A Holistic Approach to Ceramic Sculpture

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Its History, Theory, and Materiality

By

Yasumitsu Morito

Cambridge Scholars Publishing

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FOREWORD

The creation and study of ceramic work has a rich, global history spanning thousands of years. Each generation of artists has added to the work of the previous, contributing to the tradition and collective knowledge of ceramic sculpture. Over the decades of my own career, I have benefitted extensively from knowledge passed on from my teachers and mentors, which inspired my academic pursuits in glaze chemistry and ceramic arts, in addition to my sculpture practice. I, in turn, am happy to embrace and continue the tradition of ceramic education.

It is both an honor and a privilege to write the Foreword to Yasumitsu Morito's book *A Holistic Approach to Ceramic Sculpture*. I have known the author since he was one of my own sculpture students, when he participated in the Model to Monument program (M2M), a partnership between the Art Students League and the New York City Department of Parks and Recreation. The program was a nine-month seminar on the creation and study of techniques in sculpture, which the students then applied to their pieces in an exhibition of public art in Manhattan's Riverside Park South. Since this exhibition in 2013, Morito, my foremost student in this program, has demonstrated his commitment to public art in New York City with his piece *The Spirit of New York City*, in Carl Schurz Park on the Upper East Side. His long history in art education and his commitment to training the next generation of artists makes this book an important piece of his legacy as a sculptor.

The present volume is yet another building block in the history of ceramic art and sculpture, and will inform students of both the field's historical methodologies and modern innovations. As ceramic art continues to grow in both interest and popularity, this work will be integral for artists at the Art Students League and elsewhere to benefit from Morito's wisdom, experience, and talent.

Greg Wyatt
Hastings-on-Hudson, New York
March 2022

PREFACE

Art recognizes no boundaries; it includes all aspects of life and humanity – culture, religion, philosophy, science, technology, and ecology. Notably, clay was the first material used for shaping an object of art, and fire made it solid. Ceramists and sculptors gain great pleasure from clay modeling. It evokes the excitement of the initial concept. Direct contact with the material, which is original and a part of the Earth, gives us pleasure as well. In a recent study, clay, an infertile blend of minerals, might have been the birthplace of life on Earth.

This book aims to deepen and contribute to the process of ceramic work in the studio by providing a holistic view of ceramic art and resources in which people can find solutions and inspirations for their artwork. The intention is to function as supplemental instruction for my students in the ceramic studio at the Art Students League of New York (The League), a ceramic curriculum that I was instrumental in creating and taught for the first time in The League's 145-year history.

The book's contents may look and feel different than a conventional pedagogical book or the familiar ceramics handbook; the personal essays and fragmented ideas may also be reminiscent of Japanese Zuihitsu writing. This is because the book has been primarily assembled and formed from the accumulated results of past exhibitions, plus teaching and research conducted since 2014. Its primary focus is on the diverse issues and questions encountered through my teaching; i.e., issues encountered through interactions with diverse students (from high school students to college professors to working artists). Many students in my classes are working from modern, post-modern, and contemporary theory. There are two parts to the book: the first part, and lion's share, is about ceramics as a medium of art; the closing part, denoted Small Catalogue Raisonné, is comprised of excerpts from my past exhibition catalogs, which I hope will provide some ideas and inspiration for both ceramists and for artists of various persuasions working nonetheless with and/or through ceramics.

While assembling the book at home during the Covid-19 pandemic in New York City, under the horror and hope we are experiencing with the spread of this virus, the pandemic has brought the opportunity to rethink what are often called "civilizational constructs"; or, how and why we do things the way we do. In the expanded field of art practice, art moves and supports communities, facilitating not only clinical art therapies but also the link between arts engagement and the maintenance of mental health.

The arts and cultural affairs feed into the creative industries, support the innovation system, and attract talent and investment to communities.

Having grown up in a community of craftsmen and artists in Mashiko, Japan, a place inclusive to diverse forms of ceramic art, and now working in the arts community in New York City, I believe that tradition should not be a structure that restricts us, but, instead, a foundation that gives each successive generation the cumulative knowledge of all those who preceded them.

