

A HANDBOOK OF POTTERY  
FOR USE IN THE INDUSTRIAL ARTS CRAFTS PROGRAM

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1947

Submitted to the Department of Industrial Arts Education  
and Engineering Shopwork

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

for the Degree of

MASTER OF SCIENCE

1948

APPROVED BY:

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There are numerous books written on pottery and 'Ceramics' (A general term that is applied to all articles that are made from clay). The writer has used many of these books for texts and references, and through their use has found that most of these books are written for use in complete pottery courses. One author may take a scientific approach on one phase of pottery making, while another author may take a scientific approach on yet another phase. None of these books is complete and brief enough for use in a pottery craft class.

The writer has chosen and condensed the information and procedures that are given in this report from his studies of pottery at the Kansas City Art Institute and at the Oklahoma Agricultural and Mechanical College. Additional information and ideas relative to pottery as a craft have been obtained from visits with Mr. Frank of Frankoma Pottery, Sapulpa, Oklahoma, and Miss Bertha Spencer of the Industrial Arts Department, Kansas State Teachers College, Pittsburg, Kansas.

An attempt has been made to present all information of the different processes of pottery making in the light of cutting expenditures. Pottery can easily be made an expensive craft. It is the writer's belief that pottery, presented as a more conservative craft (monetarily speaking), will come within the reach of a larger number of students and that a wealth of knowledge and experience can still be gained by those students. By the time several craft classes have added to the equipment of the pottery area or room, this space should be well equipped for the craft

class at a minimum of expense. Aside from the clay, a pottery class needs a kiln more than any other equipment or supplies.

The historical survey has been made brief to serve only as an introduction to pottery and to prevent an initial boredom in the study of this craft. The list of definitions presented in Chapter One is rather extensive because of the large number of words and phrases that are peculiar to pottery. It is the writer's belief that one should be able to speak intelligently about any study that is pursued.

The other chapters of this report tell how, and attempt to explain why, certain tools are used and certain processes are followed. Each phase of pottery making is carried as far as the student will have time to progress during the period of the school year allotted to any one craft.

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## CHAPTER I

### A SHORT HISTORY OF POTTERY AND DEFINITIONS

A beginning student of the pottery craft will not have a desire for a lengthy discourse into the history of one of the oldest crafts of man. A brief history of pottery is desirable as a basis for understanding and appreciation of the pottery craft. No better introduction can be given to the student-reader than a short historical survey of this - the most versatile of crafts.

#### A Short Historical Survey.

The use of pottery has been found associated with all races. Just how it was discovered that clay could be hardened by firing is undetermined. In Genesis xi, 3, we read: "And they said one to another, go to, let us make brick, and burn them thoroughly," indicating that the firing of clay was practiced in those early days. As early as four thousand B. C. the Babylon civilization had produced enameled brick in multi-color, and their relief modeling of animals was of a high order in artistic expression.

Red earthenware dishes were made by the Egyptians as early as three thousand B. C. The Greeks began making pottery somewhat later. The Greeks finest pottery was made shortly after Pericles, about the fifth century B. C. Drawings have been found which show a potter's wheel to have been used about two thousand B. C., or during the eighteenth dynasty. The Persians made pieces of pottery that are yet to be excelled in either color or design. Some of their best ware was done in simple colors.

The earliest Roman pottery was black etruscan molded ware. This ware was produced as early as eight hundred B. C. From six hundred B. C. to two hundred B. C., the Roman ware was an imitation of Greek ware. The Romans introduced the potters wheel to western Europe. The Spanish introduced Hispano-Moresque ware which was noted for its luster. The Moors were the first to use glazes with a lead base.

The Dutch became known and recognized for outstanding ware known as the delft ware (blue and white) in the seventeenth century. The English became known for outstanding ware about 1750.

The Chinese started making pottery about three thousand B. C. They first used glazes about two hundred B. C. Many of the beautiful Chinese glazes were the results of accidents. A study of the pottery of China would be of much interest and inspiration to students of pottery. The Chinese have kept this art more in the form of a handicraft and are less fettered by machines than other countries.

It was believed that the Americans could not compete in the world trade of pottery because the country was so young. Several small potteries were established in this country as early as the fifteenth century. The industry was dispersed through Virginia, Pennsylvania, Massachusetts, New Jersey, New York, and north into Vermont. In 1889, Walter Scott Lenox of Trenton, New Jersey, began making china which was to rank with the finest porcelains of any country.

#### Definitions of Words Peculiar to the Pottery Craft.

**Alkaline:** Applied to glazes containing alkalies such as borax.

**Alumina:** Aluminum oxide ( $Al_2O_3$ ), the base of all clays.

**Appendages:** An added part; a handle, spout, leg, etc.

Bat: A flat slab of plaster or fired clay.

Biscuit, Bisque: Clay fired without a glaze.

Block: A master mold, made from an original pattern, in which cases are made.

Blowing: The bursting of ware in a too rapid biscuit fire due to steam.

Body: The inner essential part of the ware apart from any covering slip, glaze, or decoration.

Bung: A stack of filled saggars in a kiln.

Calcium Chloride: ( $\text{CaCl}_2$ ) A metallic salt used in clay slip to keep the particles in suspension.

Case: A reproduced plaster pattern cast in the original master mold or block.

Casting: Making pottery with clay slip in plaster molds.

Ceramics: The art of producing clay products. A general term covering all branches of the industry.

China: An indefinite term, usually meaning porcelain.

Crackle: A term applied to crazing when produced intentionally for decorative purposes, as the fine network of minute cracks in the glaze of satsuma ware.

Crazing: Very fine cracks which appear in a glaze due to its not "Fitting the Body"; that is, unequal shrinkage of glaze and body. It is also caused by over or under firing.

Drawing: Taking ware out of a kiln after firing.

Embossing: Decorating with raised figures or ornaments.

Engobe: A slip coat or thin layer of slip over an inferior body to improve its appearance.

Fat: Very plastic or sticky, as applied to clays.

Fettle: To scrape off cast or mold lines on cast or pressed ware.

Figure: A modeled likeness of any object.

Form: A wood, metal, pasteboard, or linoleum enclosure in which plaster is poured over a pattern to make a mold.

Fritt: A partially melted glaze.

Fritted: Applied to a glaze containing one or more ingredients which required fritting to render them insoluble in water. Glaze particles must be suspended but not dissolved in water.

Fritting: Rendering a soluble substance insoluble by melting, suddenly cooling in water, and pulverizing.

Gloss: Applied to a glaze with a shiny, glossy surface.

Glost: Glazed ware being fired.

Green: Applied to unfired clay.

Grog: Hard burnt and repowdered fire clay.

Hard: Infusible, refractory.

Jigger: A term applied variously: To a machine with a vertical spindle bearing a mold for making flat ware; to the arm and profile of such a machine; to the part carrying the mold; to a machine with a vertical profile carrier as distinguished from one with a lever arm.

Kiln: Pronounced "Kill", a furnace or oven for burning or baking clay ware.

Lead: Applied to soft earthenware glazes containing some form of lead.

Long: A term used to describe clay as being very plastic.

Majolica: Applied to a colored, opaque, glazed earthenware, or to the glaze itself.

**Matt:** Applied to a glaze where gloss has been killed by the addition of sufficient amounts of some refractory material such as alumina or silica.

**Mold:** A plaster form in which clay ware is cast or pressed.

**Muffle:** The fire-clay compartment in a kiln which holds the ware and excludes the flames.

**Paste:** Artificially compounded clay.

**Pattern:** The original, made of clay, plaster, or other material, around which a plaster mold is poured.

**Pin Marks:** Marks left on the base of pottery pieces by supports used in the glaze firing.

**Plastic:** Impressionable; said of that which will take a form under pressure, and which will hold that form when the pressure is released.

**Pressing:** Forming ware on a jigger, or hand molding with plastic clay.

**Props:** Kiln shelf supports.

**Pugging:** Putting soft fire clay between saggars, to keep out the fire and gases, when packing a kiln. Also, wedging clay in a pug mill.

**Raw:** Applied to a glaze in which all ingredients are originally insoluble in water, none requiring fritting.

**Refractory:** Hard to melt or soften; infusible.

**Return:** A part of the surface of a shape which is at an angle to the main part.

**Rib:** A small piece of bone, slate, metal, or wood used in shaping or smoothing up ware on a potter's wheel. Sometimes applied to a jiggers profile.

Rich: Applied to long or fusible clays.

Rigget: The groove in a squeeze mold for the excess clay.

Saddles: Fire-clay rods for supporting glazed ware during the fire.

Saggers: A fire-clay box in which ware is enclosed in a kiln having no muffle.

Salt: Sodium chloride ( $\text{NaCl}$ ) used to glaze brick, tile, and other coarse ware. It is thrown directly into the fire box and carried to the white hot ware in the flames.

Shape: A piece of pottery, finished, or during the process of making.

Short: Not very plastic.

Silica: Silicon oxide ( $\text{SiO}_2$ ), an important ingredient of clay, sand, or quartz.

Slaking: The property of clay which enacts crumbling and disintegration upon being immersed in water.

Slip: Clay diluted with water to a fluid state for casting, slip painting, or for use as an engobe.

Smoking: The first stage of biscuit firing during which all water is expelled from the green ware.

Soft: Applied to a glaze or clay which is fusible at comparatively low heats.

Spurs: Small fire-clay supports for glazed pieces during the fire.

Stanniferous: Applied to a white opaque containing tin.

Stilts: A common form of fire-clay supports for glazed ware in the kiln.

Sucking: Absorbing glaze from the ware in the kiln by saggers, the muffle, or other ware placed too near.

Template: A profile pattern.

Throwing: Forming ware on the potters wheel.

Turning: Finishing green ware by cutting or shaving and polishing with a tool on the lathe or potters wheel.

Wedging: Cutting, shaping, pounding, kneading, or treading clay.

Whirler: A small revolving stand used in decorating, binding, etc.

## CHAPTER 2

## CLAY

Clay, The Medium of the Potter's Craft.

Clay can be found on most any part of the earth's surface, and its composition varies widely. Nearly all clays are the product of the decomposition or erosion of feldspathic rock which makes up the earth's surface. Clays range in color from white through yellow, grey, green, red, and from blue to black. Various shades are caused by organic matter such as oxides, lime, iron, and the like.

Clays may be divided into two main classifications, the primary and secondary clays. Primary clays are those found in association with the rocks from which they were formed. Secondary clays are the result of the primary clays having been carried by water further from their source and having gathered impurities on the long journey to their final sedimentary beds.

Clay has never been found in a pure state. Impurities such as sand, silt or rock dust, small stones, vegetable matter, and other non-plastic materials are more or less mixed, in varying combinations, with the clays.

