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Documented Techniques in the Creation of Flatware

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PREFACE

This work is being undertaken for several reasons. Besides the obvious, it being a requirement for the Master of Fine Arts Degree, this work terminates several years of curiosity and questioning the whole range of the metalcrafts and jewelry areas. During my studies I became aware of the almost total lack of data or examples relating to modern or contemporary flatware, especially information dealing with the detailed description or analysis of the techniques involved in the creation of flatware. I feel a work dealing with flatware, and the techniques involved, is long overdue, especially when viewed alongside the many volumes dealing with the technical aspects of jewelry and holloware which are generally regarded as the other major silversmith areas. In addition to making a contribution to the metalcrafts field, I expect a great deal of personal satisfaction evolving from my effort. In this work I will attempt to execute and document, in writing and pictorially, various techniques in the creation of sterling silver flatware.

In addition to the documentation of the major techniques applied to flatware, I will in the course of this thesis also discuss the design of flatware and its history. I will also give a brief explanation of some of the lesser used techniques which may be applied to flatware.

At this point, I feel it would be beneficial to the reader if he would acquaint himself with the glossary provided. As in any specialized area, there are certain terms peculiar to silversmithing and these are defined in the glossary section; I have tried in most cases to eliminate or substitute the specialized terms but was not always successful.

I am indebted to several people who gave me help and exhibited much patience. My thanks go to Bill Keyser and Toby Thompson, both of whom advised me. Thanks also is extended to Colin Richmond of Oneida Silver Company who offered assistance and allowed me to photograph and examine Oneida's design facility. My special thanks go to Hans Christensen, my major advisor, my teacher and friend.

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CHAPTER I

For an understanding of flatware, a brief look at its history and evolution is in order. In addition to the evolution of its function or its place in various cultures and periods, we can also see how flatware design has evolved with changing attitudes, eating habits and, in general, the evolution of man.

Most of the more specialized pieces of flatware were derived from the three basic pieces: the knife, fork and spoon. Therefore, throughout this chapter most of my comments and observations will be directed toward these basic forms. Some examples of the specialized pieces are: jelly server, orange spoon, pie knife, sardine fork, almond scoop, lettuce fork, sugar sifter and macaroni server. The current trend now seems to call for fewer specialized pieces.

Man's first eating tool was probably a wooden skewer or spear.[1] There seems to be no documented evidence which would indicate if the skewer later developed into the knife or fork first. The fork as we know it today, with tines, was first written about in 1071 A.D.[2] Anthropologists believe that at one point the pointed stick form developed in two directions: the chopstick and the tined fork.[3] One possible reason for the two directions of development was the customs which existed as to the size of the pieces of food placed before the table. Apparently, the tined fork evolved simply to prevent the fingers from becoming stained and not because it was sanitary or more graceful than the fingers.[4] Since the earliest tined fork, there has been little change in the fork, its only major change being in the curved or scoop shaped tined section. This change was probably brought about when manners and customs dictated smaller bits of food on one's plate.[5] In some cases, those who could not afford new forks with curved tine sections simply cut tines into old spoons.[6]

The rounded knife blade appeared after the tined fork because there was no longer a need for a pointed knife for spearing.[7] Historically there has been more experimentation with knife design than with spoon or fork and this was due almost entirely to custom and habit.[8] The knife has undergone the sharp tip, the round tip, the single edge and the double. As late as the sixteenth century the end of the knife blade in some cases was made round to serve as a scoop.[9]

For many years the knife served as personal protection and adornment and was looked upon as a very personal and individual implement. In early Eskimo cultures, custom dictated special design motifs for men's and women's knives. Usually the variation was found in the handle design.[10]

The spoon has probably undergone the least change since the days when man used a cupped hand or gourd. The spoon is still merely a handle with a bowl attached to its end.

In the sixteenth century, flatware was created with its own special character which in many instances reflected the owner's individuality. During that era, a guest brought his own utensil to the host's table.[11] Few people furnished guests with utensils. Flatware in the eighteenth century was often made of melted coins and was looked upon as a matter of security and banking.[12]

Many things point to the fact that flatware represents more than simply eating tools. Although varying with the individual, to many people flatware has become a valuable symbol of elegance, refinement and status. This is illustrated by its presence in the dowry, hope chest and will.[13] Besides being a tool or status symbol, handcrafted flatware can be even more, as can any well-designed object. Well-designed, well-crafted flatware also serves as a form of pure expression, as does a painting or piece of sculpture, the major difference being that flatware is usually developed with a definite utilitarian purpose.[14]

The flatware designer must understand the limitations of his materials, tools and processes before he can begin his work, since these are the factors which actually determine the form. Drawing instruments and the use of them merely suggest limitations or forms. A craftsman must also study the relationship between the mouth, the flatware and the hand. He must understand considerations which are less apparent than these at first glance. As an example, a knife blade set at a slight angle to its handle works easier for cutting and spreading than does a blade set parallel. The actual use of an object should be considered prior to its execution. In general, flatware has been made with only the eye in mind, forgetting the hand and mouth. The designer should first concern himself with the article's utility and devote his effort toward a mechanical or functional analysis of the object putting stylistic restrictions aside.[15]

An analysis of the various functions desirable in flatware reveals a number of characteristics which should be incorporated in the total design. Materials used should be nontoxic: gold, silver, pewter, etc. The pieces must be easily cleaned and should be void of any areas which would retain bacteria, dried food or moisture. Figure 85 shows a spoon which would not be suitable for normal use due to the split area in the bowl. Spoons and forks should fit the mouth as well as carry the proper quantity of food to the mouth. Flatware should fit and be comfortable to the hand.[16] The angle of the flatware to the plate and to the mouth should be such that its use is not awkward. In general, the knife, fork and spoon each serve three functions which are often taken for granted but are nevertheless valid. A knife is a cutter, spreader and pusher. The fork is a skewer, cutter and scoop. Spoons are scoops, cutters and stirrers.[17]

A large part of the total design question is answered by simply knowing and understanding the characteristics previously discussed. Putting the various elements or characteristics together in a harmonious result is a successful design. A visually exciting curve or a forged element can easily be incorporated into the functional relationship to serve for holding, to balance, to rest or to press down upon. Emphasizing existing or necessary functional elements can create a decorative quality in itself. The proper arrangement of existing qualitites often allows the disregard of added pattern or texture. Satisfactory arrangement of balanced proportions, line and function in a piece of flatware is generally not arrived at in separate steps but carried out together.[18]

> In so many instances the plain object, if it is done well, requires a far greater degree of skill in the designing and making than an ornate object. Complexity hides all manner of defects. Therefore the well-done simple object is not really simple at all. It is a very studied integration within the object of all of the technical and esthetic requirements for good design.[19]

Arthur Pulos was more direct when he said:

> Because a good structure can be its own ornament, decoration need not be added as frosting. Useful ornament is that which appears to be indispensable to the completed whole.[20]

My personal philosophy regarding ornament, and texture, is reflected in this statement and visually in my metalwork. I feel that one of the major attributes of contemporary flatware is that it has a wide latitude of compatibility. Its lack of eighteenth century rosebuds, garlands and grape ornamentation permits it to be used with other dining objects either in harmony or contrast.

> Years of workshop repetition and industrial mimicry of Eighteenth Century forms have developed a resistance to change, increased by the relatively few smiths with the esthetic courage or technical skills to question it.[21]

Agreeing with Pulos, I hope the work and documented technical information contained in this thesis will in some way contribute toward less repetition and greater courage.

CHAPTER II

ANGLE RAISING: A SAUCE LADLE

Raising is the process of creating a hollow form from a flat sheet by gradually bringing the sides up in stages by hammering the metal at an angle against a wood or metal stake. Several advantages were gained by use of the raising technique in the creation of the bowl portion of the sauce ladle. The raised form in general is lighter, more precise, and the technique is relatively faster than a forged, stretched or cast form of similar size.

Once a design was chosen, a cardboard template was cut to conform exactly with the drawing of the ladle's bowl section (Figure 1). In this case, only one template was required since the bowl shape is essentially round as opposed to an oval top view which would require two templates, one for the oval's length and another for its width. In addition to being a guide in raising, the template was also used to determine the radius of the disk of metal which was raised (Figure 3). Disk size was easily determined by laying or rolling the edge of the cardboard against a straight edge or pencil line (Figure 2). This method established the distance from the template's top edge to the center point of the bottom, thereby determining the radius to be used in laying out the metal disk. At this point, the template was cut flat on its bottom in order for it to later sit easily against the inside of the metal form as it was being raised (Figure 4). This flat also helped establish a point at which the actual raising was begun (Figure 5). In most cases the raising line or starting circle is not critical but should not be so small as to prevent the correct size stake from fitting the form. On the other hand, the circle should not be so large that once raised, the flat bottom cannot be easily dapped out.