Taking into consideration the influence of current sociocultural transformations occurring globally, this book also seeks re-recognition of the ontological kinship of ceramics and fine art in the contemporary context. This is a thread that runs through the more discursive aspects of the text, while it also illumines some of the practical or practice-based decisions ceramists must make today. Fundamentally, ceramic art is the joy of creating things. I hope this book to be both practical and sustainable, from the pragmatic point of view and the theoretical point of view.

Yasumitsu Morito
July 2021

INTRODUCTION

SMALL HISTORY OF CERAMIC ART

Ceramics, as craft, directs our gaze to a material that has long been mainly attributed to crafts. Simultaneously, the materiality of the “craft” contains thousands of years of knowledge and a history of art that contemporary artists put into new contexts over and over. Whether useful vessels or works of art, ceramics has traveled all over the world from time immemorial and connected cultures that knew little about one another.

The term *ceramic* is derived from the Greek *keramos*, meaning “potter’s clay” or “pottery.” The origin of the Greek term is an older Sanskrit root meaning “to burn.” Almost every culture has a tradition of ceramics, which includes its social history, anthropology, and economics.

Contemporary arts are seeing this medium and practice from this aspect; practitioners of various kinds are exploring the problematics of ceramics through increasingly diverse means. Ceramics as a craft has always been an idea that transcends disciplinary boundaries.

Pottery production in Japan is known to date back to 14,000 B.C., especially during Japan’s Neolithic period, which is known as the Jōmon period. Pottery production appeared around the same time as permanent settlements in the Near East, and had become an established practice by the 5th millennium B.C. “Its development alongside permanent settlements makes sense because the fragile nature of pottery, its weight, and the requirements for its production, including a clay source, a firing facility, and fuel, makes it an impractical medium for use by nomadic people.”[1]

Glazes first appeared on stone materials in the 4th millennium B.C., and ancient Egyptian faience (frit-ware rather than clay-based) was self-glazing, as the material naturally formed a glaze-like crust in firing. Glazing on true pottery followed the invention of glass around 1500 B.C., in the Middle East and Egypt, with alkaline glazes including ash glaze, and in China, using ground feldspar.[2]

On the industrial level, the global ceramics market size is expected to reach USD 407.72 billion by 2025, according to a new report by Grand View Research, Inc. Advancement of 3D-printing technology, coupled with its rising application, is anticipated to drive the ceramics industry’s market growth. We see ceramics in a wide array of industrial applications, from the space shuttle, to the Apple watch, to bioceramics such as artificial bone and teeth.

Ceramics from ancient times to contemporary art can be found globally. Global sales of art and antiques reached an estimated USD 64.1 billion in 2019 according to economist Clare McAndrew's report "The Art Market 2020," released by Art Basel and UBS. Recently the presence of ceramics in art is becoming prominent and plays a pivotal role within the pyrometer.

From the perspective of ceramic art, art history has left the traditional canon behind, with multiple points of view emerging. The classical history of the humanities, as centering, has more recently also embraced decentering, helping both practitioners and scholars of ceramics to understand this subject appropriately, and to, notably, assimilate it across diverse disciplines, timeframes, and modalities for production and presentation.

Introduction: Endnotes

1. Paul T. Craddock, *Scientific Investigation of Copies, Fakes and Forgeries* (London: Routledge, 2009), p. 207.
2. S.K. Haldar, and Josip Tišljar, *Introduction to Mineralogy and Petrology* (Saint Louis, MO: Elsevier, 2013), p. 165.

CHAPTER ONE

WHAT IS CLAY, GLAZE, AND FIRING

1. Clay

Clay is a part of the soil in our 4.543-billion-years-old Earth that contains clay minerals that activate plasticity when it is wet. Water between the particles of clay minerals allows each particle to move easily in relation to each other, and this produces its plasticity.

Choosing clay is important in the tradition of ceramics, particularly in Japan. Oftentimes ceramists prepare their own clay from the quarry. Once, while we were in the quarry, my teacher told me to put clay in my mouth; if it sticks on my tongue, then it is a good clay for the wheel. I suspect this is because Kibushi clays (resembling a ball clay that makes a clay pliable) are very plastic, with a very fine particle size that makes them easily slaked in water when dry. It also might be because the pH of Kibushi clay is acidic, approximately pH4 and sticks on the tongue. On the other hand, some clays are alkaline, like Bentonite clay, which is highly alkaline and neutralizes acidity. Today, Bentonite clay is used to make medicine, toothpaste, cosmetics, etc.