When clay is dry it is very hard and when moistened it becomes plastic. It will yield under pressure in the plastic state and will retain the shape when the pressure is removed. This lifelike quality of clay in the plastic state has yet to be fathomed. Plastic clay, when allowed to dry, becomes hard and inert - then when moistened, regains its lifelike quality. If the plastic clay is dried, fired, and then ground into a powder as fine as the original state, the skills of all

science cannot restore this hidden quality of plasticity. Clay can be analyzed and its exact composition determined, and from other sources this composition can be duplicated exactly. Grind both batches to the same degree of fineness, and when water is added the clay will go back to its former plastic state and the exact replica of composition, taken from other sources, will remain so many lifeless particles in the water. That power which gives plasticity to clay remains unknown.

Clay is the only material known which, in its natural state, possesses plasticity. "Plasticity is that characteristic which permits changes in the shape of clay without breaking up and destroying the continuity of the material as a whole and permitting also the retention of the new form."<sup>1</sup>

#### Clays in Oklahoma.

A more thorough knowledge and deeper understanding and appreciation of clay can be given the student by arranging for exploration and discovery of local clay deposits. Clay is literally 'Dirt Cheap'. It is not necessary, though at times desirable, to obtain clay from commercial sources. The value of handwork in pottery can be enhanced through the use of a local clay that has been found, tested, and prepared by the student or craftsman. A simple method of preparing and testing clay, to determine its possibility for pottery, is presented as the next subject in this chapter.

A Division of Engineering Publication of the Oklahoma Agricultural

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<sup>1</sup> R. Horace Jenkins, Practical Pottery for Craftsmen and Students, p. 8.

and Mechanical College<sup>2</sup>, contains a report on the distribution, origin, properties, classification and adaptability of the clays and shales of Oklahoma.

Chapter VIII is a detailed discussion of the clays and shales of the State by counties. The location, area, and economic and geologic features of each county are discussed briefly. A detailed report of each clay found in the county is included and its possible economic use indicated. Many of the clays which have been classified as brick or tile clays may be used for other products, such as flower pots, red earthenware and tile. Others may be suitable for sewer pipe or paving brick, depending upon the physical properties. More detailed study of some of the more promising clays and shales may indicate other uses. The purpose of this work has been simply to indicate the location and possible uses of the clay and shale deposits of Oklahoma.<sup>3</sup>

This publication should be of interest and considerable help to the teacher and student of the pottery craft in Oklahoma. Copies of this publication may be secured by addressing a request to the Division of Engineering of the Oklahoma Agricultural and Mechanical College.

#### Testing Raw Clays.

Locating and testing raw clays can be a profitable experience for the craft class. Since a great part of the earth's surface has some kind of clay at or near the surface. There are some kind of clay deposits in most any locality. Signs and locations of clays can be found more readily by exploring road and railroad cuts, washes, gullies, creeks, and river banks. Flowed fields and hills freshly washed by rains will often show the location of clay strata.

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<sup>2</sup> Leonard Francis Sheerer, "The Clays and Shales of Oklahoma", Division of Engineering Publication, Oklahoma Agricultural and Mechanical College, Volume 3, Number 5, (September, 1932).

<sup>3</sup> Ibid., p. 1.

After locating a clay deposit, the clay must be tested to find if it is plastic and workable. There are three main criteria for a good clay. The first is plasticity. If the clay is not plastic it will not be of value to the potter. It is necessary that a clay take and retain a shape from pressure, whether it be worked by hand or by mold.

Second, the clay must have porosity. The water of plasticity in a clay must be able to escape evenly and rather freely by evaporation. If the water cannot escape from the clay it will warp and crack. The porosity of a clay allows the water of plasticity to escape, thus allowing the clay to be dried without damage. Porosity in a clay is caused by the presence of sand. Some clays which are not porous can be prepared for use by the admixture of sand. A coarse sand is better for porosity than a fine sand; however, a sand that is too porous will interfere with fine and delicate workings in the clay. A sand that is too fine will, when mixed with clay, produce a substance which is dense rather than porous. Porosity is the reverse of plasticity and the two properties must be adjusted so that they balance each other.

The third criteria for a good clay is its ability to vitrify or densify. By vitrification or densification is meant the ability of the clay to yield to high temperatures and result in a hard and durable ware. In yielding to the high temperatures the clay must retain enough resistance to heat treatment that it will not fuse or collapse during the firing. Vitrification or densification of a clay is caused by the presence of feldspar or fusible sand.

There are any number of tests that clay may be subjected to in order to determine the practicability of its use. These tests range

from one that is very simple and inexpensive, and which can be made by any craft class with a very minimum of equipment, to those requiring the most technical skill and elaborate laboratory equipment. Where the deposits of clay may not be too numerous, a test outlined and explained by Binns<sup>4</sup> may be made with standard equipment from any high school chemistry laboratory. Where clays are more plentiful and varied sources available, a more simple test as given here will serve to select a usable clay.

After locating the clay, clear any surface growth or trash away from the surface to leave a cleared area of about four to six feet square. Dig to the clear clay, taking away the subsurface materials. Take a few lumps of the clear clay and soak them in a pail or pan with enough water to make a thick paste. It may take from twenty-four to forty-eight hours for the clay to soften. Stir the clay thoroughly when it has absorbed enough water to make it pliable. If the clay is too sticky or tacky, sand may be added to make it more pliable. If the clay appears too grainy it should be allowed to stand and the top part poured off, throwing away the sediment. If the clay appears grainy after further agitation, this process may be repeated until the clay attains a plastic state.

When the clay has formed a thick paste it should be poured through a sixty mesh sieve to remove stones and other foreign matter. Allow the clay to settle and remove the water from the top. Repeat this operation until enough water has been removed to leave the clay in a thick mass

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<sup>4</sup> Charles F. Binns, The Potter's Craft, p. 21.

that is of working consistency. Remove the clay from the container and knead it well. The use of a wire in kneading is recommended to assist in careful and thorough kneading of the clay. During the kneading of the clay it can be tested by feel and shaping for plasticity.

After the clay has been well kneaded, a portion of it should be rolled out on a board or bat to a given thickness and a definitely measured rectangle cut from it. The thickness, width, and length of this piece should be noted for future reference. From another piece of the clay some small object should be made. These pieces are to be observed in drying for indications of cracks and changes in shape. After the test pieces are thoroughly dried, their size should be compared with the original measurements and the percentage of shrinkage noted. This information will be valuable if the clay is used for future work. Next, the pieces should be placed in the kiln and fired to cone 04. Other pieces may be similarly worked and fired to other temperatures to observe the practical range of firing for this clay. After the pieces have been drawn they should again be checked for size to determine the percentage of shrinkage in the kiln. For further study and experimentation, the fired clay pieces should be glazed and fired again at varying temperatures to study the action of the body and the glaze.

Through the testing of clays, the pottery student and teacher increases his knowledge of the desirable traits and characteristics of his medium. An inner gratification of achievement is heightened through completing the entire phase of producing an article from a most basic state.

### Storing Clay.

After the clay has been prepared in paste form, it should be allowed to set from about four to eight days. This is called 'Aging'. After the clay has aged for about a week it is more plastic and, in general, handles much better than the fresh clay. There are several ways in which the clay may be stored in the craft shop. The more simple type of storage containers will serve adequately and are inexpensive.

For small amounts of clay, earthenware jars are ideal. If the earthenware jar is used, it is advisable to make a tight-fitting galvanized lid, or a wooden lid lined with a galvanized metal. The stoneware covers that come with the earthenware jars are too easily broken and they do not give a tight enough fit. For greater amounts of clay, a wooden box can be constructed and lined with a galvanized metal. The bottom of the box should be covered with about one inch of plaster to retain water for the clay.

Stored clays will always harden unless they are kneaded every two or three days and water added to replace that lost through evaporation. If the craft shop stores the clay in a large clay bin, it should be worked every day and the clay kept moistened. A long nosed shovel, such as the ones used for posthole digging, is ideal for working the clay. This shovel is easy to handle and its narrowness is an aid in working down into the clay without too much force being exerted.

Clay can be purchased in the plastic state from commercial concerns. The cost of the plastic clay is approximately the same per pound as the cost of the powdered clay. The additional bulk of the plastic clay prohibits ordering any large amounts because of the storage problem.



THE CLAY BIN

FIGURE 1

It is advisable to order clay in the powdered form. Estimate the amount of plastic clay that will be used in a two to three weeks period and prepare that amount of clay for use ahead of time. This will allow a sufficient aging time and will give each class experience in preparing the clay.

A buff clay should be all that is necessary for the craft class. All of the work experiences, to train a potter craftsman, can be performed with this clay. The white, red, brown, and other clay bodies will give additional experience in glazing, but they require considerable experience in preparing and fitting glazes before this is attempted.

## CHAPTER 3

## SHAPES, AND PROFILE TEMPLATES

Designing.

One of the foremost aims of the beginning potter or craftsman should be the making of good pottery. This will necessitate study, thought, and analysis of good design for the piece of ware desired. The instructor or craft director should be particularly concerned with the shapes that the student designs for his work.

Simplicity of design, with an understanding of the possibilities as well as the limitations of the material, and a consideration of the purpose which the piece of ware is to serve should be the underlying consideration for good shape. Appendages to the basic shape should add to the dignity and beauty of the piece, as well as being basically utilitarian, else they should be excluded. With proper consideration given to the purpose and use of the object, appendages such as handles, feet, spouts, lips and lids may strengthen the form of the shape by their lines.

The forms of nature are rich in materials that suggest simple and pleasing designs that may be studied and used. Nature should not be directly imitated in design. The ideas and expressions of the forms of nature are what is desired in the pottery shapes.

A definite decision as to the shape to be made is essential. Continually changing ones mind as to a desired shape while at work on the object will not lead to successful results. The student should begin by making a full-size drawing of the shape he wishes to build. It is wise in determining the height and width of the design to select these

dimensions by comparing heights and widths on available objects. A full-size drawing on paper or cardboard will appear much larger than the finished product of the same dimensions.

Some suggestions for simple shapes that can be made by beginning students of pottery are shown on page 19. Some of these pieces may suggest or indicate a type of design for the student. The student will gain more in the final appreciation of his work if his is not a copy of something he has seen. Other forms and shapes should serve only as a guide or suggestion for the student in making his own original design.

#### Considering the Design.

The basis of all good handcraft is design. An underlying factor of good design, which should not need a lengthy discourse for emphasis, is the consideration of the material or the medium of the craft. Metal, leather, wood, stone, clay, etc., all have definite and peculiar properties which influence the design of objects to be made from them. Each of these materials named can be analyzed to determine their strength and structure and from this analysis one can outline the elements which must be taken into consideration in designing an object from each. Curtis<sup>5</sup> lists eight elements which must enter into the consideration of a completed pottery piece. These are: (1) the purpose or function of the piece; (2) the form of the piece, including proportion; (3) the final texture; (4) the color; (5) a regard for the nature of the material; (6) sincerity of the function it is to serve; (7) skillful treatment;

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<sup>5</sup> Edmund deForest Curtis, Pottery Its Craftsmanship and Its Appreciation, pp. 51-53.