With a compass set at the correct radius, a 19 gauge sterling silver disk was marked and then cut with either hand shears or the jeweler's saw. Any rough edges or burrs along the cut edge were removed with a file. The starting circle was then drawn in with the compass (Figure 5). Using a stake with a cross section closely matching the starting circle radius, the first course of raising was started (Figure 6). Holding the disk at a 45° angle to the stake, a standard cross peen raising hammer was used to begin raising and to establish the base circle along the previously drawn circle (Figure 8). The stake used for raising may either be wood or metal. I prefer to use wooden stakes where possible, thereby causing less metal stretch and fewer hammer marks in the metal. Hammer blows to the metal should be delivered approximately one-quarter inch above the contact point between the disk and stake (Figure 9). Striking the metal slightly above the disk to stake contact point actually forces the metal down at an angle. As this process is repeated many times on all surfaces of the disk, the metal is raised at an angle. To speed the raising process and to hold the mass or circumference of metal in closer to the desired shape, the disk was crimped or fluted over a grooved wooden stake (Figure 11). In addition to holding the circumference closer to the form's center, the crimping also raises the form's sides in a dishing effect. Crimping was done prior to each course of raising. The actual raising process was completed over the course of several raisings, with each new course begun where the cardboard template made contact with the bowl's sides (Figures 16, 17, 18, 19). Hammering was carried out over a circular path around the form and at the same time outward toward the edge (Figure 14). To prevent a twisting of the metal, the hammer's path was alternated clockwise and counterclockwise around the form. As the metal was hammered during each course of raising, it became work-hardened and was therefore annealed prior to the next raising. Once the form was raised to conform to the template, the form's flat bottom was hammered or dapped out using the same metal stake which was to later be used in the planishing process. In order to check the bottom's contour, another template could be taken from the drawing.

With the bowl placed over a round-head metal stake, any major low or high areas were hammered smooth with a rawhide mallet. To remove the raising hammer marks and to further refine the form's contour, the bowl was planished several times over the same metal stake used previously (Figure 21). Planishing was carried out over a circular path, alternating clockwise and counterclockwise from the top center to the lower edges. Since it is often difficult to know where the metal has been previously planished, circular pencil lines were laid out around the bowl's outer surface and used as reference and guidelines (Figure 20). Care was taken during the planishing to overlap the hammer's path and to change the pencil line location either upward or downward to prevent a groove or circular indentation from forming where one path began and another ended. As in the raising process, the metal became work-hardened and required annealing prior to the next planishing.

To form a lip on each side of the ladle bowl, a small dapping hammer was used in conjunction with the rounded edge of a piece of soft pine wood (Figure 22). The same dapping hammer was next used as a stake in planishing small irregularities out of the bowl's lip. At this point, all that remained to be done to the bowl section was routine filing, emorying and polishing.

The ladle's handle was begun using a piece of square sterling rod measuring one-quarter inch by five inches (Figure 23). To start, the handle was forged across approximately one-third of its end width, the middle one-third remained unaltered and the remaining one-third end was forged to a taper where it would eventually join the bowl section. By forging the metal perpendicular to its axis in achieving the taper, the metal was stretched an additional two inches in length. At its widest point, one-half inch in width was gained through forging. After the basic forging was completed, the handle was trued and planished to remove forging marks (Figure 25). Final refinement of the handle was a matter of routine filing, emorying and polishing. The handle and bowl section were joined with silver solder and the entire piece was given a light buff. Figure 27 shows the finished piece. A more detailed discussion of the technical aspects of forging are presented in Chapter III and the reader is encouraged to refer to that chapter.

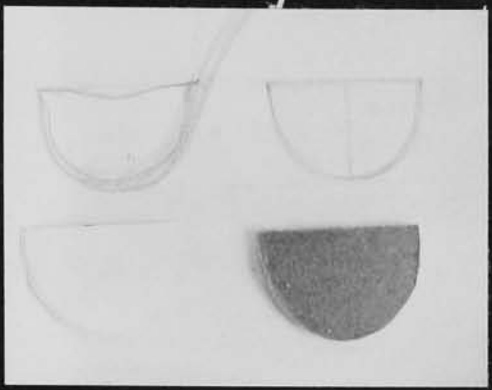

FIGURE 1

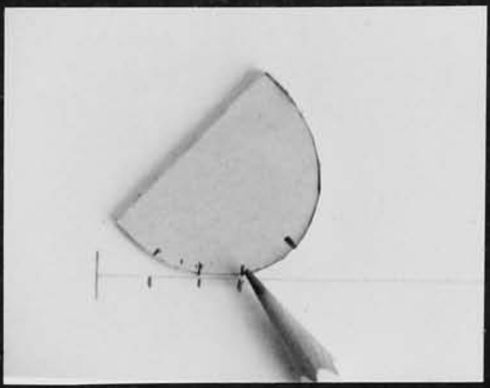

FIGURE 2

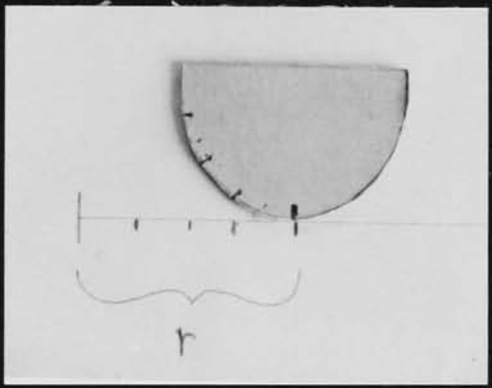

FIGURE 3

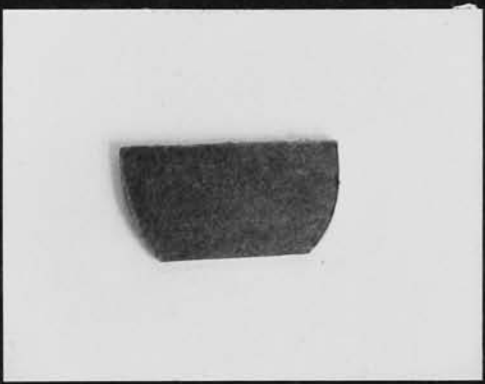

FIGURE 4

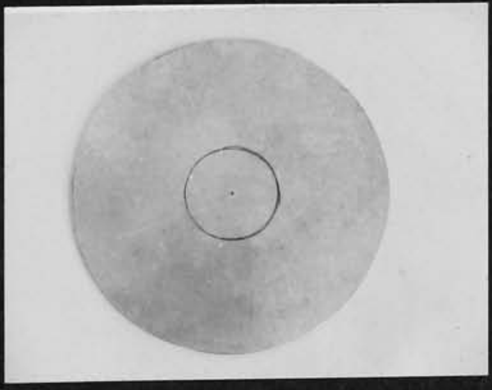

FIGURE 5

FIGURE 6

FIGURE 7

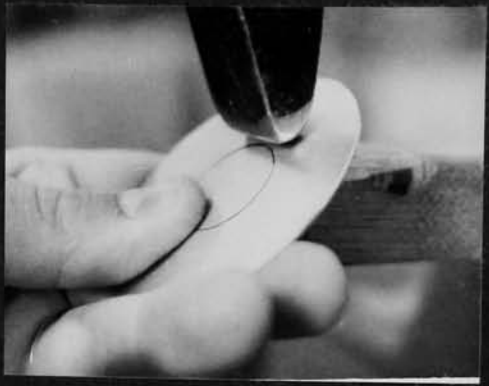

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 11

FIGURE 12

FIGURE 13

FIGURE 14

FIGURE 15

FIGURE 16

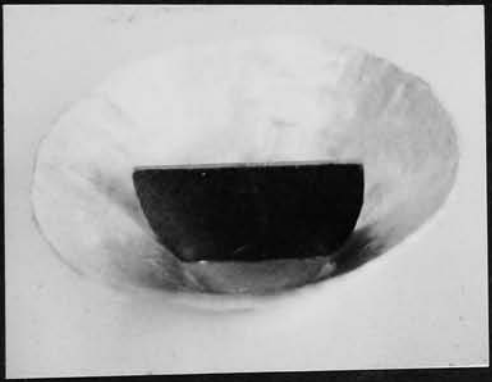

FIGURE 17

FIGURE 18

FIGURE 19

FIGURE 20

FIGURE 21

FIGURE 22

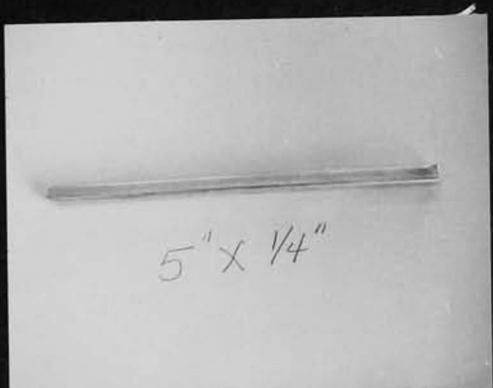

FIGURE 23

FIGURE 24

FIGURE 25

FIGURE 26

FIGURE 27

CHAPTER III

FORGING: A DINNER FORK AND JAM SPOON

Forging is the process of shaping, thickening or thinning metal by the impact between the metal being worked, a hammerface and a supporting element such as an anvil or stake. Metal is actually moved or redistributed by blows of the hammer. The common forging hammer's head has a cross peen face (Figure 29). As the cross peen is driven into the metal being worked, the metal is moved in direction perpendicular to the cross peen's face (Figure 29).