There are two types of clays: primary clays and secondary. Primary clays are formed in soil as residual deposits and remain there. Secondary clays are clays deposited in a new sedimentary deposit after being transported by water erosion from their original locations.

It is typical for clay deposits to occur in low-energy environments, such as in large lakes or ocean basins. Clays are formed when parent rocks which are clay minerals break down and hydrate to form new mineral particles with new properties. In this process, water molecules are inserted into the crystal structure.

The main mineralogical constituents of clay belong to groups of kaolinite, montmorillonite, illite, and chlorite.[1] Kaolinite, in the kaolin group, is a fundamental clay mineral for ceramic clays with the chemical composition Al2Si2O5(OH)4. In nature this mineral is found in its purest form as kaolin. Kaolin is a primary material of porcelain.

When we collect clay at the quarry or the hillside or the river, where clay is naturally deposited, the clay is often soft and easy to dig. But these deposits have, countless millions of times, hardened into rocks throughout the Earth's sedimentary record. The transformation of sediment to hard rock occurs deep within the Earth's crust. We have learned to examine rock outcrops at the surface, then drill into the crust, to capture the various stages of the journey. Analyzing rock samples with different kinds of microscopes and chemical analyses allows us to understand the processes of this transformation. The transition from sediment to hard, hammer-ringing rock is a marvel of nature that we usually take for granted. Geologists commonly refer to this transformation as Diagenesis.[2]

There are three main causes for the transformation of sediment into rock: pressure; temperature; and chemical reactions. This process occurs as a soft sediment and is gradually buried under the other layers of sediment. This burial process begins on the Earth's surface, where sand is deposited on the seafloor; it is a common occurrence in geology, but could happen with any kind of sediment deposited anywhere. Over millennia, the layer of sand is buried by other layers of sediment or volcanic rock, mud, silt, coal, gravel, and volcanic lava. Consequently, the sand grains move closer together due to the weight of the sediment layers overlying it. The layer is therefore thinner than when it was on the seafloor. During compaction, seawater will also be squeezed out of between the sand grains. The seawater will play a significant role in chemical reactions.

Other kinds of sediment can be compressed even more than sand. We know that temperature increases as we go deeper in the Earth's crust – the average is about 1°C/33m depth.[3] The sand layer also becomes warmer as it is buried. And, as temperatures increase, chemical reactions become faster. Certain reactions begin when a specific temperature is reached. The conversion of organic matter into the various components of oil and gas (hydrocarbons) is an example of this. The optimum temperature for this process is between 80 and 120°C, which means in many places the sediments are buried under 3km or deeper.

It is amazing to imagine this whole journey when I see limestone or marble at the carving studio next to the ceramic room at The League. Marble is formed when the limestone is affected by heat and high pressure during the process of metamorphism. Metamorphosis changes calcite limestone into the interlocking calcite crystals of marble. The majority of marble forms at convergent plate boundaries where large areas of the Earth's crust undergo regional metamorphism. Contact metamorphism also forms marble when a hot magma body heats adjacent limestone or dolostone.

This "geomorphic paleohistory" got me thinking about how ceramic firing speeds up these millions of years in the process of natural metamorphism. High temperatures and pressures in the kiln recrystallize minerals. They allow the atoms and ions to reorganize and stabilize the crystals. And this is an infinite process; stone becomes clay, and over time clay becomes stone through an endless cyclical transformation.

Clay Definitions

Stoneware – Stoneware refers to a high-fired (about 2200F/1204C) ceramic clay: i.e., a feldspar-quartz blend that is semi-vitreous (not translucent and not of zero porosity). Stonewares are noted for their excellent working properties; this is because they are mostly ball-clay-based rather than kaolin-based. All of the clay (except porcelain) that we use at The League is stoneware.

