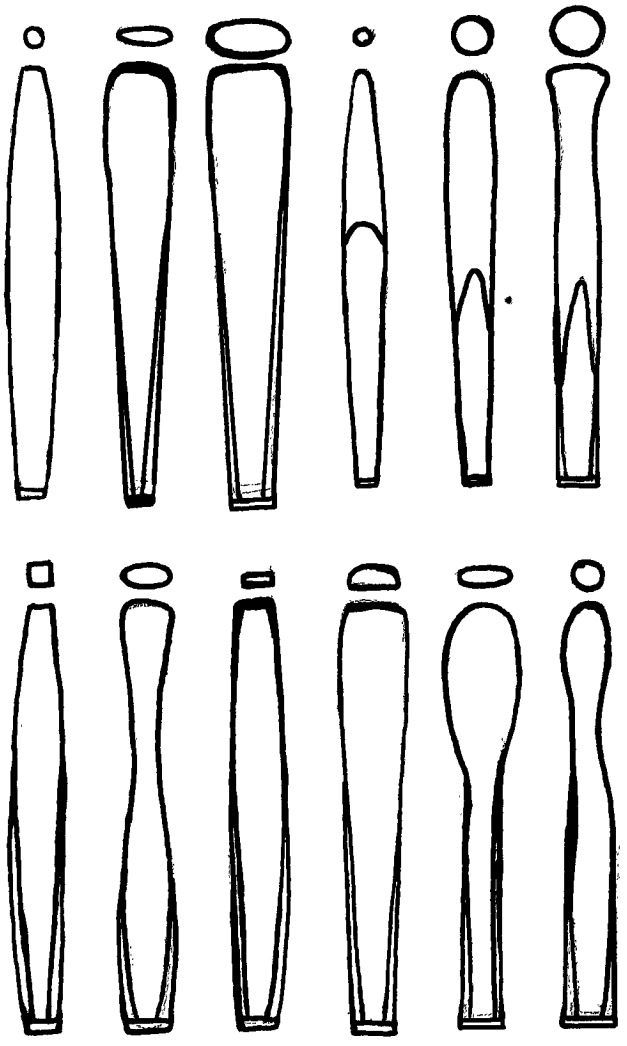


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Fig. 72. Repousse' Tools

advisable to slightly round the corners to prevent cutting the metal.[23]

Modeling Tools (Fig. 71)[22]

These tools are flat or convex tipped tools for working surfaces smooth or for punching down areas around raised relief.[24]

Matting or Graining Tools (Fig. 71)[22]

A texturing tool used to create an all-over pattern. These tools can be easily be made by filing notches or drilling a design on the end of a square or round rod.[25]

Pointed or Dotting Tool

A tool shaped similar to a center punch used for a texture design often called "pricking".

Pitch

Pitch is a black or dark, viscous substance obtained as a residue in the distillation of tars and other organic materials such as plaster, tallow, and a little linseed oil, it creates a surface which is both residual and firm and adhesive in nature.

Because the firmness of the pitch depends partially upon the temperature, it is usually necessary for the craftsman to prepare his own. If planishing a hollow form, harder pitch is needed but choosing a softer consistency is more effective. (In cold weather the pitch must be softer and in warmer weather vice versa.)

The basic formula for pitch that is most effective for my needs is:

| | |
|---|---|
| Burgundy or Swedish Pitch | 7 parts |
| Plaster of Paris or powder pumice | 10 parts |
| Tallow or linseed oil | 1 part [26] |

Break the pitch up into pieces of two or three inches. (It usually comes in two pound pans that if dropped on the floor or hammered gently will break the pitch easily.) Then put it in a pot and melt over a low gas flame. Do not overheat pitch. With the pitch put the tallow and wait for it all to be completely melted. When melting is completed add the plaster

of paris by handfuls and stir in gradually until all the elements are mixed thoroughly. Be careful not to overheat the pitch because overheating causes the pitch to lose its elasticity and stickiness.

If one can't purchase tallow, it can be easily made from suet. Heat the suet (pork is the best) until the small pieces turn light brown. Then pour off the liquid into a container that has cheese cloth or silk over it to strain the liquid. Tallow is best if refrigerated until used.