SELECTION OF SIMPLE SHAPES

FIGURE 2

and (8) surface enrichment or other additional interests. The skilled craftsman would not necessarily give individual attention to each of these elements; however, his final work will conform to these elements through a developed sense of good form and design. It is well for the beginning student to analyze his design in the light of these elements in order to perfect his design ability.

#### A Consideration of Function.

Pottery is a useful craft. It is a necessary industry. The products of the pottery craft have at times been forced into the realm of the fine arts. This has been done through the evolutions and refinements of the elements of design. Basically and essentially, pottery remains a craft. The purpose of pottery is basically utilitarian. Whatever the purpose of the object to be made, the design should augment that service. The purpose may be purely utilitarian or purely aesthetic. If the design does not have a purpose or if the purpose is lost at some later stage in making the object, the final result will be bad. A pitcher may be of pleasing proportion, line and color making it attractive, and it may be inexpensive - making it available for general use. If it is so constructed that it will not pour properly and easily it is of poor design. The more readily the purpose is defined, and the object fulfills this function, the nearer the piece will conform to what is accepted as good design. The design of the object must be and remain in keeping with the service to which it is to be put.

A vase for tall or short flowers, a pitcher, an ash tray, a lamp base, whatever the purpose of the object, the design must be in keeping with that purpose. A handle can well serve as an illustration of purpose.

A handle serves as a means by which the object may be picked up and carried. It must be strong enough to lift the object and to support it when it is full. The handle must be so formed that the hand can grasp it easily and naturally. It must be so placed that the wrist and arm are not uncomfortable in lifting the object irregardless of the amount of the contents. The handle must be shaped to provide a strong and secure joint where it connects with the object. It should be pleasing as to line, and not detract from the overall contour or profile of the object to which it is attached. However, the function should not be sacrificed to the line and appearance. The function remains the basic consideration. Good line is generally achieved when the function is served.

#### Form.

Careful designing of an object is an essential to pleasing results. Only those people who have had considerable experience in design can form a mental image of an object, and retain that image while producing its exactness in clay. The student should begin with the purpose of the object in mind and then, disregarding the details or small appendages, consider the overall shape and proportions of the object.

Decide the height and width. This is known as the primary mass. If the greater distance is in the height, it is a vertical mass. If it is longer than it is high, it is a horizontal mass. The next consideration should be the division of the mass. If the object is to be a horizontal mass and a simple object, it will have two divisions with dominance and subordination. If the object is a vertical mass it should either be symmetrical or have three horizontal divisions with the dominance in the center and the two sides equal. These rules apply to the basic

shape which the student should consider in his initial projects. They do not necessarily apply to free or abstract forms. Examples of good proportion are: 3 to 5, 5 to 8, 7 to 10. These proportions may not be used when functional requirements must be fulfilled.

After considering the overall proportion and the division of the mass, the line or profile of the object is to be considered. Every material has limitations to its lines. Clay being plastic, calls for a flowing line. The Chinese potters were masters of line. Seldom did they use a straight line; their lines were so slightly curved that they appear straight. It is this delicate molding of form that is possible in clay and makes well-designed pottery so pleasing. Lines must show strength in the object. Those lines which change their course several times become weak and do not show much character in the object. Lines which start at the base and sweep to the top in almost mathematical proportion are strong.

From a study of good form, several valuable conclusions can be drawn to aid the student in his design. Rectangular outlines are more pleasing than square ones. A shape that cannot be mathematically defined is more pleasing than one which readily falls into a definite proportion. The greater diameter may be either in the upper or lower half, but should be so placed that it does not divide the object into a definite proportion. The width of the top and bottom should have a definite relation to each other. Ornate and elaborate outlines or surfaces should be avoided.

### Texture.

The texture of the object has much to do in the integration of the other elements into a pleasing and harmonious whole. Texture can be achieved in the preparation of the clay body, in the firing of the clay,

in materials applied to the fired clay, and in combinations of these. The texture of the object may range from the roughness of the unfinished clay to the highly formal polish of a glass glaze.

One method of controlling the texture of the clay body is through the selection of a sieve through which the powdered clay is sifted. The use of a fine sieve will result in a clay body which has a very fine and delicate smoothness. The opposite extreme of this would be a total disregard of straining the powdered clay, leaving small stones, twigs, and other foreign matter in the clay to be burned out during the firing. Another method of controlling the texture of the body is by adding sand or grog to make it more coarse. The fineness or coarseness of the sand, and the degree of fineness to which the grog has been ground will vary the texture of the clay.

A most interesting effect can be achieved in the texture of the clay by mixing sawdust or shavings of wood into the clay before it is formed. These wood particles will burn out during the firing. A fine sawdust leaves a somewhat coarse texture to the clay as well as making the fired piece much lighter in weight. Shavings and chips of wood, mixed with the clay before forming, prevent the potter from working in other than large, rough shapes. When this ware is fired and the chips or shavings burned from it, the final result is a rough, lava-like texture.

Apart from surface decoration, the glaze offers a wide variety of textures for the object. By increasing the temperature of the fire or by the addition of flint or boric acid, the brilliance of the glaze can be increased. Lowering the temperature of the fire, adding kaolin, or adding rutile will dull the glaze. Kinds of glazes as determined by

their hard chemical content offer a wide range of textures as follows: soft, hard, clear, opaque, matt, raw, fritted, lead, leadless, majolica, stanniferous and alkaline. Texture through the use of glazes can be augmented by various pigments applied to the raw or biscuit ware without further firing.

### Color.

The basis of color in the clay product is in the clay itself. The variety of colors found in the different raw clays offer a potter a wide range from which to choose. The color of the raw clay may be altered before forming by the admixture of metal oxides. Some of the oxides and their resultant color are: cobalt oxide, blue; chrome oxide, green; iron oxide, red-brown; and manganese oxide, dark brown. There are still others from which varying colors may be obtained.

There is an unlimited range of color and color combinations that can be achieved on the ware through the combinations of the body of the ware and the glaze applied. The transparent and opaque glazes react differently with the different colors of clay body. Glost firing is another variant in achieving color and color combinations. The character of the flux and the temperature to which the glost fire is carried influences the color of the glaze. The temperatures to which the kiln is fired usually runs from 605°C. (cone 022) to 2015°C. (cone 42). This range is divided into three fairly definite temperature ranges. The lower range runs from 605°C. to about 800°C. (cone 015). The middle range runs from 800°C. to 1,210°C. (cone 4). The high range runs from 1,210°C. on up. The lowest range produces (in a dull-red heat) the more brilliant colors and lusters. Since the low range does not produce sufficient heat to

mature the body of the clay, the ware must first be biscuit fired at a higher temperature and then the glost fire made. Ceramic colors have their individual characteristics and qualities which are brought out by the glost fire. One of the most interesting, if not too often pleasant, phases of the potters work is the glost kiln. When new glazes or temperatures or a combination of the two are being tried, the result is highly unpredictable. Some of the most cherished pieces of the potters ware will be the results of 'accidents' in the glost fire.

#### Regarding the Nature of the Material.

In order to get the most enjoyment and better results from the clay product, it is necessary that one have a clear understanding and appreciation of the possibilities and limitations of the material. One should not attempt to make an object of clay appear as though it were of another material. Nor should an object be made of clay that should obviously be made of another material. An object that demands straight lines and flat planes is not a proper problem for clay. The ability of plastic clay to take and hold a shape, and the ability of clay to vitrify under sufficient heat should suggest a wide enough range of objects to be made without trying to use clay in place of another material.

#### Sincerity of the Material and its Function.

If the honest qualities and the honest limitations of the material are followed in its use, the resultant product is not apt to be bad. A teapot or pitcher that is made into a lamp base with a dinner plate or soup bowl for a shade is a shining example of what not to do with pottery. A soup bowl should look like a soup bowl, it should be so constructed that it will hold a reasonable amount of soup, and it should be used for

a soup bowl. A pitcher should be made to pour without slopping and dripping the contents. Sincerity of the material and the honest function of the object are to be given serious consideration.

### Skillful Treatment.

Thoughtful consideration of the design and function of the article must be followed by skillful execution. Good design is meaningless if the work is haphazard. A thorough knowledge of the material, tools, and processes leads to sound design. It is expected that craftsmanship and skill will be combined with the knowledge. For the beginning pottery student, and until one becomes proficient in working the clay, it is advisable that a template of the design be made and used as a guide in forming the object. Care and patience in making the first pieces of pottery will compensate the potter through the final result of these and subsequent pieces.

### Additional Interests.

A solid color ware may be of occasional interest and provide just the right touch when arranged with other objects. Too, a solid color can become monotonous, especially if the area is large or if the object is to be used away from other color and form that would subordinate its monotony. When a fine line and true color will not satisfy the aesthetic spirit of the craftsman, some form of surface decoration becomes necessary. A crackled glaze, a faint spray of a contrasting color, a simple line incision, -- any of these may serve the additional interest needed. Whatever is needed or considered for an additional interest, the student should keep in mind the purpose and function of the piece and do nothing to alter the purpose of the ware.

### Profile Templates, Their Need and Use.

Profiles should be used by the beginning potter to aid him in making the shape he has designed. Only an experienced potter can form a mental picture of a good design, retain the mental image, and work the clay to that exact shape. The template can be made of metal, wood, or cardboard. The latter being sufficient, more easily made, and durable enough for one piece of work.

To make the template, a profile of the desired shape should be drawn on the cardboard. Only one half, or one side, of the profile need be drawn. The profile should be about one eighth larger than the desired size of the object to allow for shrinkage in drying. Using a sharp knife or razor blade, cut the line of profile as drawn on the cardboard. The concave side (outside) of the profile will be used. Cut a horizontal line along the top and bottom of the profile so that it may be placed against the object from time to time during the construction. The diameter of the top and bottom of the object should be noted on the template so that these dimensions may be checked with those of the work as often as necessary to control the shape.

Begin the work with a clay bottom that is sufficiently thick for the size of the piece being made. As the sides of the piece are built up, the outline should be checked continually with the profile to insure adherence to the original design. Be sure to check the diameter of the piece as the sides are built up. A common mistake that is made when this is not done, is a gradual enlargement of the diameter towards the top of the piece.

If the clay is too soft to hold the shape as the article is built



CHECKING THE FORM WITH A TEMPLATE

FIGURE 3

up, the piece should be allowed to set long enough for the clay to harden and hold the shape before further work is done. The work should be checked with the profile after the piece has set to be sure that the outline is being followed, and that the piece has not lost the shape that was formed.