Rather than describe the forging process for a spoon and a fork separately, I will describe them as like processes up to the point of their final shaping. The creation of a fork and spoon is an identical process except the shape and forming of the bowl or tine section. The fork and spoon will be documented separately during this phase.

The material used in forging the spoon and fork started, in this case, as a piece of square sterling silver rod one-half inch thick and three inches long (Figure 28). As the beginning step, half of the material, or about one and one-half inches, was forged across its width, the metal turned over and the opposite side worked a like amount (Figure 32). This end would eventually be the bowl or tine section. In general, metal is forged on both sides a like amount in order to maintain its straightness and to prevent one side from moving at a greater rate than the other. The remaining unworked portion was forged in the direction of the metal's axis or along what would eventually be the form's handle (Figure 33). In order to lengthen and thin this half of the form, the metal was struck perpendicular to its length (Figure 33).

Throughout the forging process, it is important that the metal not be allowed to become work-hardened to the point of cracking. The craftsman soon learns to feel the metal become resistant to the hammer blows and he anneals the work.

While forging, the metal closest to the surface has a tendency to move at a greater rate than the metal closer to the center. This characteristic is due to the depth of the hammer's penetration and happens less as hammer penetration is greater, or on thinner material, or when greater force is applied to the hammer blows. Figure 35 shows a cross section of metal with poor hammer penetration. If this condition were allowed to continue without preventive measures, the sides of the cross section would eventually make contact at the top and bottom edges to form a closed channel. Folding over of the edges may be prevented by planishing back the sharp or extended edges after each forging step. If the edges begin to fold and cannot be planished out, the metal must be filed smooth at that point. If this problem is allowed to exist, the closed channel is actually lost inside the edge of the form and is usually revealed as an undesirable crack in the final steps of finishing.

As the handle section of the form was being elongated, it was also being tapered toward the end by increasing the force of the blows toward the end. When the handle end was elongated and tapered to a length approximately three times that of the bowl section, forging was complete at that end.

Working now at the bowl section, the desired bowl width was attained by forging the metal parallel or across the width of its axis. When working the bowl section it is important that the metal is not allowed to become thinner than 16 guage. Enough thickness must be maintained to allow for future planishing, filing, etc. Proper bowl shape and thickness were achieved together, using a dapping hammer on an anvil surface. A circular path of hammer blows was followed from the center of the bowl outward (Figure 36). The dapping hammer, while thinning the metal, also dished the bowl upward. When the bowl's proper thickness was attained, the front corners of the bowl were cut to a more rounded profile with the jeweler's saw (Figure 38). This shape is not necessarily the final bowl shape, it would of course depend somewhat on whether the object will be a fork or spoon and what type fork or spoon. The final, more precise shape would be filed or sawed in at the final stages of work. Using a dished-out portion of soft wood, a tree stump worked well, the bowl area's depth and shape were hammered in using a dapping hammer which closely matched the desired cross section of the bowl's shape (Figure 40). Care was taken while dapping the bowl into the soft wood not to stretch the metal to the point of cracking. With the dapping hammer previously used mounted on a vise, the bowl was thoroughly planished several times (Figure 41). The more thorough the planishing, the less time is required in stoning the inner bowl surface which was the next process (Figure 42). After stoning, the final shape is refined and the desired finish completed (Figure 43).

At this point, the shape of the bowl section was modified by cutting and filing into its final form (Figure 44). The jam spoon was created by simply cutting the bowl diagonally and finishing smooth (Figure 45).

The dinner fork was completed by glueing black construction paper to the tine area as a guide in determining where the tines should be eventually cut (Figure 46). When it was decided where the tines would be cut, a mark was scribed around the paper templates and this line cut with the jeweler's saw (Figure 48). A small jeweler's file was used to remove saw marks and a strip of cotton rag used to polish between the tines (Figure 49). The final step was the light buffing of both the fork and spoon. Figures 50 and 51 show the finished pieces.