Pitch Bowl

The pitch bowl is a cast iron hemispherical bowl about ½ inch thick which makes it hefty when filled. This, when placed on chasing pad or ring, may allow the piece to be turned at various angles for the best tool control.[27]

Other variations for recipes of pitch:

| | | |
|---|---|---|
| 1. | Asphatum | 2 parts |
| | Yellow beeswax | 2 parts |
| | Powdered white rosin | 1 part [28] |

Other variations for recipes of pitch, (continued)

| | | |
|---|---|---|
| 2. | Pitch | 10 lb. |
| | Brickdust | 20 lb. |
| | Resin | 4 lb. |
| | Tallow | 2 lb. [29] |
| 3. | Pitch | 6 parts |
| | Brickdust | 8 parts |
| | Resin | 1 part |
| | Linseed Oil | 1 part [29] |
| 4. | Pitch | 14 lb. |
| | Resin | 14 lb. |
| | Plaster of Paris | 7 lb. |
| | Tallow | 8 oz. [29] |
| 5. | Black pitch | 2 parts |
| | Rosin | 4 parts |
| | Tallow | 3 parts |
| | Fine bolus | 3 parts |
| | Linseed Oil | 10-12 drops [30] |
| 6. | Black pitch | 5 lb. |
| | Whiting | 5 lb. |
| | ½ Ordinary tallow candle | [30] |
| 7. | Pitch | 4 parts |
| | Rosin | 4 parts |
| | Plaster of Paris | 2 parts [30] |

# PART IV.: APPLICATION OF PROCESS

Art bids us touch and taste and
hear and see the world, and shrinks
from what Blake calls mathematical
form, from every abstract
thing, from all that is of the
brain only, from all that is
not a fountain jetting from the
entire hopes, memories and sensations
of the body...

God guard me from those thoughts men think
In the mind alone;
He that sings a lasting song
Thinks a marrow-bone.[31]

The craftsman is a man extraordinarily sensitive to the world around him and his inner self as so beautifully indicated by this excerpt from W. B. Yeats. I feel as an artist that a great deal of the success of a craftsman lies in his extrasensitive perception of the world around him. Designs come from an initial impulse of nature, although time often removes the original source to man's subconscious. In nature, forms resolve themselves perfectly and combine harmoniously to create a tranquil view for one with the eyes to see and the artist

seeks to restate this form to awaken the world to beauty.

## INTEGRATION OF FORM

> I am seeking an integration between
> what I feel and what I have learned
> by objective criteria... above all
> I hope to resolve the polarity
> which exists between an essentially
> emotional view of nature and
> a classical, austere sense of design.[32]

I found that metalwork was a spontaneous, plastic, and flexible means of working for the more deliberated mind. Through metal I could achieve volumetric forms and make a statement of permanency in our now fast moving disposable world. I have explored both jewelry and hollow ware because of their technological and aesthetic interrelationship. For me they are almost inseperable because I view both in sculptural terms.

My first venture at combining the techniques of chasing and forging was in experiment in balancing of forms. In the Chased Silver Belt Buckle, the chased element was a simple raised pillow form in which

chasing was approached as a surface treatment in which repousse' and chasing was used (Fig. 78). Because of the dominance of the pillowy chased form it was necessary to have a strong counter balance. This was resolved by adding a large agate stone. In order to integrate these massive forms and to make the buckle functional another technique was used. Gold was chased and inlaid into the stone and across the chased area and then forging became the final natural physical and aesthetic bond between the two elements. At this point, I began to realize forging could be a natural answer to the problem of chasing and at the same time give the optical relief of a smooth surface and line in comparison to the intricate detail of chasing.

From this experiment I became enthusiastic about the form possibility in metal by raising a general shape and then carrying the design to a unique statement by additional forming and texturing with chasing tools. Through these techniques a very soft organic form could be created. For me this was a relief from the traditional hard edge surface used on metal, but at the same time, I realized these two surface treatments could be used to compliment each other.

The Pendant-Locket (Fig. 76, Fig. 77) shows a

later attempt to integrate these forms. I was concerned with creating a locket that would fit comfortably between the breasts and follow the natural lines of the body. Forging was a logical method of achieving a simple, effective neckpiece to carry the chased element. Again, I was interested in surface treatment from the subtle smooth to file textured neckpiece to the intricate texturing of the lower forms. In this case, I chose to try to begin to break the overall textured form arrived at in my first piece of chasing by having various protrusions on the overall smoothly textured surface to create an optical movement.