Vertical marks will be left on the piece through checking with the template. These marks can be removed when the piece is finally worked down. The potter should not be concerned if the marks of the process shows. This is much more desirable than a sanded or shaven piece. As the piece hardens and as the work progresses, the inside of the piece should be worked down to a fairly even surface. The potter must be sure that the coils or strips of clay are well bonded together, else the piece will crack along the joint as it dries.

A feeling of mastery of the clay is achieved when the craftsman can begin his work with a definite pattern and complete it according to the original intention.

## CHAPTER 4

## FORMING THE CLAY

The process of coil forming for clay products is an ancient one. Through the ages this process has remained a basic and handicraft one. The pleasure of building with clay comes from its plastic quality which is associated with no other material. Coil building should be the basic process of the pottery craft class. Familiarity with the material in this manner will give the student valuable experience applicable to the other processes of the craft.

Tools and Equipment Needed.

The cost of tools and equipment for even basic courses in pottery can be listed to run into large sums of money. Since the hand tools of the craft are used to shape the ware, and shapes are indefinite in number, so the number of hand tools that can be bought and made are indefinite. The potter can purchase any number of wooden and metal hand tools, and they may also be bought in a strikingly beautiful plastic material which are almost works of art alone. The writer has found that the plastic tools become marred too easily and lose the desired smooth surface. It might be well to recall here that the most expensive set of tools for any craft remains valueless unless the worker knows and understands the possibilities and limitations of the material with which he is working. In pottery this is especially true, and the writer knows of no better way in which to become acquainted with clay than in working with it with the hands. So for the pottery craft, the following tools

and equipment are suggested: a small pocket or paring knife, a piece of stiff cardboard with which to make templates, a small sponge, a rag or two to be moistened and wrapped around the piece to prevent it drying between classes, a small square of canvas or oilcloth (if oilcloth is used, the clay should be worked on the back side of the material), a larger piece of oilcloth or plastic material to be placed around the wet cloth to prevent evaporation of the water, and - of course - the most useful of tools, the hands.

With these materials, and clay, the potter is ready to begin making an object. Irregardless of the design of the piece, to the potter it will be the beginning of a profitable experience. Make your design, cut your template (be sure to note the major diameters), grab a large handful of plastic clay, and begin.

#### Coil Forming.

There are three methods that may be used in building pieces by hand. One method is to roll out the clay into slabs and cut even strips from this to build up the shape. Another method is by taking small pinches or dabs of clay and adding them to the shape to build it up. The third method is by rolling the clay into lengths of coils and using these to build the shape. Of the three methods, the latter is the most commonly used and offers better control of the outline of the shape along with reasonable speed in making it.

The clay must be in good plastic condition and not 'short'. Take a handful of the clay and knead it carefully. Take a portion of the kneaded clay and roll it into a ball about the size of an egg. Place this on an even surface and roll it forwards and backwards with the

palms of the hands. After a little experience one will get the feel of the clay and will be able to do this quickly and efficiently. The palms of the hands should move outward with the clay as it elongates into a rope-like form. Too much pressure should not be exerted on the clay or it will have a tendency to flatten out instead of elongating in a smooth roll. The pressure and the amount of pull or stretch with the palms must be regulated to give an even coil from the clay. Lumpy and uneven coils will result in an uneven wall and loss of shape to the object being made.

Only one or two coils should be made at a time, otherwise the coils will become too dry before using and will not work into the piece well. Take one of the coils and begin forming the base of the object by starting from about the center of the cloth and coiling the clay outwards until the desired diameter of the base is formed. The coils should then be worked with the fingers to smooth over the top and bond the coils together. After working the top of the coils together and making a smooth and even surface (the potter must be careful to prevent an uneven pressure which will result in an uneven base), the base should be turned over and the underside worked in the same manner. When smoothing down the coils of the base, the motion of the fingers should be alternated to prevent stretching the base in one direction and loosing its circular form.

When the coils of the base are well bonded and a smooth even surface obtained, the student should begin on the wall of the piece. Either of two ways of forming the wall of the piece may be used. One method is to keep a continual coil of clay spiraling to form the wall. This method

will leave the top edge of the piece uneven; however, the top of the piece can be trimmed when the piece is finished to leave an even edge. The other method, recommended by some potters, is to break and fasten the coil after each revolution, beginning each new coil at a different point on the circumference so that all joints will not be in line vertically. The potter should decide which method is the easier for him.

As the clay coils are spiraled around the wall, they must be firmly attached to the ones underneath. If this is not done, the piece will crack and the coils will separate during drying. A light smear with the fingers can be used to help bond the coils. Moistening the coils with a sponge will help give a more secure joint. Before working to too great a height on the wall, the potter should work the coils together, inside and out, to form a smooth surface of the clay. The clay walls should be worked as the base of the piece was worked. By working the outside wall with an upward motion of the fingers, and the inside wall with a downward motion, the thickness and shape of the walls can be controlled better. The walls should be worked with little or no water. The temptation to use water on the walls will be great, but its use will cause the walls to become soft and lose their shape.

The clay coils should be very pliable in order to get a good joint between coils. This is why it is desirable to roll the coils as they are used rather than rolling several at one time. Since the coils must be very plastic and soft, it will be necessary for the potter to set the work aside from time to time and allow the clay that has been shaped to harden so that it will hold other coils built up on top of it. Failure to do this will cause the lower part of the object to give way to the



THE COIL METHOD OF FORMING

FIGURE 4

weight of the upper part, and the work will be all to do over again.

Mention has not been made, in this process, of the use of the template. Too much emphasis cannot be made as to the importance of its use. The potter should strive to obtain the shape of the design he has started with, and this will be impossible unless the work is checked as it progresses. Marks made by the template on the side of the object should be disregarded as they can be removed when the outside of the piece is worked down. The work is started with a thought in mind when making the design, and should end with the thought expressed - using the clay as a means of expression.

The student's first work should be limited to rather simple, straight lines. It might be well for the student to make a simple cylindrical form as his first work. After some degree of accuracy has been attained in working with the clay, the student should begin building simple curved shapes, gradually working towards more complicated shapes. Dishes and platters may be made by the use of coils of clay. As the dish is worked up and out, it will be necessary for the student to allow more time between addition of coils in order for the last coil to dry or harden sufficiently to hold additional weight.

When a piece is set aside between classes or working time, a cloth soaked in water and wrung out should be wrapped lightly around it. This will keep the piece moist and pliable so that it may be worked easily during the next period. It is also advisable to keep a yard or so of oilcloth or plastic material to place over the cloth and prevent it from drying out. This is particularly necessary when the piece is to be left for more than a day without working. Another way of keeping

the piece moist between working times is by placing it in a damp box.

While the potter is forming the clay piece, the lump of clay from which the coils are made may become too dry to work. The clay will dry and harden quickly when exposed to the air. The student can keep the clay moist by keeping a dampened cloth over it and keeping the clay on a wet, plaster bat. Paper hand towels have been used for the same purpose as the wet cloth. The paper towels will stick to the clay as they dry and are a nuisance to scrape off. Similarly, as the cloths begin to rot or fray they should be discarded. Lint and pieces of cloth are equally tiresome to remove from the clay. It is disheartening to have a material stick to a finished piece of work and have to scrape away and repair part of it.

When forming the piece, if a short arc is to be made, the coil of clay should be moistened with the sponge to prevent it from cracking as it is bent to the arc. The profile of a piece is curved out or in by placing one coil off center on the one below it in the direction the profile is to go. With the coils wadded securely as they are placed one upon the other, the inside of the piece can be smoothed and the outside left as is to add to the texture or pattern. Close adherence to the template is not possible when this is done, but it should be followed as closely as possible. Coils are joined at the ends by pinching them off in a tapered fashion and pressing them together, working them into the round shape when this is done. A blunt joint is more difficult to make and is apt to crack loose in drying. To attach a damp coil to one that has dried somewhat, the dry coil should be moistened with the sponge before they are pinched together.

All pieces of clay that are left over can be used again. There is no waste in the clay product. A container should be kept for the dry clay and as it is needed it can be crushed and processed for plasticity again. If there should be any question as to the cleanliness of the clay after it has been handled, lysol should be added to the water that is poured on the clay. This should sterilize the clay to the satisfaction of the most sanitary-minded person.

### The Damp Box.

The necessity for keeping the piece moist until it is finished should be stressed. After the piece is finished it is allowed to become leather hard before it is finally scraped or polished. If the piece dries before this is done, the only way it can be smoothed (besides moistening it again with a sponge and working it down) is by scraping with a knife blade or by sanding, and this detracts from the handicraft of the potter.

Each student can make his own damp box in which the piece is kept moist between work periods. A metal can with a lid that fits over the outside will serve nicely. The can should be painted inside and out to prevent it from rusting. It will be easier to manage if the student will fasten the lid to a shelf or some heavy object. The lid can be nailed or held with screws. The lid should fit snug to the can to make it as airtight as possible. When the work is set aside a damp cloth should be draped loosely around it, placed in the lid, and the can set in place. It will be much more convenient to remove the can from the lid and take out the work than to try to remove the work from the can without misshaping the piece in some way. A low, sturdy shelf could

easily be built in the class room on which to fasten the individual damp boxes.

A damp box to store larger or additional pieces can be made similarly to the one described for a clay bin. A wooden box lined with zinc to prevent rotting, and a close fitting lid can be built by the students. Plaster slabs should be made to line the walls of the box. Wood or plaster strips should be placed along the bottom about one inch apart and two inches high. If about an inch of water is kept in the bottom of the box, the plaster along the sides will absorb enough to keep the air in the box moist and prevent the pieces from drying. Another way to prepare the inside of the box is to leave the plaster slabs from the walls and cover each piece with a cloth which should hang down and into the water. By capillary action the cloths will keep the pieces damp. The use of paper towels in the damp box is not desirable. When the paper remains damp for any length of time they begin to fall apart and are easily torn when one tries to remove them. About the only time when a paper towel is useful about the clay is when one is drying a moistened clay object. By placing the damp clay on a piece of paper, contraction in drying is aided without cracking the piece. If a damp clay object is placed on a board or plaster bat to dry, it is apt to bond itself to either of those objects forcing the clay to crack in drying.

#### Strip Forming.

Strip forming may be a more expedient way of making a piece than with coils, but some of the feel of the clay is lost in this method of forming. An advantage in forming a piece by the strip method is the



THE DAMP BOX

FIGURE 5

flat edges that are to be welded together instead of getting a weld between the circular pieces of the coil method. There may be a disadvantage in that the coils lend themselves more to profile forming than do the strips. This disadvantage can be overcome by cutting the strips narrower, but some time is lost in the additional welds that must be made with the narrower strips.