FIGURE 28

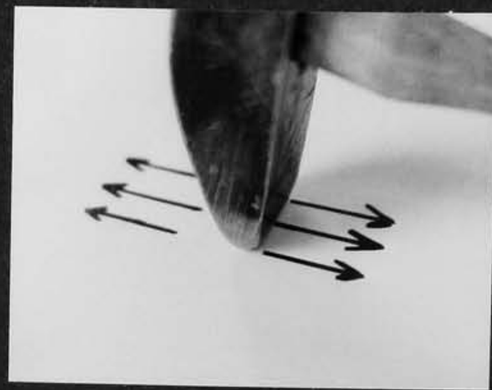

FIGURE 29

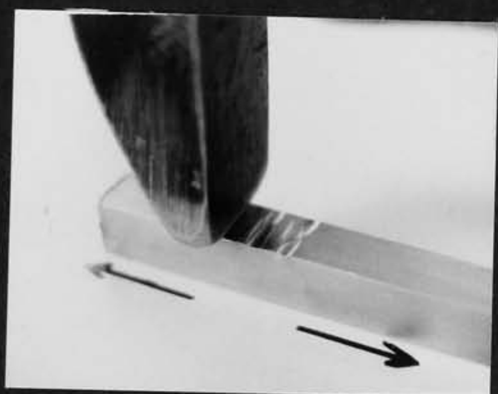

FIGURE 30

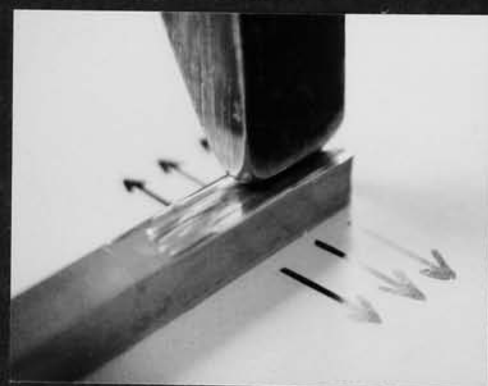

FIGURE 31

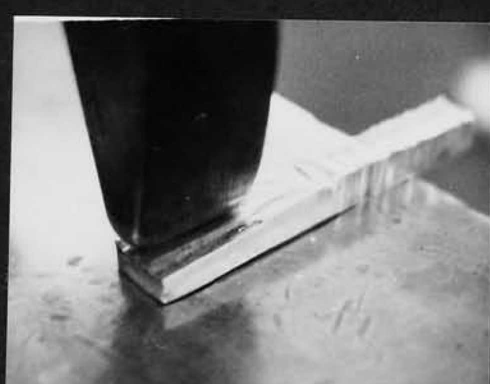

FIGURE 32

FIGURE 33

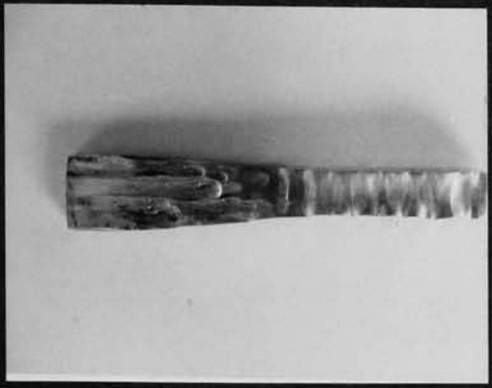

FIGURE 34

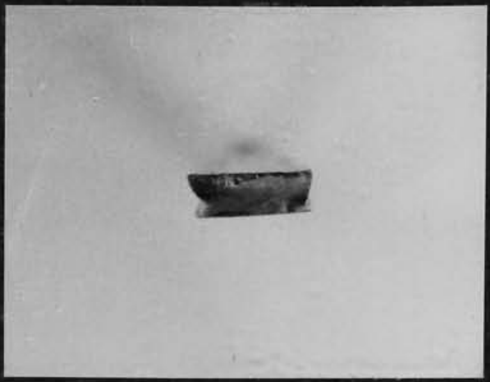

FIGURE 35

FIGURE 36

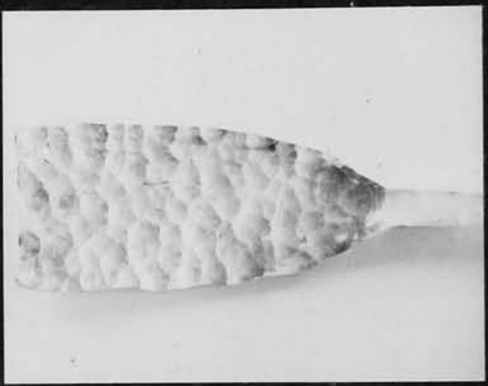

FIGURE 37

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FIGURE 39

FIGURE 40

FIGURE 41

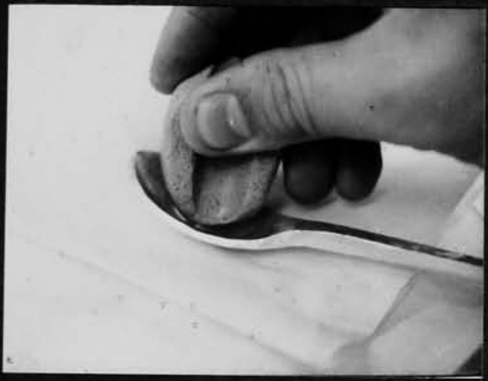

FIGURE 42

FIGURE 43

FIGURE 44

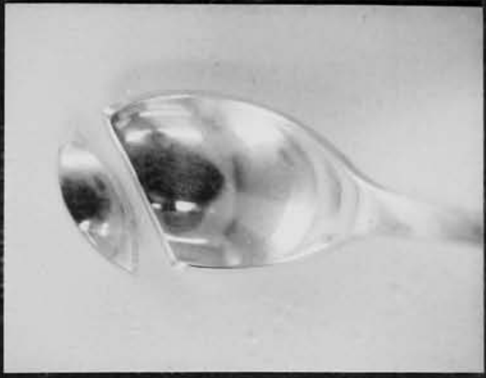

FIGURE 45

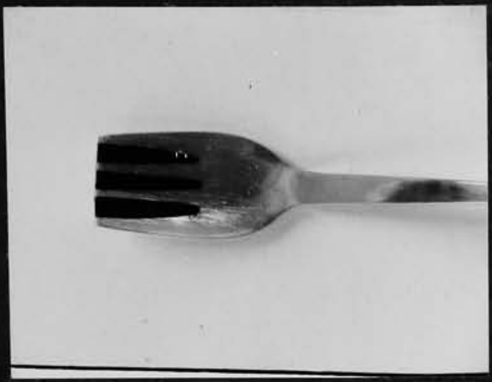

FIGURE 46

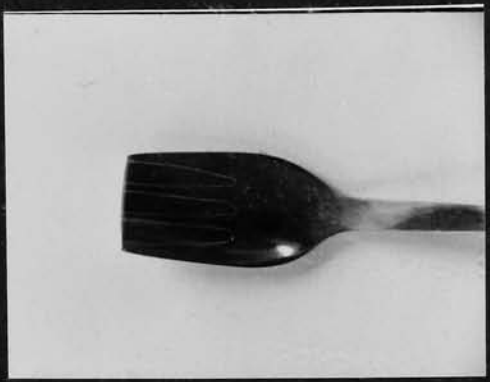

FIGURE 47

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FIGURE 49

FIGURE 50

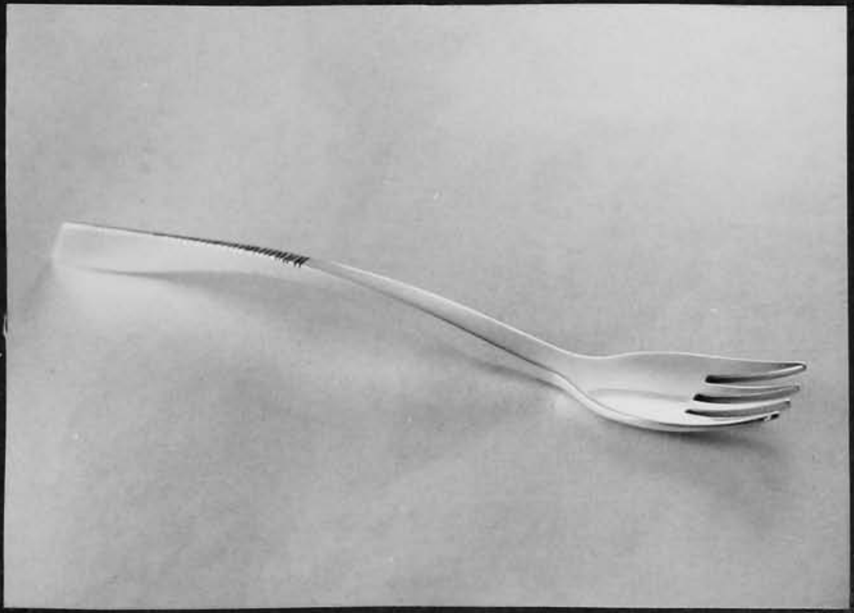

FIGURE 51

CHAPTER IV

CASTING: A SUGAR SPOON

In its most basic form, casting is the filling of a cavity or negative area with a liquid substance which on contact with the cavity area solidifies into the shape of the cavity into which it was poured.

The cavity area, or its shape in this case, was determined by a wax model in the basic shape of the sugar spoon which I planned to produce (Figure 52). Instead of being poured, the liquid substance, in this case sterling silver, was thrown or injected into the cavity via centrifugal force exerted by the rotating arm of a centrifugal casting machine (Figure 71).

Once a design was decided on, a block of carving wax approximately one and one-half inches by one inch by four inches was used to begin the model-making process (Figure 53). The general outline of the model was scribed onto the wax following a template taken from the design drawings (Figure 54). Using a jeweler's saw, the wax was cut along scribe lines; top, bottom and sides of model (Figure 55). Once the general shape was roughly cut with the saw, the form was refined further with a file on the outer surfaces and a round metal burring tool on the inner surface of the spoon bowl (Figures 56, 59).

In order for the molten metal to encounter less resistance into the model cavity, an extra path or sprue was added using a length of round wax wire (Figure 61). This sprue was attached between the spoon's tang section and the bowl section of the model. The two joints were made using an electrically heated wax tool (Figure 61).

Next the model was attached to a sprue base (Figure 62) by means of additional wax which was melted into the area at the junction of the model and the sprue base (Figure 63). All joints and transitions created in the model or in mounting the model should be made as smooth and even as possible to allow the flow of molten metal to be fast and smooth, with a minimum of liquid turbulence. In addition to being a support for holding the model in a vertical position, the conical shape of the sprue base's center (button) acts as a path between the ceramic crucible and the cavity area for the molten silver's travel.

To allow the surface of the model to remain free of air bubbles during the investment process, a thin coating of investment material was painted on the model. Be sure all areas are covered (Figure 64). The painting-on process may be repeated several times to insure a complete covering and a complete elimination of surface air pockets or traps. After the painted-on surface is dry, the investment flask is placed on the sprue base and the distance between the uppermost part of the model and top edge of the flask is measured and should be at least one-half inch (Figure 65). If this distance is too small, the investment could easily blow out at this point during casting. The cavity walls or the investment compound was poured around the model and allowed to set for at least forty-five minutes (Figure 66). During this time the investment becomes hard enough to allow handling of the flask. The investment compound is a commercially prepared substance which was mixed approximately 2,2 parts to 1 part water, its consistency and texture, wet or dry, resembling plaster.

After drying, the sprue base was removed from the flask and the flask placed sprue down in the kiln (Figure 67). The flask was placed on a metal screen or trivet to allow elimination of wax and gas between the flask and kiln bottom. This also allows a more even flow of heat surrounding the flask. Kiln temperature for the wax burnout was slowly raised up to 1200° Fahrenheit over a period of four hours and allowed to drop back to 600° Fahrenheit over the next two hours. This procedure was followed to insure a complete wax elimination with as little thermal shock as possible. Abrupt temperature changes or thermal shock can cause the cavity wall to crumble or flake and in turn create pitts or flaws in the metal casting. The reader will find that every author or investment manufacturer has his own recommendations for burnout temperatures, times and investment to water ratios. The ratios, times and temperatures given here have served me for well over a hundred castings with little difficulty encountered. With elimination of the wax from the investment, an exact impression of the wax model remains as the cavity or negative area.

When the kiln temperature returned to 600° Fahrenheit, metal tongs were used to place the flask on the arm of the casting machine. The ceramic crucible containing a predetermined amount of silver was positioned against the sprue opening in the investment flask and the metal melted using a suitable torch (Figure 68). An oxygen-acetylene torch proved excellent for this job. As soon as the silver becomes completely molten and free of surface oxides or foreign matter, the torch was removed and the casting arm released to spin. Release of the arm and removal of the torch should be simultaneous to prevent premature cooling of the metal. Figure 71 shows the casting process just prior to rotation of the machine's arm. In predetermining the amount of silver to melt, the weight of the wax model and sprue is calculated and this figure multiplied ten times since the sterling silver to wax weight ratio is 10 to 1. In most cases an added amount of about 15 to 20 grams of metal is used to insure a sufficient amount to fill the sprue button. When the machine's arm stopped rotating, the flask was removed and allowed to cool several minutes before plunging it into water. Placing the flask into water while still hot aided in the removal of investment material from the flask and from the casting. The remainder of investment was brushed from around the spoon and the sprue removed (Figure 69).

If it is desirable at this point to make minor changes in the form, files or a saw may be used to subtract material or if additions are needed, pieces may be soldered onto the form. Just prior to the final finishing of the piece, a hollow sterling and bronze handle was fabricated and soldered on to the casting. All that remained was the routine filing, emorying and buffing. Figure 72 shows the finished piece.