At this stage, I had a strong desire to make my forms even more three-dimensional so it was necessary for me to move to hollow ware. Up to this point, I had been making my chased forms basically a variation from a bowl shape.

My next attempt was a Bud Vase (Fig. 73). In the design, I desired to move away from the traditional approach. Deriving my design from the praying mantis, I was able to create a single bud vase that developed into two legs and balanced on these three forms. By using square stock and using a forged tapering method, I could achieve a gradual expansion of metal to meet

the cone-like form of the bud vase. A simple plug type connection created the technical strength needed for the piece and by a gradual filing the forms could be made to appear to flow smoothly one into the other. Chasing played the finishing touch in this piece by creating an intricate play of light on the edge of the bud vase and reaching down in a positive re-echoing of the lower point of integration of the two legs.

From this small intricate piece of hollow ware, I moved into one of my major involvements which was a set of Candlesticks and a Chalice (Fig. 74, Fig. 75). This became a major experiment with the techniques of raising and forging with chasing used to highlight the forms. All three forms starting from a basic cone involving heavy raising to reach the desired form. After planishing, chasing was done strictly from the exterior which was a limitation set on the piece by the form. Previous to this, I had been able to work the metal from both sides using chasing and repousse', but often in hollow ware this is not possible. After all this was completed, forging was used for the basis of these designs. In this case, it proved a stable base for the heavy chalice, caused by the inner liner for the cup, and the candlesticks needed the extra weight on the lower portion of the design for physical

balance. In the chalice I had the forged forms make a gentle curve and come up to hold the chalice while on the candlesticks I had the raised form come down to reach the heavy stock.

In all I came to the general conclusion that forged elements and chased raised shapes have an infinite number of possibilities for design. The secret for success lies in the planning and designing of the piece. There must be a definite physical relationship between the elements for them to come off as a unified piece. Raised, chased shapes can allow the craftsman to obtain great volume in his pieces and maintain a relatively light weight piece and forging can act as a stabilizer both physically and visually for the design. For those with the decisive frame of mind, metalwork can be a spontaneous and plastic material. One need only remember to express in the medium the natural and simple properties of the particular material employed and his limitations will be minimal.

"It will be shown that art, like philosophy, is a spiritual activity through which we raise the world-substance to communal consciousness, and that, moreover, it is the special task of art to accomplish this work for the effective content of the world.

According to this view the function of art is not to gratify the percipient in any way-not even the loftiest way, but to make known to him something of which he is ignorant."[33]

## GLOSSARY

Abrasives: Natural or synthetic materials used in powders of various grits; solids of various cross sections and forms or lengths, or mounted on papers and cloths, whose main purpose is to wear away metal surfaces, edges, etc.

Annealing: Heat-treating a metal to a temperature below its critical range, mainly to relieve residual stress, but also to render the metal soft for further cold working.

Asbestos: A mineral unaffected by fire which is processed and used for gloves, boards, luting, plaster, yarn, and cloth and in other forms when heated or fire resistance is the function of the object.

Binding: The use of iron binding wire to hold units together while they are being soldered.

Blocking: The beginning stages of forming metal by hammering sheet into a depression creating another dimension.

Burnishing: A polishing process applied to metals by the use of a burnisher (a tool made of steel, agate, or bloodstone). The process is used

Burnishing, (continued): to highlight dull areas after the surface has been oxidized and then pumiced in chasing.

Crimping: A beginning process in a method of raising a form that involved a special stake called a valley stake, or a wood form with a longitudinal depression; in conjunction with a crimping or narrow-faced hammer. Radiating grooves are made in the metal that are then smoothed out with the aid of hammers and stakes or anvils.

Coursing: A name sometimes given to raising a shape by hammering from the outside toward the edge in spirals and shaping the form by stages or "courses" to its final form.

Fire-Scale: An oxide that forms below the surface of copper-bearing alloys such as sterling silver; when thick, the oxide is usually due mainly to overheating or unprotected heating.

Flux: A chemical in liquid, paste, or powder form that assists in the flow of solder by dissolving, preventing, or hindering

Flux, (continued): the formation of oxide and other foreign material that might impede the flow.

Liver of Sulfur: Mixed potassium sulphides used in a water solution to create a patina, or color, to oxidize or "antique" metal surfaces.

Malleability: The property of metal that allows it to be formed by hammering or rolling processes in any direction without breaking or cracking.

Matting: Imparting a pebbled or grained texture to the surface of metal for textural effect in contrast to a polished surface.