The clay should be well kneaded and rolled out into a thin sheet about one-quarter of an inch thick. A rolling pin or other hard cylindrical object can be used to roll out the clay. The clay should be rolled out on a piece of canvas or on the back of an oilcloth. After rolling the clay for a while in one direction, roll perpendicular to that direction to remove the corrugated effect from the surface of the clay. From the sheet of clay cut the strips the desired width. The base of the object should be cut from the sheet of clay to the desired shape. Allow the clay to dry enough that the strips can be taken from the cloth without being pulled into. The strips of clay need to be somewhat drier than the coiled clay for working. When the strips can be handled without breaking, one is taken from the cloth and formed into a wall about the base of the object. Each strip should complete a turn about the base of the object. Small lengths should be kneaded together and rolled out again. Moisten the ends of the strips with a sponge to give a better bond. As one strip is placed upon another it should be securely welded and formed to the desired shape. If the clay strips are too dry or hard they will crack as they are formed to the profile desired. Care must be taken that the bond between the strips is not broken during the forming. To form the strips, place the thumbs on the

inside and the first two or three fingers on the outside and work around the piece until the shape conforms to the template. As the shape is formed, other strips are added, shaped, and checked with the template. To join the ends of a strip together, they may be cut across the width to an angle to give more surface for a more secure weld.

In strip forming as well as coil forming, the student should begin by making a plain cylindrical shape. The clay strips will be more useful if they are used for a straight walled object than for one whose walls are curved.

### Slab Forming.

This method of forming is particularly adaptable to shapes that are made up of flat planes and surfaces. Shapes of that nature are not particularly exciting when executed in clay. Flat planes and surfaces lend their formation more to woods and metals.

Making a slab shape in clay is a very simple cut and dried procedure which may give some training in making layout patterns (such training will be valuable in sheetmetal work), and perhaps some training in mechanical drawing.

After the object to be made has been designed and dimensioned, the shapes of the sides, base, and other parts of the object are laid out to full size on a stiff piece of paper or cardboard. Allowance must be made for the shrinkage which will take place in the clay. The clay is kneaded and rolled out to thickness as in strip forming. The patterns for the different surfaces are then laid out on the clay and a knife is used to cut these shapes from the clay sheet. As soon as the clay has dried sufficiently to be handled without pulling into, the shapes are

separated from the sheet of clay and laid out on a bat. The edges should be beveled at about  $45^{\circ}$  before they are assembled.

When the pieces are ready to be placed together, the edges should be painted with a light coating of slip and the pieces stuck together. Very damp clay should be used to strengthen the bond of the joints on the inside of the object. When the sections have been fastened together and the pieces allowed to dry somewhat, the outside should be finished down and if desired, polished by rubbing the object with a damp sponge or with the smooth edge of a stick. Shapes that can be easily formed by slabs of clay are: round objects with straight sides or lines that change directions by angles, and square or rectangular objects.

#### Appendages.

The appendage should be considered in the design of the object after the general mass and shape has been decided. An appendage should appear to be a definite part of the object, not an afterthought. Considerable thought must be given to the shape of the appendage, and as to how the shape of the appendage will affect the design. An appendage should appear to grow out of the object. Small appendages such as feet can easily be formed by hand. When several feet are being made for an object, they should be made at the same time and out of the same batch of kneaded clay so that their shrinkage will be the same. Spouts and handles can be formed from pressed and coiled clay, respectively.

When attaching an appendage to its object, the surfaces to be joined should be scratched with some pointed object to roughen them for a better bond. Slip can be applied to these surfaces with a brush or by using the tip of a finger - dipping it in the slip and rubbing the



POLISHING THE PIECE WITH A SPONGE

FIGURE 6

slip on the surface. The appendage should be held firmly to the object until the slip has had sufficient time to set and hold the two together. While the appendage is being attached with the right hand, the left hand can exert equal pressure on the inside of the object to prevent any loss in shape.

## CHAPTER 5

## MOLD MAKING AND CASTING

One of the methods of pottery making, pouring - or casting, has often been condemned as too mechanical or commercial for a craft class. Casting is an honest way of working with clay. The process by which a piece is made may be said to be less important than producing a beautiful piece of pottery. Clay slip, by its form and variable consistency, lends itself to pouring in a plaster mold. It is an honest use of a particular form of a material.

The Pattern.

The original pattern can be made of wood, plaster, clay, or any other material that will withstand the pressure of poured plaster. If the pattern is made of clay and the walls are of sufficient strength, it will need no further preparation. A wood or plaster pattern will need to be prepared before a plaster mold is made of it. Wood can be waxed to prevent it from sticking to the plaster. If a wood pattern is to be used to make several plaster molds, it is best prepared by soaking it in linseed oil. A plaster pattern should be carefully rubbed with a paste wax or painted with a medium thick coat of slip just before the plaster is poured over it.

Wood patterns can be made by building or shaping the wood with consideration for the outside shape only. The inside of the cast shape conforms to the outside in slip casting. Wood objects turned on the lathe make suitable patterns for molds. A hard wood, such as cherry or maple, with a close grain is desirable for a wood pattern. The wood must



WOOD PATTERN FOR A MOLD

FIGURE 7

be hard and close grained so that it will not warp or check when the plaster mold is made.

Irregardless of the type of pattern used, it should be made larger than the cast shape that is desired. How much larger the pattern should be than the shape desired can be determined by experimenting with the slip that is to be used. Some object should be cast from the slip to be used, measurements being made of the original pattern and of the cast object after it has dried, and again of the object after it has been fired. By comparing the measurements, the size that the new pattern should be made, is determined.

The pattern may be made of plastic clay. The clay can be built up into a solid mass considering only the outside shape. A clay object that has not been fired can be used for a pattern providing the walls are thick enough to withstand the pressure of the plaster before it sets. The surface of the clay pattern should be as smooth or textured as is desired in the object to be cast. In making a clay pattern, a template should be used that has been cut to allow for shrinkage in the cast object.

Plaster is perhaps one of the best materials for making the pattern. It can be cast in a cylindrical form and turned on a lathe. A large chunk of plaster can be made and carved to the desired shape. The plaster pattern, when made from a casting plaster, can be finished to a very smooth surface.

Whatever the material to be used in making the pattern, it must be finished to a smooth surface, or have the surface texture that is desired in the cast object. Smooth surfaces are better for casting as the plaster

mold is easier to clean between castings. The mold must be cleaned after each cast to insure an even surface for the next casting.

### Mixing Plaster.

Plaster can be obtained from any hardware, lumber yard, or builder's supply store. When ordering plaster for the pottery class or laboratory, 'casting plaster' should be specified. This is a finer ground plaster and will give better results than the ordinary plaster.

The casting plaster will be used for making molds, bats, patterns, and plaster slabs for the clay bin and damp box. Plaster has the property to solidify when mixed with the proper proportion of water. In a dry, solid state it will absorb water from clay. The plaster bat can be soaked in water and used to keep the clay damp. It is a versatile material necessary for the pottery class.

The equipment desirable for mixing plaster should consist of a hand wash pan or dish pan (either of these used should be enameled), scales (if the plaster is to be weighed), a pint or quart can (if the plaster and water are to be measured), and several tin cans for pouring the plaster. The plaster is ordinarily ordered in one hundred pound bags as needed.

There are three methods commonly used in determining the amounts of plaster to water for the right consistency. Either of the three should give satisfactory results. One method is to measure ten parts of plaster to seven parts of water. Another method used is to weigh the plaster and water, using two and one-half to three pounds of plaster for each quart of water. The writer has used a third method and found it quite satisfactory. The amount of water needed is estimated in the mixing pan and

the plaster is sifted in until the water has all been absorbed and small amounts of damp plaster appear on the surface. In either method the water is placed in the pan first and the plaster sifted in rapidly. This may be done by sprinkling handfuls of plaster evenly over the water to prevent the plaster building up in one or two mounds.

When the plaster has been added to the water, it should be allowed to set for about two minutes in order that any small lumps of plaster will become completely dissolved. Stir the plaster with the hand. With the fingers extended and together, slide the hand into the plaster at an angle to keep from taking air into the mixture. Keeping the hand below the surface, rotate it from the wrist to stir the plaster and mix it thoroughly. Any lumps or foreign matter that may be in the plaster should be removed. After the plaster has been stirred, the pan should be jarred several times to cause any air bubbles to rise to the surface. Air bubbles in the plaster will become air holes in the plaster mold and if these are formed next to the pattern they will have to be filled.

#### Making Molds.

Besides the plaster and the pattern, only scrap materials need be used in making the plaster mold. Scrap boards, with one face planed true and soaked in oil, can be used to pour upon and to build up the sides of the mold. Scraps of polished granite or marble can be obtained from the local stone works to be used for the same purpose. Several brick or small cement blocks are handy to use for propping the sides. For circular forms, linoleum or tar-coated roofing paper can be cut to width for the height of the mold, wrapped around the object (leaving room for the plaster to be poured) and held together with rubber bands cut from

old inner tubes or tied with cord. The expense of the pottery craft depends upon the ingenuity of the teacher and students.

One piece molds can be made for those objects or patterns which are larger at the top than the base, and which have no returns between the top and the base. An inverted cone or pyramid illustrates the pattern that can be cast in a one piece mold. The pattern is placed upside down on the surface upon which the mold is to be made. For a round or square pattern, a cylindrical form is best for the outside of the mold. Using a strip of linoleum or roofing paper cut to extend about two inches above the base of the pattern, wrap around the pattern leaving a minimum of two inches of space from the point of the pattern furthest from the center. In other words, the minimum thickness of the plaster mold will be two inches. Band or tie the form securely. Around the outside base of the form, press strips of clay to bind the form and the board or slab on which the mold will be poured. This is done to prevent the plaster from leaking out and to help hold the shape of the form. If necessary, brick can be placed against the form for further support.

With the form secured and supported, and the pattern in place, the plaster should be mixed and a clean can or cup ready to pour the plaster. It is necessary that the pattern and form be prepared before mixing the plaster. Plaster must be poured when at a certain consistency for the best results. The plaster hardens the longer it sets and if poured too late it will form into a bad impression of the pattern. If the plaster is poured too soon, a soft mold will result. Plaster should be poured over the mold when it is the consistency of thick cream.

When the plaster is the right consistency, fill the cup or can that

is to be used for pouring and pour a light coating over the pattern and the bottom of the form. The plaster must be dipped and poured evenly and smoothly to prevent forming bubbles in it. If there is a possibility of bubbles having formed around the pattern, blow on the first coating of plaster to force the plaster around the pattern and the bubbles out. Fill the form with the plaster and even off the top. Any straight object can be used to smooth and even the top of the poured form.

Until one has sufficient experience to estimate the amount of plaster that is needed for a form, there may be more plaster than the form will hold. This excess plaster should be poured in an old pie tin or similar form and used as a hat. Jar the plaster in the tin to settle it and scrape the top level. When the plaster has dried it can be dumped out. Wipe the pan in which the plaster was mixed, and the hands, with newspaper or paper towels and wash out in a tub. Plaster should not be washed into any plumbing as it will clog up the drain.