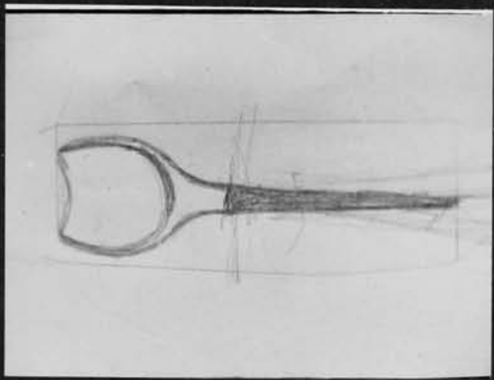

FIGURE 52

FIGURE 53

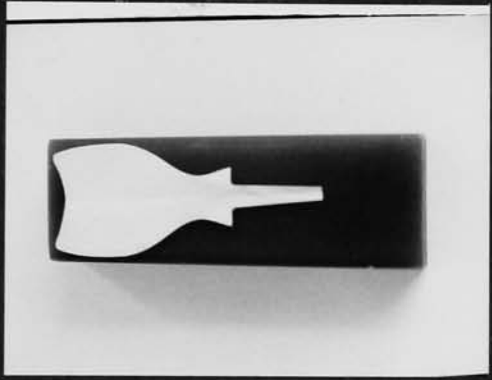

FIGURE 54

FIGURE 55

FIGURE 56

FIGURE 57

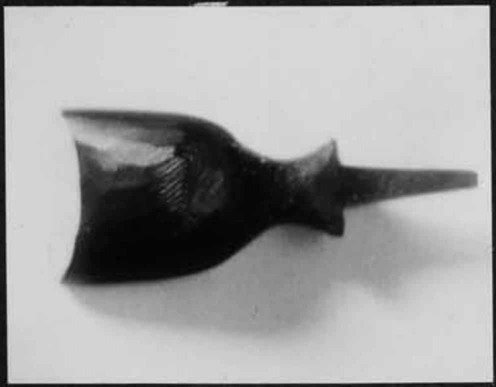

FIGURE 58

FIGURE 59

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FIGURE 61

FIGURE 62

FIGURE 63

FIGURE 64

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FIGURE 66

FIGURE 67

FIGURE 68

FIGURE 69

FIGURE 70

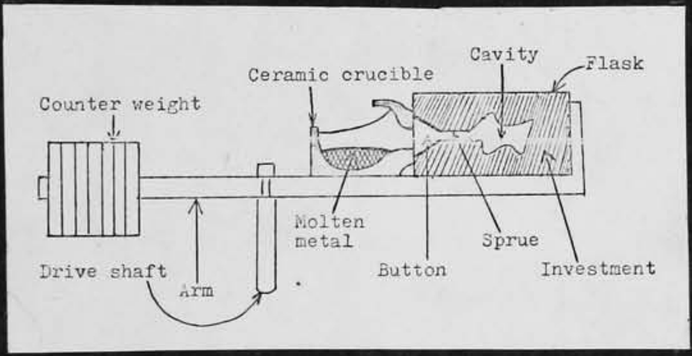

FIGURE 71

FIGURE 72

CHAPTER V

STRETCHING: A BABY SPOON

> If a very thick edge is desired . . . , the so-called stretching method can be used. In this method, employed by several contemporary craftsmen, one starts with a thick piece of metal, as thick as the edge desired. The metal object is thinned and formed away from its edge towards its center, working in a circle, with a heavy forming hammer. Hammer the metal over a smooth flat piece of steel or over an anvil.[22] (See Figure 76.)

For the most part, stretching has been used for larger forms: bowls, chalices, trays and creamers, forms other than flatware. My approach to the stretching process here was very direct because I wanted to create a piece with thick edges which flowed into a thinner section. Because of the extreme thickness I wanted, I decided to start my work with a piece of 7 gauge sterling (Figure 75).

Using a cardboard template taken from the design drawing (Figure 74), the spoon's exact shape was cut from the sterling plate. The only major change in metal thickness was in the bowl area and where the handle and bowl join (Figure 77). Other variations from the raw stock were some slight bending, planishing to harden, and the filing of edges (Figures 79, 82). Other than the stretching of the bowl section, the remainder of the work involved in this piece was of a routine nature. Figure 84 shows the finished spoon. The bowl section of the punch ladle in Figure 83 was also stretched from a disk of 7 gauge sterling.

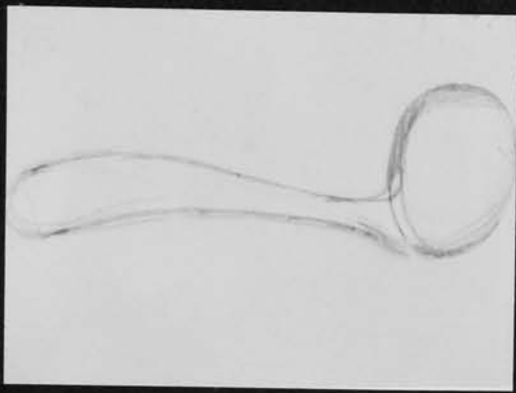

FIGURE 73

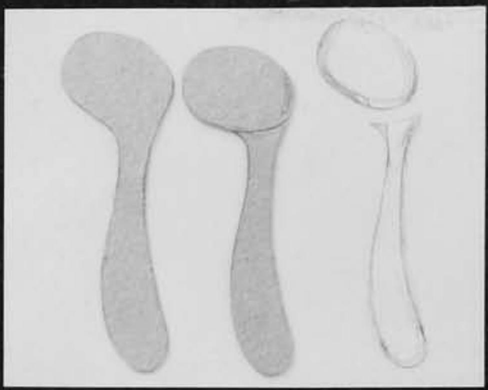

FIGURE 74

FIGURE 75

FIGURE 76

FIGURE 77

FIGURE 78

FIGURE 79

FIGURE 80

FIGURE 81

FIGURE 82

FIGURE 83

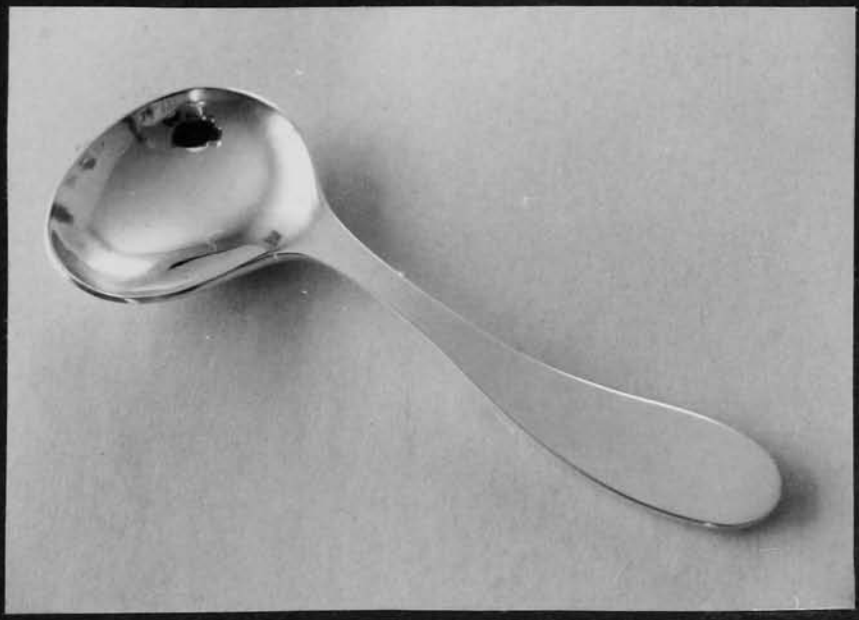

FIGURE 84

FABRICATED FLATWARE

Using standard gauges of metal in flat sheet and wire form, Alexander Calder produced several pieces of fabricated flatware. Calder has taken sheets of metal and folded them the way one might make a toy paper airplane. To hold the form together he has used rivets rather than solder (Figure 85). In Figure 86 Calder used standard sizes and shapes of wire with a few simple bends and some additional wire wrapping to hold the forms together. Using simple techniques and few tools, Calder has achieved some extremely unique flatware forms which, though simple, meet all functional requirements associated with each particular type.

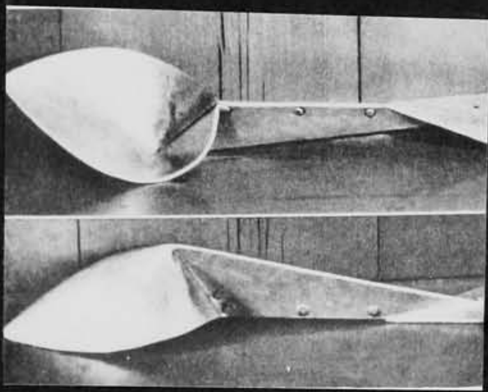

FIGURE 85

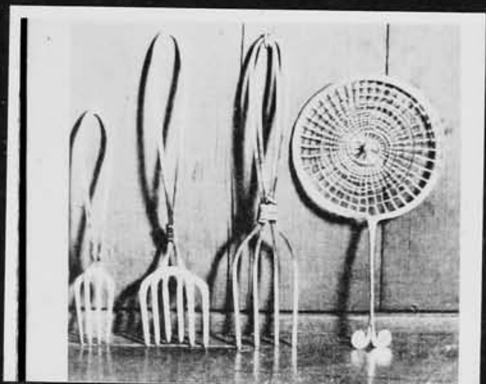

FIGURE 86

ELECTROFORMING

Philip Morton says: "The process of electroforming is a mode of electrodeposition utilizing the electroplating equipment and following the technical process of electroplating."[23] Oppo Untracht further states:

> Electroplating, of which electroforming is an application, is a method of covering an article with a thin coat of metal, called a plating, by electrodeposition. Electroforming is a process of reproducing or creating a metal object through the use of a model, metallic or nonmetallic; permanent or temporary; by the electrical deposition of metal upon the model while it is suspended in a . . . bath.[24]

Put simply, electroforming is a heavy layer of plating applied to a model. To enable a layer of metal to be deposited on a model's surface, this surface must first be painted or sprayed with a coating of electro-conductive material such as copper or silver based paint. The theory of plating is as follows:

> Certain chemical compounds containing metals, when dissolved in water, dissociate (separate) into an equal number of positive (+) and negative (-) particles called ions. A direct current, when passed through the solution, will deposit the positive (the metal ion) onto the item to be plated. The solution is called an electrolyte. The current enters the solution at the anode (+) terminal and leaves at the cathode (-) terminal, and the passage of a current through the solution is known as electrolysis. At the cathode during electrolysis, metal is deposited on the object being plated, and at the anode new metal is added to the solution if the anode is a metal similar to the plating metal.[25] (See Figures 87 and 88.)