Pickle: An acid solution used for the removal of oxides or "flux glass" from metal surfaces, usually after soldering.

Planishing: A smoothing process for finishing raised shapes by the use of special, slightly domed-faced planishing hammers and an anvil or a stake. The entire surface is hammered systematically.

Plastic: Capable of being molded, modeled, or formed.

Quenching: The rapid cooling of metals from high temperatures by bringing them in contact with

Quenching, (continued): liquids, solids, or gases to "set" desired qualities.

Soldering: The joining of metals by the use of alloys that flow at a temperature lower than that of the metals being joined.

Stake: A kind of anvil with a tang and used to secure it in a hardie hole, bench hole, bench vice, or stake holder. Metals are hammered against it for shaping.

Stamping: A process by which patterns are made on smooth metal surfaces with a punch.

Stretching: A method of forming metal shapes that consist of shaping a thick piece of metal (disc or bar) by hammering it on a metal surface; in the case of circular or raised shapes, hammering starts from the center and spirals outwards.

Upsetting: A forging process in which metal is compressed as when forming a rivet head or when edge thickening is desired.

FOOTNOTES

1 Michael D'Grando, Jewelry Form and Technique (London:Van Nostrand Reinhold Co., 1969), p.10

2 Herbert Maryon, Metalwork and Enamelling (New York:Dover Publications Inc., 1955), p.113

3 W.R. Lethaby, The Artistic Craft Series of Technical Handbooks, No.II Silverwork and Jewelry (New York:D. Appleton and Co., 1903), p.50

4 Richard Thomas, Metalsmithing for the Artist-Craftsman (Philadelphia:Chilton Co., 1960), p.11

5 Oppi Untracht, Metal Techniques for Craftsmen (Garden City, N.Y.:Doubleday and Co. Inc., 1968), p.246

6 Ibid., p.485

7 Antonio Cirino and Augustus F. Rose, Jewelry Making and Design (Providence, R.I.:Metalcrafts Publishing Co., 1917), p.97

8 Robert von Newmann, The Design and Creation of Jewelry (Philadelphia:Chilton Books, 1961), p.66

9 Greta Pack, Jewelry and Enameling (New York: D. Van Nostrand Co. Inc., 1941), p.78

10 Ibid., p.79

11 Ibid., p.80

12 Thomas, Op. Cit., p. 37-38

13 Philip Morton, Contemporary Jewelry (New York: Holt, Rinehart and Winston, Inc., 1970), p.190

14 Maryon, Op. Cit., p.113

15 Bernard Cuzner, A Silversmith's Manual (London: N.A.G. Press Ltd., 1953), p.171

16 Morton, Op. Cit., p.253

17 Morton, Op. Cit., p.100

FOOTNOTES, (continued)

18 Untracht, Op. Cit. p.281

19 H. Wilson, Silverwork and Jewelry (London: Sir Issac Pitman and Sons Ltd., 1962), p.47

20 John Crawford, Introduction to Jewelry Making (New York:Watson Cruptill Publications, 1969), p.12

21 Pack, Op. Cit., p.77

22 Untracht, Op. Cit., p.85

23 Cuzner, Op. Cit. p.160

24 von Newmann, Op. Cit. p.65

25 Ibid., p.65

26 Ibid., p.66

27 Cirino, Op. Cit., p.98

28 Untracht, Op. Cit., p.130

29 Maryon, Op. Cit., p.117

30 Wilson, Op. Cit., p.37

31 Lee A. Jacobus, Aesthetics and The Arts (New York:McGraw Hill Book Co., 1968), p.122

32 Ibid., p.123

33 Ibid., p.129

# BIBLIOGRAPHY

Cirino, Antonio and Augustus F. Rose, Jewelry Making and Design. Providence, R.I.:Metalcrafts Publishing Co., 1917.

Crawford, John, Introduction to Jewelry Making. New York: Watson Cruptill Publications, 1969.

Cuzner, Bernard, N.R.D., A Silversmith's Manual. London:NAG Press Ltd., 1949.

D'Grando, Michael, Jewelry Forming and Technique. London:Van Nostrand Reinhold Co., 1969.

Jacobus, Lee A., Aesthetics and The Arts. New York: McGraw Hill Book Co., 1968.

Lethaby, W.F., Silverwork and Jewelry, The Artistic Craft Series of Technical Handbooks, No.II. New York:D. Appleton and Company, 1903.