When the plaster has set it will be warm. This will take about ten or fifteen minutes. The plaster will not harden for about two hours. As soon as the plaster has set, the form can be removed from around it, and the pattern removed. Care should be taken in removing the pattern so as not to mar the mold.

A turned pattern that has only one return, such as the Scotia Curve or a sphere, can be cast in a two-part mold. The picture on page 52 shows a pattern with one return and the two-part mold made from it. To make the two-part mold, a line should be drawn around the pattern marking it in half vertically. Using dabs of clay, prop the pattern on its side with chunks of clay so that the vertical division drawn on the pattern



SEPARATING THE MOLD AND PATTERN

FIGURE 8

is in a true horizontal plane. Build a platform of clay out from the center lines around the pattern, extending two inches from the pattern away from the base and the major division of the pattern. When this is done there will be one-half (in length) of the pattern showing above the clay. A rectangular wall should now be built up around the pattern and clay extending two to three inches above the highest part of the pattern, and laying flush against the top or mouth of the pattern. Brick or boards can be used for the wall. Using plastic clay, make a fill at the inside joints of the form and along any cracks or seams of the form. Coat the inside walls with slip and pour the plaster into this form.

As soon as the first half of the mold has set, the form should be removed and the mold inverted leaving the pattern in it. Remove the clay that was used as a platform around the pattern and replace the form being sure that it still extends two inches or more above the greatest height of the pattern showing. Cut two V-shaped notches on a side along the outer edge of the first half of the mold. Paint the surface of the plaster and the walls of the form with slip and pour the other half of the mold. When that plaster has set the form can be removed, the mold divided, and the pattern removed. Set the mold aside to dry.

When there is more than one return, the mold will have to be made in three or more pieces. A craft class will not ordinarily have time for this since practice in making the one piece mold should be had before the two piece mold is attempted and so on. When there is more than one return to the pattern or object, there are technical difficulties encountered in casting the piece which must be overcome in removing the cast piece from the mold before shrinkage separates the piece at one of

the returns.

When the mold has set and the pattern removed, the clay and slip particles should be washed off leaving the mold clean. The mold or pieces of the mold must be set aside to become thoroughly dry before pouring the slip. For best results, the mold should be allowed to dry from one to three days (depending on the temperature and the humidity) before the potter attempts to pour a piece.

Patience exercised in preparing the pattern and form for casting will save time and effort in making the mold. It is disheartening to say the least to begin pouring the plaster in a form and have the form give at some place and have the plaster to pour out over the table and the floor. It is a messy job to clean up the plaster, and the work is to be done all over again. Be sure that the form is fastened together securely, and that all cracks and joints are well-bonded with clay. In making the two-piece mold, care must be taken in handling the pattern if it is made of clay; after the first half is poured, if the pattern is damaged in turning the mold over it must be repaired before the second half is poured. Be careful in removing the pattern from the mold so that the mold is not cracked or chipped next to the pattern.

#### Preparing Slip.

Slip may be made from plastic clay by adding water to it and working until it is the consistency of thick cream. This is the hard way. An easier way is to take the powdered clay and run it through a sixty or eighty mesh sieve, then sprinkle this into a tub or crock that has been half-filled with water. Add the powdered clay to the water until the clay particles fill up to the surface. Stir thoroughly until the clay

is well dissolved and there is a thin paste. The slip is better when aged, so mix the slip a week or so before it is to be used. Since slip is used for patching plastic pieces, attaching appendages, and for various other work in the pottery class, it is well to keep some on hand at all times.

Slip will keep indefinitely if kept covered with water. The water can be removed before the slip is used as the clay particles have a tendency to settle leaving clear water on top. As much of this water can be removed as necessary to make the slip the right consistency. Each time before the slip is used, it should be stirred thoroughly to bring it to an even consistency, and any lumps that have formed should be dissolved or removed.

Metallic oxides can be added to slip for colorants. Some interesting effects can be achieved through different combinations of colored slip and glazes. A green piece can be dipped in a colored slip to give the appearance of a colored body, or lines scratched through the thin layer of colored slip to reveal the other clay underneath. The latter is called Sgraffito Decoration and some beautiful pieces are decorated in this manner.

### Casting.

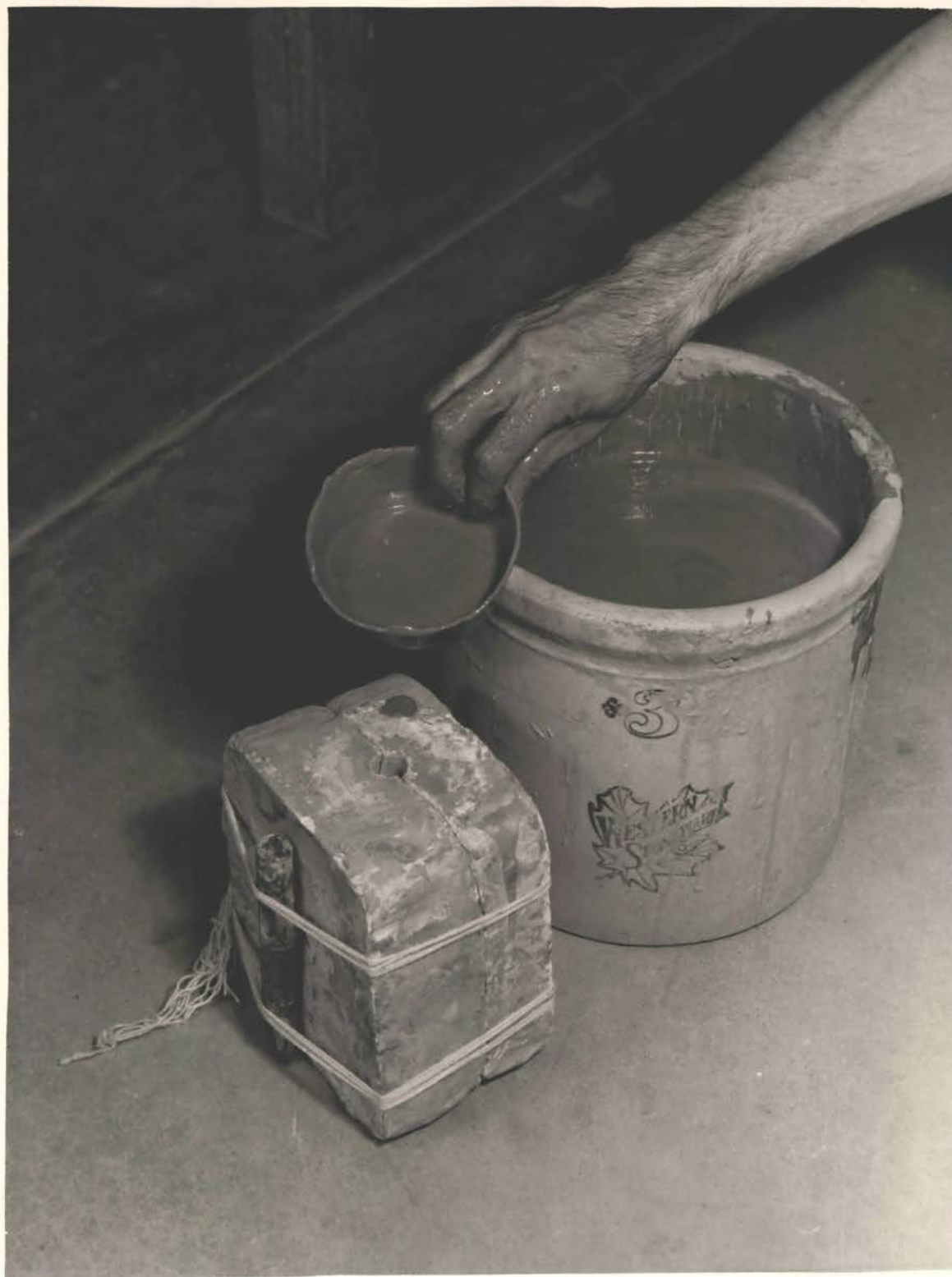
When the mold has become thoroughly dry and porous, it is ready for pouring. Wipe out the inside of the mold with a damp sponge. This will remove any dust or other foreign matter. In the case of the two-piece mold, fasten the two pieces together. The notches that were cut in the first half of the mold before pouring the second half were filled when the second half was poured. These notches help to hold the mold in line

and makes it easier to fit the two pieces together.

One-half to three-quarter inch bands cut from an inner tube are very good for holding sections of a mold together. They can be stretched on the pieces of mold and their elasticity will hold the pieces firmly. Cord or string may be used for the same purpose, but when either are used, a wedge must be forced between them and the plaster to take up slack.

Siphon off the excess water on the slip and stir it thoroughly. It is best to use a container for dipping that will hold as much slip as the mold takes. A little neater job will result if the mold is filled in one pouring. If the mold is filled partially then additional slip is poured in, there will be a small dark line on the piece where the two pourings met. Tin cans are sufficient although some people prefer a pitcher. A small lip can be pinched in the can to cause it to pour easily.

Pour the slip carefully into the mold to prevent bubbles forming which will be carried down the side of the mold and result in small holes in the green ware. Jar the mold to settle the slip and prevent air bubbles forming. After the mold is filled with slip, a noticeable settling of it will take place. More slip should be added as needed to keep the mold filled. The plaster is porous and will absorb the moisture from the clay or slip next to it. This forms a wall of firm clay around the inside surface of the mold. By scraping the extra slip from the opening of the mold, the thickness of the clay wall can be noted. When the clay wall is the desired thickness, the slip is poured from the mold leaving the center hollow. Different clays react differently, so the time for a given thickness to form in a mold will vary with the clays being used.



POURING SLIP INTO THE MOLD

FIGURE 9

The thickness of the slip will also vary the time for the wall to form; thick slip forming a wall to a particular thickness sooner than a thinner slip.

When the excess slip has been poured from the mold, some potters recommend turning the mold upside down to allow any additional slip to drain from the mold. For small pieces this is a good practice. For larger pieces it might be well to set the molds upright. The extra slip that remains in the mold will settle to the bottom adding support where it is needed.

The top of the mold should be cleaned, scraping away the clay that has formed around the opening in the mold. Set the mold aside to let the clay body inside dry more thoroughly. If the mold is poured in the afternoon it should be left standing overnight. The clay will pull away from the plaster wall of the mold as it dries. Small pieces can be removed after less time in the mold than larger ones. The clay must be stiff enough to hold the shape of the large piece before it is taken from the mold.

When the casting is stiff enough to remove from the one-piece mold, tip the piece upside down holding one hand over the opening or inside the cast piece to receive it. Set the casting on a shelf to dry. With the two-piece mold, the pieces must be pried apart after removing the bands. Care in separating the pieces will prevent damage to the cast body. The damp clay will mar easily in contact with the plaster mold. Lift one-half of the mold from the casting and jar the casting loose from the other half and lift it out. Where the mold fits together, a small ridge of clay will be formed on the casting. This should be removed by cutting



THE CASTING, SHOWING SHRINKAGE IN THE MOLD

FIGURE 10

or scraping down and around the casting. Smooth the top edge of the casting, and if desired, imprint your name or initials on the bottom. Set it aside to dry before firing.