Earthenware – Most of the clay found in nature could be called "earthenware clay." A secondary clay, earthenware, has been transported by moving water, picking up minerals and other materials along the way. Earthenware melts at a lower temperature than other clays due to its many impurities. It becomes tight and hard-fired below 1200°C.

Terracotta – The word comes from the Latin for "baked earth." It refers most often to an unglazed earthenware. Terracotta is the term normally used for sculpture. A late 6th-century B.C. Etruscan sculpture, *Sarcophagus of the Spouses,* Greek Tanagra figurines, and the well-known, late 3rd-century B.C. Chinese terracotta army are examples of ancient masterpieces fashioned from terracotta. Most of the sculptors in history left terracotta sculptures behind, including: Michelangelo; Bernini; Canova; Rodin; Brancusi; Noguchi; Moore; and Picasso.

In architecture, dating back to the Babylonian architectures that have extensive use of terracotta, it is a proven material that has stood for thousands of years. From the late 1800s, it was molded into decorative details on the façades of elaborate Arts and Crafts buildings. In New York City, the Flatiron Building on East 23rd Street, the Alwyn Court Building (that includes the Petrosian cafe on the corner of West 58th Street and 7th Avenue), one block from The League, and the Plaza Hotel at Central Park South have terracotta in the façade. They were all built in the early 1900s. Alwyn Court was built between 1907 and 1909, the Flatiron Building in 1902, and the Plaza Hotel in 1907.

Contemporary architects have returned to using terracotta for statement-making new buildings. Some of these forward-looking structures have innovative uses for this otherwise traditional material. For example, a grid of terracotta panels frames the expansive glass windows of a new residential building at 10 Bond Street by Selldorf Architects in New York's NoHo neighborhood. Glazed for a deep-red finish, the terracotta pays homage to the older brick buildings that surround it. Glazes can transform terracotta with its russet hue and texture, into sleek, colorful tilework, as seen at Central St. Giles Court in London's Camden Town, a mixed-use re-development project jointly executed by Fletcher Priest Architects and Renzo Piano Building Workshop. The re-development project features a façade made with steel, glass, and vibrant tiles of glazed terracotta cast with a cross-hatch pattern.

Porcelain – The term refers to a white clay whose primary material is Kaolin. Its recipe can be from only pure kaolin to about 25% each of kaolin, ball clay, feldspar, and silica. It is said that porcelain was invented at about the time of the Eastern Han Empire (25-220 A.D.) to the Tang Dynasty (618-906 A.D.). Kaolin was named after "Gaoling," a village near Jingdezhen in the southern province of Jiangxi in China. As a result of François Xavier d'Entrecolles' reports on the making of Jingdezhen porcelain, the term *kaolin* entered English usage in 1727. In Japan, porcelain production began in the early 17th century. The first porcelain made in Japan by Korean potters is known as early Imari, and refers to a port near the Arita kilns. The U.S. President Richard Nixon presented the porcelain sculpture of the swans to Mao Zedong as a gift during his historic visit to China in 1972. The sculpture was created at E.M. Boehm Studios in Trenton, New Jersey.

Hard-paste porcelain – Hard-paste porcelain refers to artificial porcelain that is made from a compound of the feldspathic rock petuntse and kaolin fired at high temperature around 1400°C. It was first made in China around the 7th or 8th century. Early European porcelain was created at the German Meissen factory in the early 18th century; it was made from kaolin and alabaster paste and fired to temperatures up to 1350-1400°C (2462-2552°F) in a wood-fired kiln.

Soft-paste porcelain – Many European potters attempted to replicate hard-paste Chinese export porcelain during the 18th century, and the best copies match hard-paste in whiteness and translucency but not in strength. Between 1575 and 1587, Medici porcelain was the first successful attempt in Europe to make a soft-paste imitation of Chinese porcelain. People find the painted decorations and feeling of the material to be highly attractive. They rarely comprised the key ingredients for hard-paste, including kaolin or English china stone, although some manufacturers did include one or the other of these, but fired at a lower hard-paste temperature, i.e., around 1250-1320°C (2282-2408°F).