Although electroforming has been used for many years industrially and for the past several years by contemporary jewelers, its use in the flatware area is practically non-existent.

Figure 89 shows an example of how electroforming was used to create a hollow handle which could eventually be used as a knife handle. For experimental purposes, a commercially manufactured plastic handle was used as a model. First the model was painted with a coat of copper base paint. After drying, the model was attached, using a copper wire, to the cathode (-) side of the plating unit and allowed to plate in a copper sulphate plating solution for several hours at which time a metal thickness of twenty-six gauge was achieved. After the proper metal thickness was attained, the inside or plastic model was melted out leaving an extremely light hollow handle.

In order to develop a greater understanding of the tremendous amount of technical data involved in plating, the interested reader should familiarize himself first with basic electronics and chemistry, and then several of the references listed in this thesis. Pay particular attention to all safety precautions when dealing with the chemicals and plating apparatus.

FIGURE 87

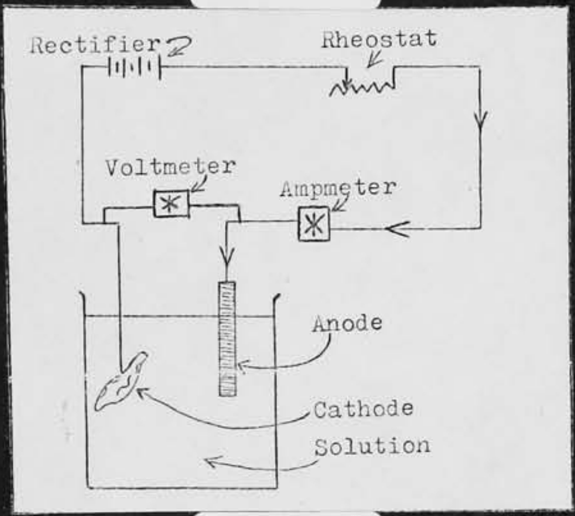

FIGURE 88

FIGURE 89

STAMPING: COMMERCIAL FLATWARE

In a strict technical sense, stamping is a forging process. Creating a handcrafted, forged piece of flatware requires many hammer blows, filing, polishing and many hours. Once the tooling is complete, a commercial piece of flatware is created in one second with nô filing and buffing, if needed, is automatic. A metal blank or a piece of metal stock slightly larger than a finished piece is stamped between a positive and a negative hardened steel die. The stamping process is so precise and clean that all excess metal is cut away and the piece finished smooth with one blow of the press. The tremendous energy required of a stamping machine is generated by either hydraulic pressure or a large cast iron flywheel. The many tons of pressure are transferred from the hydraulic or flywheel section to the dies through pistons and levers. The real art or creative element of commercial flatware takes place in the designing, prototype, model building and die cutting. Prototypes are usually in the form of a hand-carved or chased sterling silver blanks. The designer's work is usually traced or prick punched onto a standard blank and the craftsman chases, carves and engraves the design much like a sculptor would work a relief (Figures 90, 91). The finished prototype will be used prior to production for management decisions, market surveys, machine designers or the die cutters. Some designers prefer to work their designs directly in a three-dimensional medium. Clay, plasticene and plaster are commonly used (Figures 92, 93). Probably the most tedious task in a commercial studio is the creation of the steel dies (Figure 94). These are detailed and refined to such a fine degree that stampings often do not require polishing. Finished dies are handled carefully to maintain their scratch-free surfaces (Figure 95). At the present time, almost all steel dies are carved or engraved by hand. Literally millions of pieces are stamped from one set of dies.

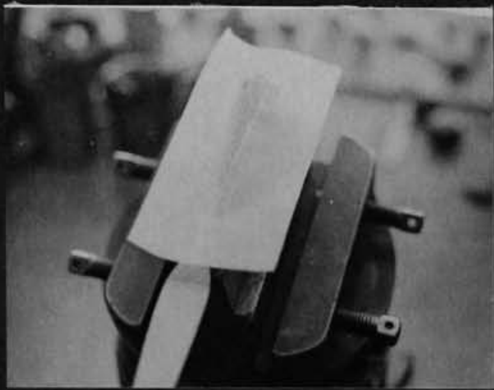

FIGURE 90

FIGURE 91

FIGURE 92

FIGURE 93

FIGURE 94

FIGURE 95

CONCLUSION

Shortly after the beginning of this thesis, I realized that in order to give detailed study of every process in the creation of flatware, several thousand pages and months would be expended in the endeavor. Many of the topics that I touched briefly could in themselves easily be used by others as a thesis topic. Throughout the technical areas of this thesis, I have written primarily with the metal worker in mind and have therefore eliminated some of the routine and obvious steps which I feel were not necessary. I believe the average craftsman, aided with this paper's technical data, photographs and glossary, could create flatware.

> A good silversmith owes it to himself and to his client to master as many forming processes as possible. By such breadth of knowledge he will be able to work directly and to avoid preciousness which would lead to his declaring one method or another useless simply because he doesn't know it.[26]

Contemporary flatware is another way of adding artistic expression to our time. The craftsman's success in doing this is a measure of his ability of observation and esthetic insight, as well as of his skill and mastering of the various techniques.[27]