Maryon, Herbert, F.S.A., Metalwork and Enamelling. New York:Dover Publications Inc., 1955.

Morton, Philip, Contemporary Jewelry, A Studio Handbook. New York:Holt, Rinehart and Winston, Inc., 1970.

Neumann, Robert von, The Design and Creation of Jewelry. Philadelphia:Chilton Books, 1964.

Pack, Greta, Jewelry and Enameling. New York:D. Van Nostrand Co. Inc., 1941.

Thomas, Richard, Metalsmithing for the Artist-Craftsman. Philadelphia:Chilton Comapny, 1960.

Turabian, Kate L., A Manual for Writers of Term Papers, Thesis, and Dissertations. Chicago:The University of Chicago Press, 1967.

Untracht, Oppi, Metal Techniques for Craftsmen. New York:Doubleday and Company, Inc., 1968.

Wilson, H., Silverwork and Jewelry. London: Sir Issac Pitman and Sons Ltd., 1962.

# PORTFOLIO

Fig. 73

Fig. 73. Bud Vase

Fig. 74

Fig. 74. Chalice

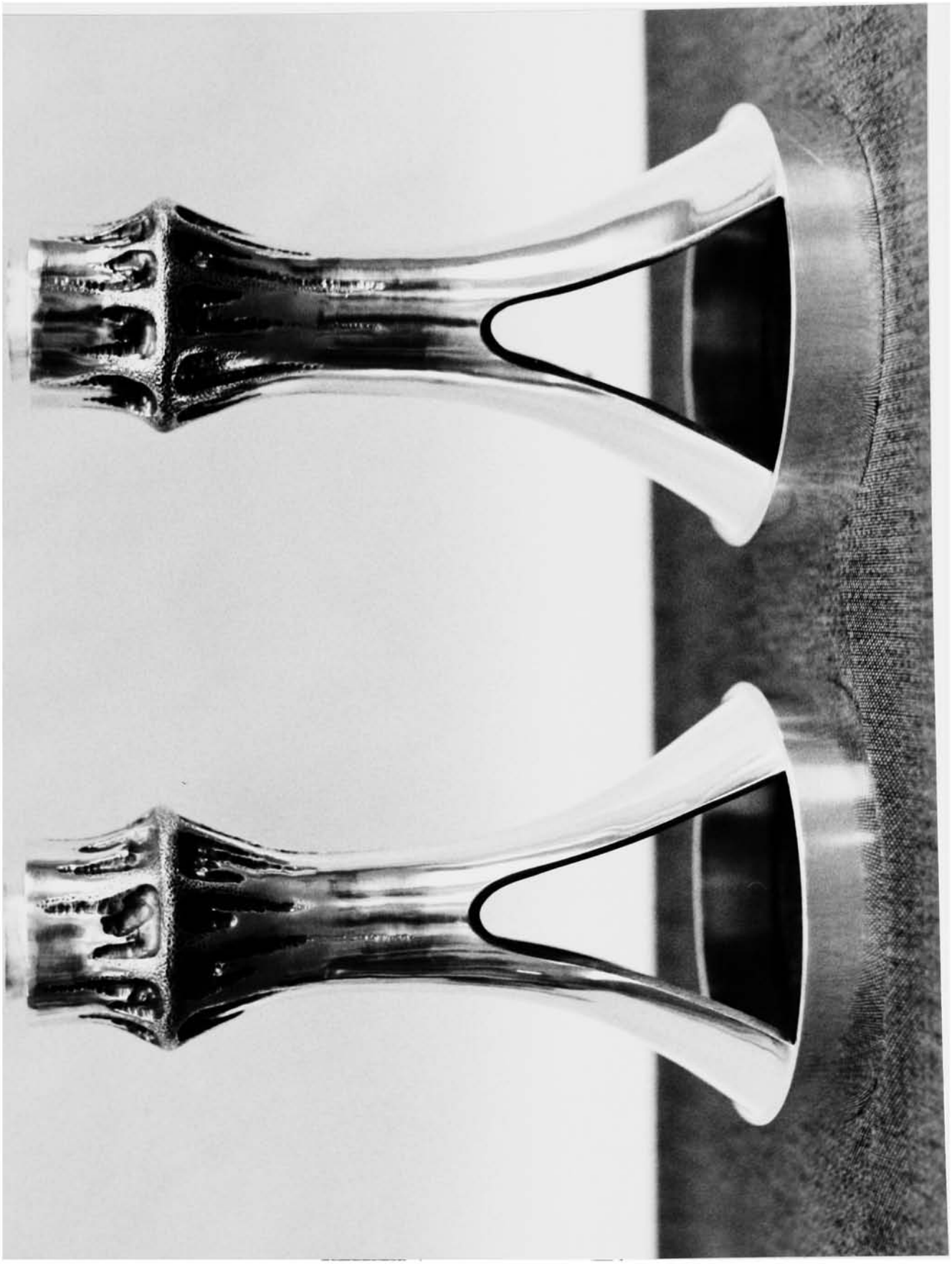

Fig. 75. Candlesticks

Fig. 77. Detail of Pendant-Locket

Fig. 78. Belt Buckle

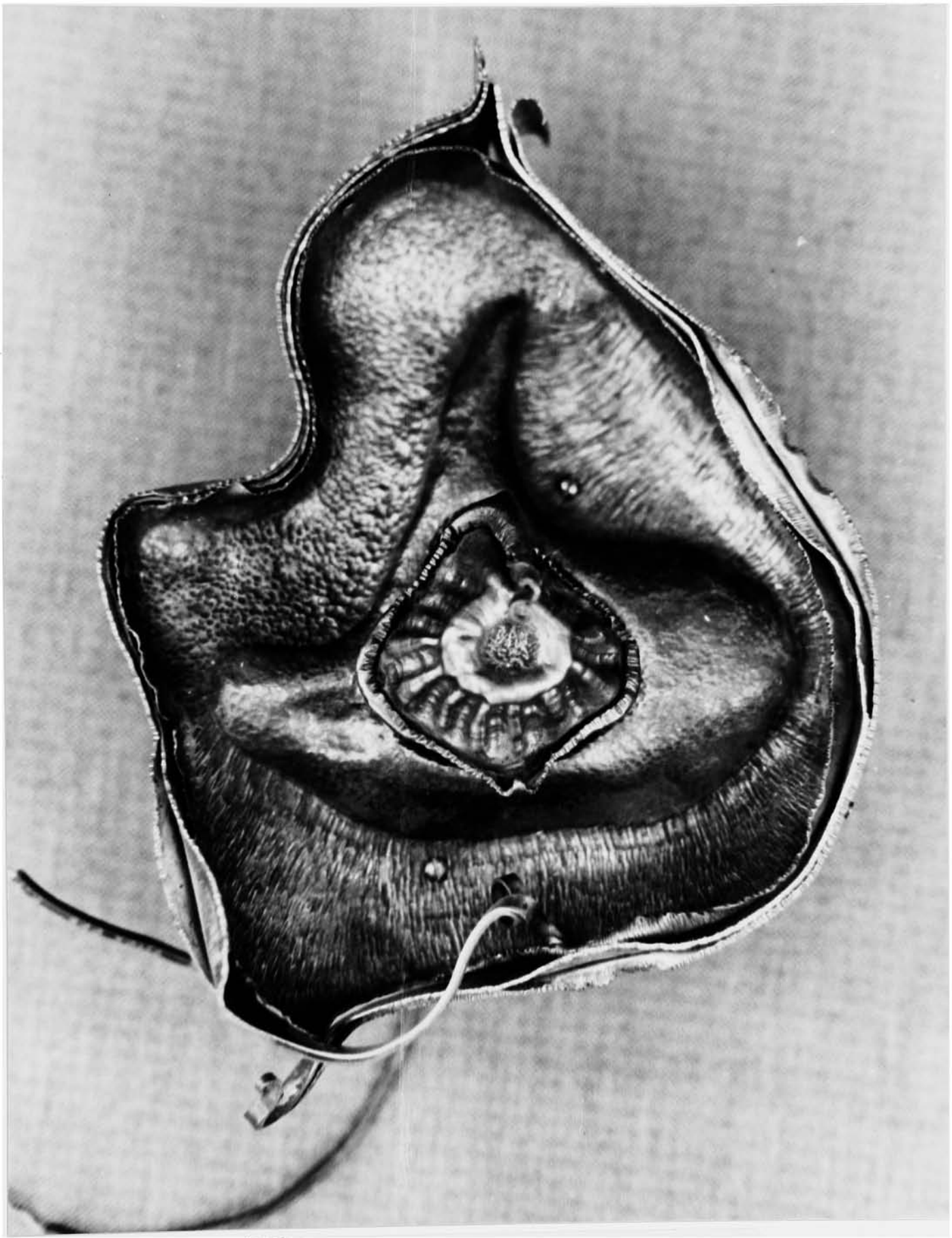

Fig. 79. Dimmer light switch

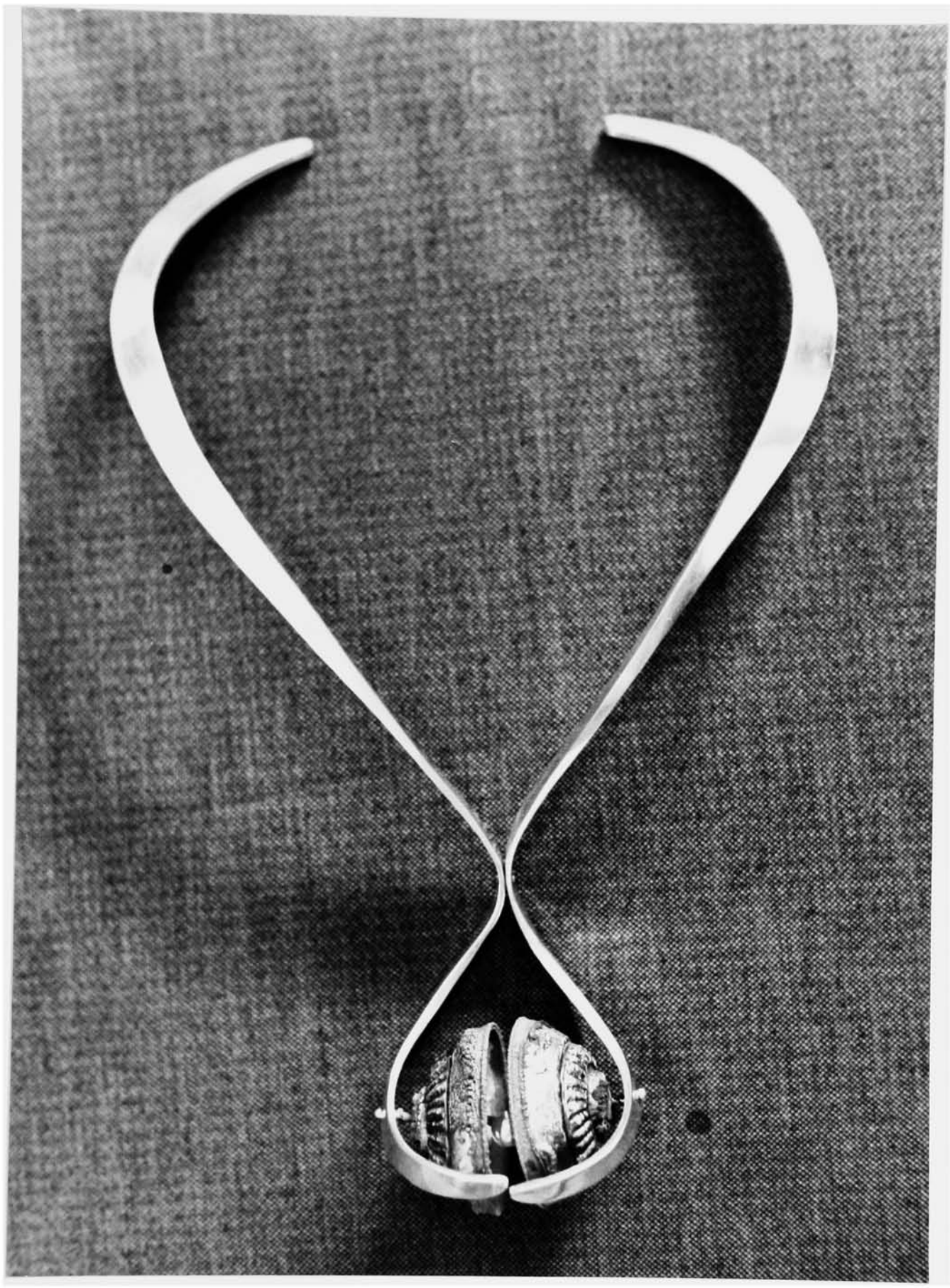

Fig. 80. Pendant-Forged&Chased