In casting, the potter can make one or a dozen pieces from the original pattern. Where several cups, plates, or similar articles are wanted, casting is quick and effective. When sculpturing is done, the inside of the piece must be hollowed out to prevent the piece bursting in the kiln. If a mold is made and a piece cast, the cause of bursting will have been eliminated in the cast piece. The difference between a commercial piece and that of the craftsman is a matter of treatment rather than process. The cast piece can be worked down by hand and given the same surface treatment as one built by hand.

The mold should be cleaned and allowed to dry out between each casting, and cleaned with a damp cloth before each pouring. The drying time can be hastened by placing the molds near the kiln, in the sunshine, or in the wintertime, by placing them in the furnace room or on radiators.



THE PATTERN, MOLD, CASTING AND GLAZED PIECE

FIGURE 11

## CHAPTER 6

## FINISHING WITH GLAZE AND PAINT

The writer has attempted to explain in more detail those processes of the pottery craft from which the student can gain the most value at a minimum of expense. Like any craft, pottery can entail a great expenditure by the school for machinery and other equipment, and for supplies. Work required of the student can also be made expensive. On the other hand, the pottery craft can be made very economical with practically no cost to the school or student.

Glaze and Glazes.

Glazes are one of the expensive items of the pottery craft. Without careful study and preparation the result of a glaze on a clay body is unknown until the piece is drawn from the glaze fire. If a desire for experimentation has permeated the attitude of the class, glazes and glazing offers an open field for the students. A mediocre piece may become a thing of beauty, while a well designed and executed piece may be completely ruined in the glaze fire.

A glaze is a covering that has been melted on the piece. Glazing is the process of covering the body of the ware with a thin coat of glass. When successful, a glaze improves the appearance and durability of the piece, as well as making it impervious to liquids. The glaze may be bright, dull, transparent, opaque, colored or clear. The glaze must have three features. First, it must have something to make it melt; this is called the 'Flux'. Second, it must have something to make it stick to the piece, otherwise it may melt and run off or leave

bare places on the piece; this is known as an 'Anti-flowing' or 'Viscous' material. And third, the glaze must have something to make it adjust to the body of the clay so that in cooling the bodies contract equally and prevent the piece from crazing; adjusting the glaze is called 'Glaze-fitting'.

If a kiln is available to the craft class, and glazing is to be done, it might be well to order the glazes already prepared from the same supply house that the clay is purchased from. In this way the glazes will have been pre-tested and the temperature at which the glaze should be fired will be supplied the craft class. If the class has prepared its clay from a local deposit, a sample of the clay may be sent the supply house from which the glazes are to be purchased, and the clay tested there to determine the proper glazes for it.

Many potters will argue that the potter should prepare his own glazes, and that desired training and experience will be forfeited if glazes are bought ready-mixed. This is certainly true of advanced classes in pottery where a basic understanding of glazing has been developed and there is sufficient time during the class periods for the potter to conduct his experiments. For the craft class, where time is a premium and some physical reward is needed, glazes, if used at all, should be pre-tested to insure against loss or damage to the work in the glaze kiln.

#### Applying the Glaze.

There are three methods by which the glaze may be applied. It may be sprayed on the piece; it may be applied with a brush; and the piece may be dipped in the glaze. Glazes are prepared in a liquid or



DIPPING THE PIECE IN A GLAZE

FIGURE 12

semi-liquid state. The thickness of the glaze is determined by the amount of water in which the chemicals are suspended. A glaze that is too thin for application may be thickened by allowing the particles to settle and removing the necessary amount of clear water from the top of the container. Water should be added to a glaze that is too thick.

Dipping the piece is the most economical, safe, and expedient method of application. The glaze must be in a container large enough to receive the piece to be glazed. Larger amounts of glaze are needed for this method but there is no waste, and small amounts can be used for the smaller pieces until all of the glaze has been used.

Spraying the glaze on the piece is the next best method if equipment for spraying is available to the class. Care must be taken in spraying that the glaze mist is not inhaled. The glaze contains lead which is poisonous. The piece to be glazed should be placed in a shallow pan on a disk that can be revolved easily. Shields should be placed at the sides and behind the piece to be glazed to catch the extra glaze. The piece is turned as the glaze is applied and care taken to prevent building up the glaze in one spot causing it to run on the piece.

Applying the glaze with a brush is rather slow, and the craftsman must be sure that the glaze is evenly applied and that it adheres to all parts of the piece. A number 12 water color brush, of cheap grade, is recommended for applying the glaze in this manner. The glaze should be stirred continually to keep the particles in suspension. Dip the brush in the glaze and apply the glaze by touching the brush to the piece. Work around the piece applying the glaze from top to bottom as it is revolved. Two to four turns of the piece will be sufficient.



APPLYING GLAZE WITH A BRUSH

FIGURE 13

Glazes should be built up on the piece from one-thirty second to one-sixteenth of an inch thick. For spraying and dipping, the biscuit ware should be dipped in water first and allowed to stand until the moisture has left the surface. The insides of small-necked vessels or vases can be glazed by first dampening with water then pouring some of the glaze into the piece, revolving it to bring the glaze in contact with all the wall, and pouring the excess glaze back into the container. After the glaze has been applied to the piece, the base should be scraped clean to prevent the glaze from running on to the bottom and forming droplets.

After the piece has been glazed, it should be set aside for the moisture to evaporate before it is placed in the kiln. The piece must be handled carefully as the glaze takes on a powder form in drying and is easily brushed from the piece or pieces of dried glaze are chipped off. If small cracks appear in the dried glaze they should be smoothed over with the fingers before the piece is fired. The hands should be carefully washed after this is done to remove all particles of the glaze.

Some glazes can be applied directly to the green clay and the clay and glaze fired in one operation. Information as to the adaptability of the glazes should be secured from the supplier. Gum Arabic may be used in the glaze to help bond it to the ware until it is fired. The Gum Arabic should be mixed with water until it is a thick syrup consistency and added to the glaze as needed. Used in too large quantities, the Gum Arabic has a tendency to peel from the ware.

Decorations can be applied to the green ware by painting figures on the ware with colored slip. Portions of the surface of the piece may be

cut or scraped away and the colored slip used to fill these places, or the slip may be applied as an over lay.

### Painting Biscuit Ware.

For a craft class that does not have sufficient funds to buy a kiln, the green ware can be fired in a 'Home-made' outdoor kiln. Kilns that can be built outdoors for biscuit firing will be discussed in the next chapter. Biscuit ware can be decorated with ordinary pigments and made serviceable.

To prepare the biscuit ware for painting, it should be sized with a coat of ordinary mucilage. The mucilage can be used as a medium for dry pigments. Water color, show card paints, and india inks can be used to paint the biscuit ware. The piece is painted with brushes the same as these materials are used on paper or cardboard. After the piece is painted, it should be rubbed with a paste wax and polished. If any of the colors should smear under the wax, the piece should be sprayed with a white shellac or clear lacquer.

If the piece is a decorative one only, and is not to be filled with a liquid or need to be washed, the inside of the piece can be finished the same as the outside. If the piece is to be used as a flower bowl or for some other practical use where it is to hold a liquid, the inside will have to be made leak-proof. To prepare the biscuit ware for holding a liquid, place it in an ordinary oven and heat it just enough to drive any moisture from the piece. While the biscuit ware is heating, melt some paraffin in a small sauce pan or tin can. When the biscuit ware has been heated sufficiently, remove it from the oven and pour the melted paraffin into it. Revolve the piece to cause the paraffin to come in



PAINTED BISCUIT WARE

FIGURE 14.

contact with the entire inside surface. Pour the remaining paraffin out and set the piece upside down on two sticks or similar objects so that it can drain. By heating the object before pouring in the melted paraffin, the paraffin is prevented from congealing upon coming in contact with the cool surface. By causing the paraffin to penetrate the surface of the ware, the piece is made leak-proof as the coating cannot crack or be rubbed off.

The use of paraffin to seal an inner surface can also be used on a glazed piece in which the glaze did not form a complete coating on the inside, and on a piece in which the glaze has crazed.

## CHAPTER 7

## KILNS, STACKING AND FIRING

Of all the processes in making pottery, firing in the kiln is probably the most enjoyable (although sometimes disappointing). After designing, shaping, and finishing the piece, the final fruit of the effort comes from the kiln. Most forms of clay are soft and easily broken until they have been fired. It is after the biscuit or glaze firing that the piece becomes a useful product of the potter, and the success of the potter hinges on the outcome of the firing.

Kilns.

There are many types of kilns that may be bought or made. If the pottery class cannot raise or secure sufficient funds with which to purchase a kiln, one should be built of native material and used for biscuit firing, if not for glaze firing. Kilns come in sizes determined by the inside measurements or cubic space of the oven. Kilns also vary as to the type of fuel that is used such as oil, coal, gas, or electricity. A kiln should be selected that uses the most economical fuel available to the school. In most localities of Oklahoma, a gas kiln will be the most economical to operate. Where the amount available for the purchase of a kiln is meager, a small electric kiln may serve the purpose for a small class.

Commercially made kilns range in size and price from about fifty dollars for one that has an oven or chamber about the size of a six inch cube, to several thousand dollars for one that has an oven about one and one-half cubic yards in size. The price varies also with the



A GAS-FIRED, MUFFLE TYPE KILN

FIGURE 15

number and accuracy of controls with which the kiln is equipped. A very good kiln that will serve the purpose of the average pottery craft class can be bought for about three hundred to four hundred dollars. By emphasizing hand work, and making the other tools and equipment that are needed in the pottery craft, there should be sufficient funds to buy one of the medium priced kilns.

Kilns are further classified as 'Open-fire' and 'Muffle'. The open-fire is one in which the flames come into the oven or kiln chamber. In this kind of kiln it is often necessary to place the pieces to be fired in 'Saggers' which are fired-clay cases that are used to protect the ware from the flames. The muffle kiln is one in which the flames and fumes are conducted around the chamber through pipes or between an inner and outer wall of the kiln.

A kiln can be built and fired with wood or coal, and the only cost of this would be the labor. This is not advisable for the craft class due to the limited amount of time available to the class, and the length of time it would take to construct and fire such a kiln. Where the cost has prohibited the purchase of a kiln, some craft classes have been able to make arrangements to have their pieces fired at a neighboring school or college.

#### Preparing the Kiln.

Furniture used in the kiln generally consists of a number of refractory shelves, the length of which are slightly less than the width of the kiln that is used, and refractory supports of varying height to allow for different size pieces without a loss of space. For biscuit firing, the kiln and shelves can be used without further preparation.