PORTFOLIO

FIGURE 96

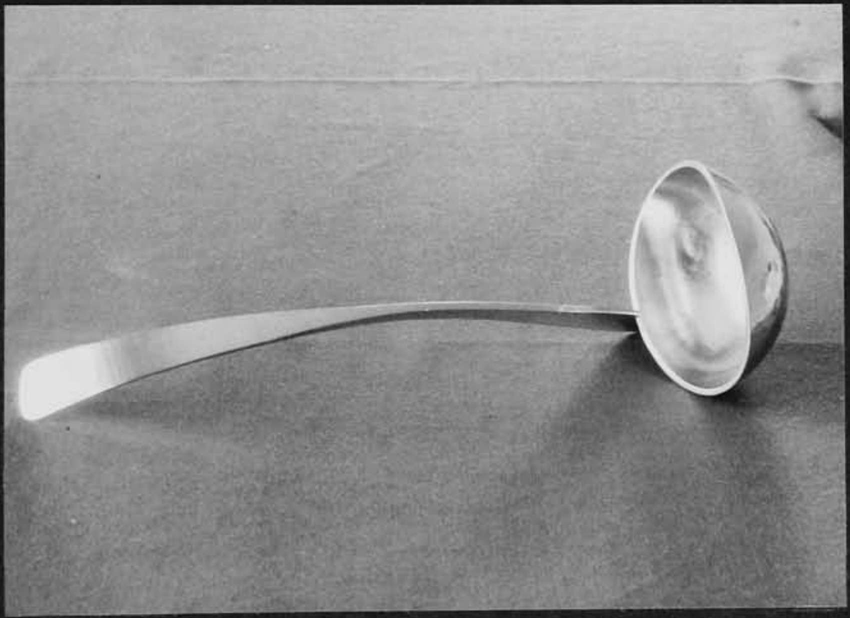

FIGURE 97

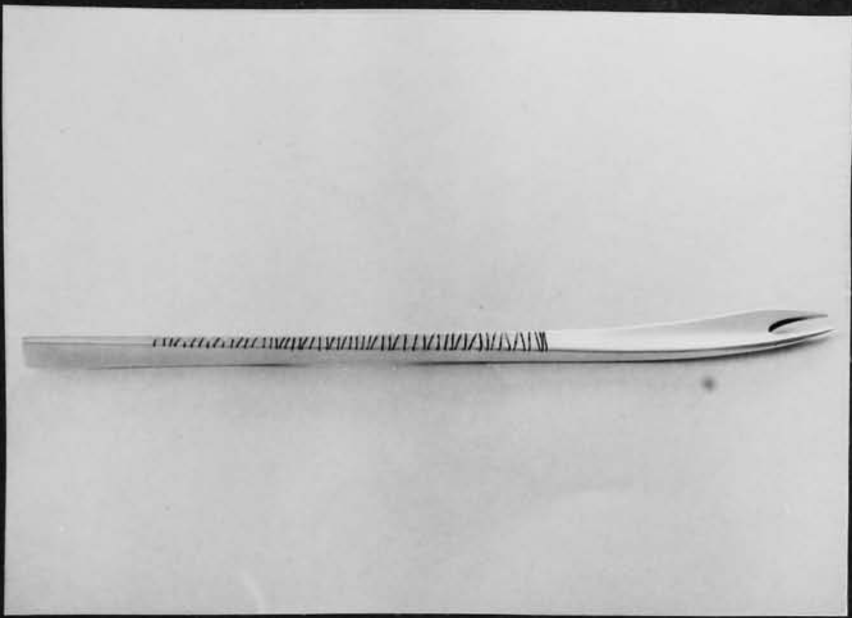

FIGURE 98

FIGURE 99

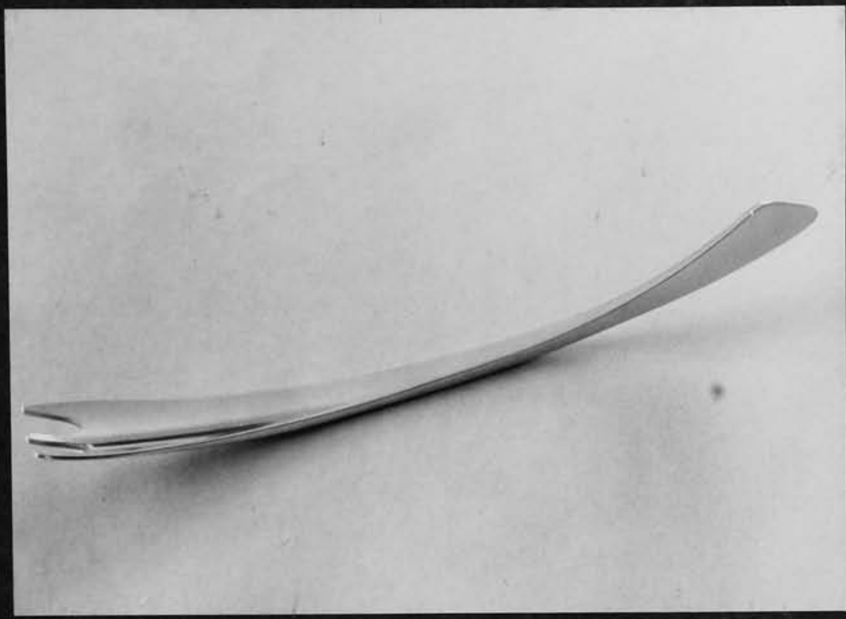

FIGURE 100

FIGURE 101

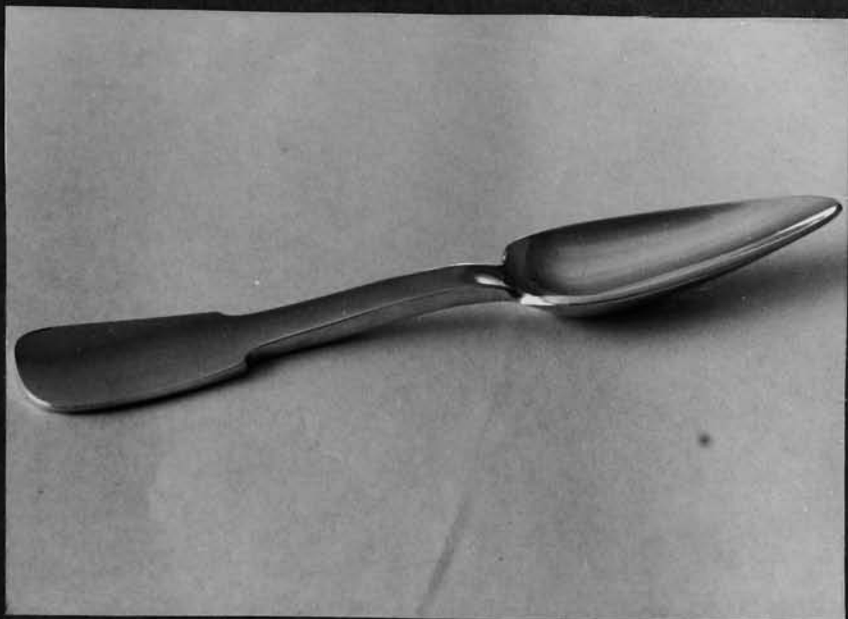

FIGURE 102

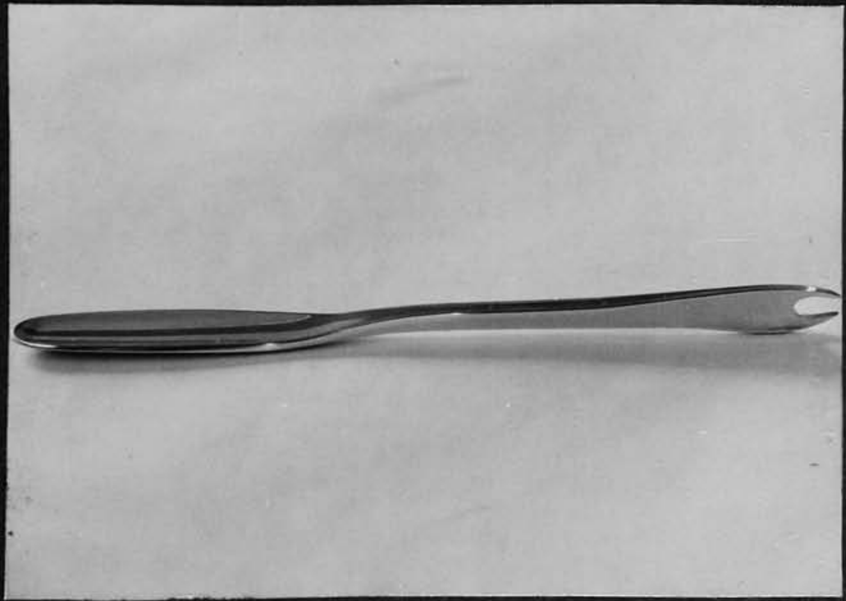

FIGURE 103

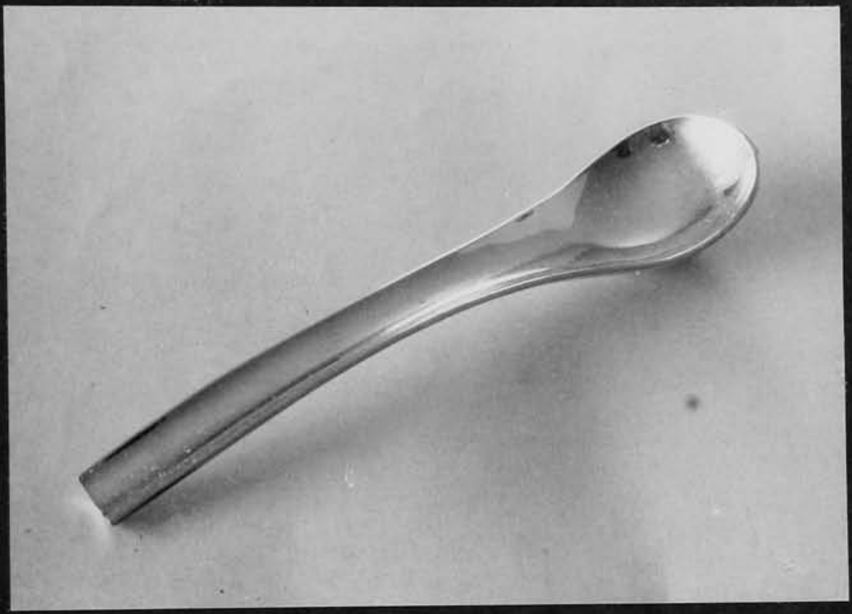

FIGURE 104

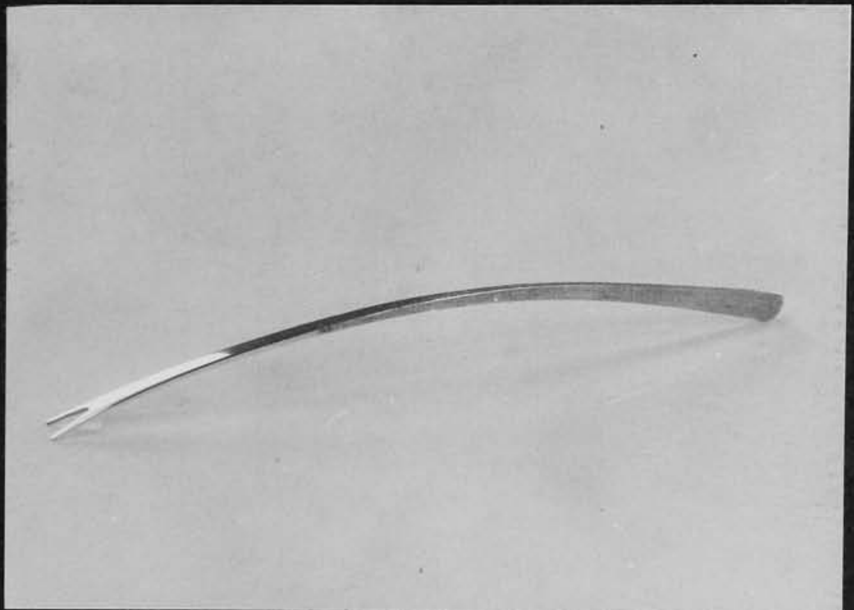

FIGURE 105

FIGURE 106

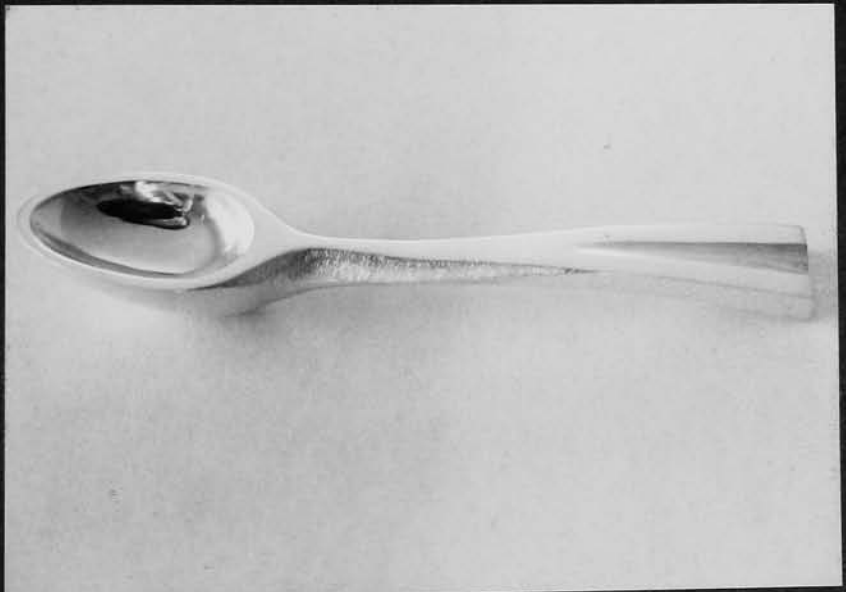

FIGURE 107

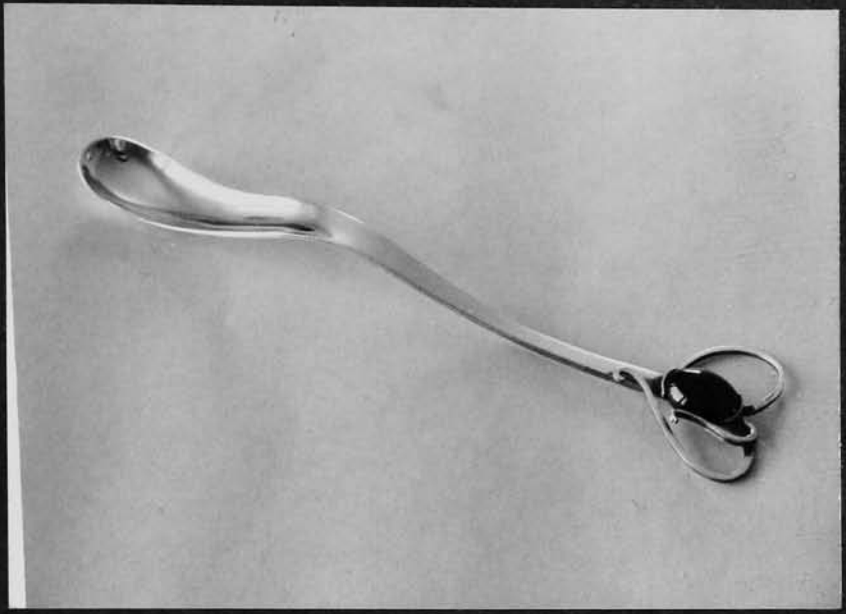

FIGURE 108

FIGURE 109

FIGURE 110

FIGURE 111

GLOSSARY

<u>air pocket</u> usually a negative or undercut area of surface which will not allow entrapped air to vent

<u>ammeter</u> an instrument for measuring electric current

<u>anneal</u> heat treating a metal to a specific temperature to relieve residual stresses and soften the metal

<u>anode</u> the positive pole of an electrolytic cell, usually the supply source of the metal being deposited

<u>anvil</u> a block of iron, formed in a characteristic shape and usually with a hardened steel face, against which a smith holds metal to be supported while hammered

<u>axis</u> a lengthwise central line, real or imaginary, around which parts of a body are arranged

<u>blank</u> a piece of material prepared to be made into something by a further operation

<u>buff</u> to polish with a soft abrasive wheel or cloth

<u>burnout</u> the process of wax elimination from the inside of an investment material

<u>burr</u> a cutting tool much like a drill bit with additional cutting surfaces

<u>button</u> the small funnel or conical shape in the center of a sprue base; the funnel-like area allows a smooth, fast injection of metal into the casting area

<u>cathode</u> the negatively charged pole in an electrolytic cell on which the metal is deposited

<u>cast</u> to reproduce a given shape by pouring a temporarily flued material into a mold; the solidified material is the reproduction

<u>chasing</u> a process involving surface modeling of metal from the front with the aid of various shaped punches and hammer

<u>crimping</u> grooves hammered into the metal and radiating from the metal's center

<u>cross peen</u> the narrow, rounded face of a forming hammer

crucible a refractory container for metal to be melted

dapping the use of a hammer constructed with a ball-like face

die a metal form into which a softer metal is stamped or pressed and thereby leaving a like impression on the softer material

electroconductive a material's ability to conduct electricity

electrodeposition to deposit electrically

electroforming to form electrically

electrolysis chemical decomposition by the action of an electric current

electrolyte a substance in which electrolysis takes place

electroplating to plate or cover with a coating by electrical means

emory the use of a silicon carbide material as an abrasive to remove and smooth metal

engrave making of lines or textures in metal with gravers, burins or scorpers

fabricate to construct by putting together standardized parts

file a hardened steel tool having cutting ridges or teeth upon its surface; used for the cutting and removal of metal

flask a container for a casting model or investing material

forging the process of shaping metal by repeated hammer blows

gauge a standard measure for metal thickness

investment a refractory material used in the making of molds for casting metals

oxides a combination of oxygen and other elements on the surface of metals

planishing a process whereby irregularities of a metal's surface are uniformly hammered with a flat-faced hammer

raising the creation of a hollow form from a flat piece of metal; the metal is normally hammered at an angle over a metal or wooden stake

rectifier a mechanism used to convert electrical current from alternating to direct current

rheostat a mechanism used to vary the voltage of electrical current output

<u>sprue</u> a channel to convey molten metal

<u>stake</u> tools of selected shapes over which metal is hammered and formed; stakes are usually mounted in an anvil or vise

<u>stamping</u> the process of pressing a piece of metal or soft material into a negative shape and thereby transferring the impression into the softer material; this may be done also between two hardened surfaces

<u>sterling</u> alloy of 925 parts pure silver and 75 parts copper

<u>stoneing</u> - use of pumace or other abrasive stone in the cutting or smoothing of a metal surface

<u>stretching</u> the process used in thinning a metal surface from the outer edge inward

<u>voltmeter</u> a mechanism used to measure electrical voltage

<u>work hardened</u> a hardening of metal created by working, hammering or bending the molecular structure into a compressed state

FOOTNOTES

[1]Walker Art Center, _Knife/ Fork/ Spoon_ (Minneapolis, Minnesota: Walker Art Center, 1951), p. 16.

[2]_Ibid_.

[3]_Ibid_., p. 17.

[4]_Ibid_., P. 16.

[5]_Ibid_., p. 31.

[6]_Ibid_.

[7]_Ibid_., p. 29.

[8]_Ibid_., p. 16.

[9]_Ibid_., p. 30.

[10]_Ibid_., p. 16.

[11]_Ibid_., p. 30.

[12]_Ibid_., p. 56.

[13]_Ibid_., p. 7.

[14]Arthur Pulos, "A Silversmith Speak up about his Craft," _Craft Horizons_, XIII, No. 4 (July-August, 1953), p. 35.

[15]Burl Neff Osburn and Gordon Owen Wilber, _Pewter_ (Scranton, Pennsylvania: International Textbook Company, 1938), p. 25.

[16]Walker Art Center, _op_. _cit_., p. 6.

[17]_Ibid_., p. 12.

[18]Osburn and Wilber, _op_. _cit_., p. 25.

[19]Walker Art Center, _op_. _cit_., p. 42.

[20]Pulos, _op_. _cit_., p. 35.

[21]_Ibid_.

[22]Murray Bovin, Silversmithing and Art Metal for Schools, Tradesmen, Craftsmen (Forest Hills, New York: Murray Bovin, 1963), p. 54.

[23]Philip Morton, Contemporary Jewelry (New York: Holt, Rinehart and Winston, Inc., 1970), p. 23.

[24]Oppi Untracht, Metal Techniques for Craftsmen (Garden City, New York: Doubleday and Company, Inc., 1968), p. 379.

[25]Bovin, op. cit., p. 109.

[26]Pulos, op. cit., p. 35.

[27]Morton, op. cit., p. 10.

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