For the glost kiln, the floor and shelves will need to be coated with a preparation to prevent the glaze from adhering to the refractory material.

When a new kiln has been installed, it is well to fire it while empty the first time. In the first firing the connections can be checked for safety as well as dependability during the firing, and any foreign matter that is in the kiln will be burnt out.

To prepare the kiln for a glost firing, all shelves and supports should be removed from the kiln, the shelves and floor cleaned, and a protective coating applied to these surfaces. This coating is called a 'Wash', and can be made by mixing equal parts of flint and kaolin with enough water to make a thick paste. Apply the wash to the shelves and the floor of the kiln and allow it to dry before stacking.

After a glost firing, the shelves should be removed from the kiln and those on which glaze has run, cleaned. All that is needed for cleaning the wash and glaze from the shelves and kiln is a hammer or mallet and a cold chisel. A stiff, wire brush will aid in removing small pieces of the wash and in brushing out the kiln. After each cleaning, the shelves and kiln should receive another coat of the wash.

#### Stacking the Biscuit Kiln.

A record or log of all the firings should be kept, showing the length of time for the kiln to reach a certain temperature and the humidity and other weather conditions. This will serve as an index in ascertaining the time for future firings. Even with the use of cones or a thermometer attached to the kiln, the time element is of value to know.

Before and after firing, the kiln should be checked for any cracks

that may have occurred in the walls of the kiln. It is necessary to repair these cracks to prevent the flames from blackening the biscuit ware or interfering in the proper firing of the glazed ware. Cracks can be repaired by first moistening the wall around the crack and then mending the cracks with a fire-clay paste. Mix fire-clay with water until it is a thick paste and apply to the moistened cracks with a palette knife, being sure to force it well into the cracks and smooth it even with the surface of the kiln wall. A damp brush can be used for the final smoothing down of the patch.

For biscuit firing, the floor and shelves of the kiln should be dusted finely with powdered flint. Begin by placing the larger pieces in the kiln first, and then place smaller pieces inside them. Dust the insides of the larger pieces with flint before placing others inside them. The number of pieces that may be stacked within each other is controlled by the total weight upon the bottom piece. Supports and shelves are used to receive additional weights as the kiln is filled. When stacking one piece upon another, be sure to allow plenty of air space so that the heat can get to all pieces evenly.

Each piece should be checked as it is placed in the kiln to be sure that it has dried sufficiently. An easy way of checking the piece is to hold it against the cheek to feel for coolness; if the piece is cool, it has not dried sufficiently and should be set aside for a longer drying period. A piece that is not 'Bone Dry' will probably explode in the kiln. This not only ruins the piece in question - the flying particles are apt to damage other pieces in the kiln as well.

When the kiln is stacked, two or three pyrometric cones graduated

in series should be placed in a position where they can be seen through the peep-hole in the kiln. These cones are prepared for the kiln by anchoring them in a small wad of clay, leaning each one slightly so that when they melt they will not fall on each other. These cones are numbered from .022 to 39, and each cone has a definite melting temperature. A wide range of the cones and their temperature for fusing is given on page 77.

One of the big problems of firing is to have a steady, uniform heat, that increases slowly to the desired temperature. The temperature of the kiln must be kept low for the first two or three hours to allow all moisture to be driven from the piece before the heat is increased. In the case of a gas kiln, it is wise to turn on the pilot light and allow this to burn overnight before increasing the heat. If the temperature is raised too quickly, the moisture content in the clay will cause the piece to explode.

After the moisture content has left the pieces, the temperature can be increased gradually by the hour. It is better to increase the heat slower than necessary than to increase it too fast. Sudden rises in temperature will cause the pieces to crack from uneven expansion. As the temperature rises, it can be increased every half-hour until the desired heat is attained. Changes in climatic conditions will affect the firing time of the kiln, so the student should not become discouraged if the firing time is longer than anticipated. A check should be made to see that all doors and windows are closed, especially when the kiln is turned off and the cooling period has begun. Drafts can perceptually affect a sudden change in the temperature of the kiln.

## THE FUSING POINTS OF CONES

CONE NUMBER	FUSING POINT OF SEGER CONES		FUSING POINT OF PYROMETRIC CONES	
	FAHRENHEIT	CENTIGRADE	FAHRENHEIT	CENTIGRADE
.010	1,742	950	1,634	890
.09	1,778	970	1,706	930
.08	1,814	990	1,733	945
.07	1,850	1,010	1,757	975
.06	1,886	1,030	1,841	1,005
.05	1,922	1,050	1,886	1,030
.04	1,958	1,070	1,922	1,050
.03	1,994	1,090	1,976	1,080
.02	2,030	1,110	2,003	1,095
.01	2,066	1,130	2,030	1,110
1	2,102	1,150	2,057	1,125
2	2,138	1,170	2,075	1,135
3	2,174	1,190	2,093	1,145
4	2,210	1,210	2,129	1,165
5	2,246	1,230	2,156	1,180
6	2,282	1,250	2,174	1,190
7	2,318	1,270	2,210	1,210
8	2,354	1,290	2,237	1,225
9	2,390	1,310	2,282	1,250

CHART 1

This is only a partial chart of the cones and the temperatures at which they fuse. The temperatures of the cones shown here extend above and below the ordinary firings of the pottery craft class.

It is as necessary that the kiln cool slowly as it is that it be heated gradually. A sudden drop in temperature, when cooling the kiln, will cause the pieces to contract unequally and crack or break.

Most biscuit kilns should be fired to about Cone 04 or 05, this will vary with the kind of clay that is used. When the cone that indicates the temperature desired begins to bend, the fire should be held at this range to allow the heat to 'Soak In'. When the cone has bent over and touches the clay base, the fire should be turned out and all dampers on the kiln closed.

Most kilns have a small plug in the door of the kiln. This plug is used to determine when the kiln has cooled sufficiently for opening. When the kiln has cooled for at least six to eight hours, it can be tested by pulling the plug and placing it against the palm of the hand to feel the amount of heat left in the kiln. The pieces should not be removed from the kiln, or subjected to a draft, until they can be comfortably handled in the bare hands. The biscuit ware is now ready to be painted or glazed.

#### Stacking and Firing the Glost Kiln.

Greater care needs to be taken in stacking the glost kiln than in stacking the biscuit kiln. While the pieces may be stacked one upon the other in the biscuit kiln, in the glost kiln great care must be taken to keep the pieces separated. The glazed pieces should be separated by at least one-half of an inch and each piece should be set on three pronged stilts to prevent the piece from being stuck to the shelf. As the temperature of the kiln is increased, the powdered glaze that is on the piece begins to melt and takes the form of molten glass. If

the glaze has been applied too thick, or if it does not stick to the piece, it will 'run'. It is seldom that a glaze firing does not include several pieces on which the glaze has run. If one of the glazed pieces touches another or comes in contact with any object while the glaze is in a molten state, the pieces or objects will become bonded together.

When stacking the glaze kiln, the shelves must be evenly and sturdily placed. It would be well to jar the shelves gently as they are stacked, to see if any of the pieces are precariously balanced. The shelf props should reach at least one-half an inch above the tallest piece to prevent the glaze from sticking to the shelf over it. The glazed pieces must be handled carefully to prevent rubbing or chipping off any of the glaze. The shelves and supports should be placed carefully to prevent jarring the pieces or hitting against them. The shelves should be wedged in place with dabs of fire-clay to prevent settling when the kiln is fired. A slight settling might cause the pieces to slide together and become stuck. In the biscuit kiln, small pieces are often set between larger bulbous pieces where there is shelf room; this must be guarded against in the glaze kiln as the glaze is apt to drop off of the other pieces onto anything that may be underneath.

Place two or three cones in the glaze kiln in front of the peep-hole, the same as in the biscuit kiln. It should be noted here that the cones that are used should be selected in regard to the heat that is desired for the particular firing. For example, if one wishes to fire to Cone 04, a Cone 05 and Cone 04 should be placed in the kiln. Some potters like to have the next higher cone, above the temperature desired, placed in the kiln too. The two cones have as their purpose:

Cone 05 to warn of the approaching temperature that is desired, Cone 04 to show that the desired temperature has been reached.

In firing the glost kiln it is important to fire only the glazes requiring the same temperature at one time. Some glazes are ruined by too great a heat while others require high temperatures for their fusing. The glost kiln should be fired slowly and gradually as the biscuit kiln; however, it is not as important to keep the kiln at a low temperature for the first few hours as it is for the biscuit kiln. The gradual increase in firing and cooling the glost kiln is the prime essential. More care must be taken in getting the glost kiln back to room temperature before opening than in the biscuit kiln. The clay body can stand cooling more rapidly in the last stages of cooling than can the glaze. Cooling too rapidly, even at low temperatures, is apt to cause the glaze to craze.

When the glost kiln has returned to room temperature the pieces can be removed. When drawing the ware, one should have a hammer and chisel at hand for separating the stilts from the pieces. Gloves should be worn to protect the hands from the sharp edges of the glaze. The edges are as sharp as splinters of glass and will cut as readily. Any rough edges or droplets should be ground from the piece on an emery wheel to smooth the piece and allow it to set steady.

Clean the shelves of any glaze that may have dropped on them. Repaint the shelves that have been scraped with a wash coat of flint and kaolin. Throw away the stilts that have been broken or coated with glaze. The kiln is now ready for the next firing.

## APPENDIX A

## A LIST OF EQUIPMENT DESIRABLE FOR A POTTERY CRAFT CLASS

School Equipment.

- 1 Kiln,  $24\frac{1}{2}$  X  $24\frac{1}{2}$  X  $33\frac{1}{2}$  inch chamber.
- 5 Bench Whirlers,  $8\frac{1}{2}$  inch diameter head.
- 8 Kiln Shelves, 12 X 24 X 1 inch.
- 4 doz. Shelf Supports, 1 doz. @ 2, 4, 6, and 10 inches.
- 3 gross Assorted Stilts.
- 1 Clay Bin, to be made, 14 X 16 X 48 inches.
- 1 Damp Box, to be made, 12 X 12 X 48 inches.
- 3 Library Tables for work benches.
- 20 Plaster Bats, to be made, 10 inch diameter by one inch thick.
- 1 Dish Pan for mixing plaster.
- 30 One Pound Coffee Jars with lids, for glazes.
- 2 Five Gallon Crock for slip.
- 1 60 Mesh Sieve.
- 1 80 Mesh Sieve.

Individual Equipment.

- Cardboard.
- Sponge.
- Pocket or Paring Knife.
- Assorted Wooden Tools, Shaped as Desired.
- One No. 12 Water Color Brush.
- One Yard of Oilcloth or Plastic Film.
- Cotton Rags.
- One Sheet No. 0 Sand Paper.

*Films.*

## APPENDIX B

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