Bone china – Bone ash, feldspathic material, and kaolin comprise this artificial porcelain. It is defined as "ware with a translucent body" and contains, at minimum, 30% animal bone ash. Thomas Frye developed bone china at his Bow porcelain factory near Bow in East London in 1748. Compared to porcelain, bone china has a warmer off-white hue. It is bisque-fired at 1250-1300°C (2282-2372°F), and then glaze-fired at 1100-1150°C (2012-2102°F). As the body moves to a great extent at the higher temperature, accelerated by the addition of glaze, the reversed firing order (high-biscuit firings and low-glaze firings) is chosen so that there is less chance of distortion.

Clay Types in Artworks

Each clay type has its own characteristics and works for certain things but is not so ideal for other things. For example, I like red clay when I use a warm color glaze because the iron oxide inside the clay reacts with the glaze and enhances the result. White clay is good for light glaze colors, such as celadon glazes, because there are fewer oxides to contend with. Grog is a small stone, and clay with grog is good for hand-building (versus turning) and sculpture, because it supports the clay. It reduces drying shrinkage and prevents cracks. It is also good for reconnecting or mending pieces when the clay is semi-wet.

The study of the material can be done simultaneously with the investigation of form and function. Clay is the foundation "stone" in ceramics and connects to the environment, Earth, and material reality; but it is not the whole story. Knowing the materials you work with provides macro insights about the art field that ceramics ultimately inhabits. Visiting local quarries wherever I work, in Mashiko, Japan, Central America, New York, and seeing raw clays is very interesting. In New York, I have discovered local clay at the beach in East Hampton that has a high plasticity for sculpting and also fires well. Clay is a physical entity while at the same time connecting to metaphysics, i.e., via art history and art theory, as exemplified in Mono-ha, Mingei, Medium-Specificity, Arte Povera, Minimalism, Earth Art, Environmental Art, etc.

Earthenware

FIG. 1.1

The flame-shaped earthenware H. 45 cm.
Collection of the Tokamachi City Museum, Japan
Via Wikimedia Commons

The Jōmon period (ca.10,500-ca.300 B.C.), which covers a great expanse of time, constitutes Japan's Neolithic period and vessels from this period are some of the oldest in the world.[4] Its name is derived from the "cord markings" that characterize the ceramics made during this time.

Middle Jōmon jars have fantastical coiled collars, and Late Jōmon vessels often feature patterns of spirals or snakes. The flame-shaped earthenware is a style that flourished in the Niigata region in the middle of the Jōmon period (around 3,400-2,400 B.C.). It is believed that the flame-type vessel was used for rituals.

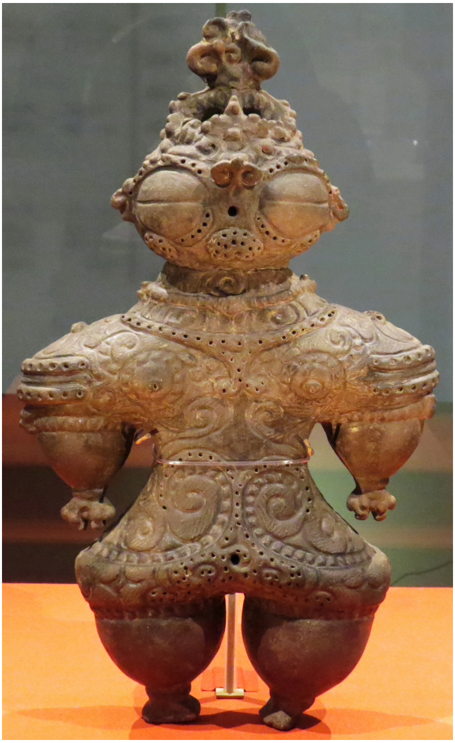

FIG. 1.2

Clay statue, late Jōmon period (1,000-400 B.C.)
Collection of the Tokyo National Museum
Via Wikimedia Commons

There are a number of theories about Jōmon dogu. In the figures, we see the concept of reproduction and creation rooted in the mystery of human birth. Also, they can be interpreted as a wish for a safe delivery. Another theory suggests that dogu are dynamic representations of a rich hunter's bounty.[5]

Furthermore, since the majority of dogu were destroyed, it is also suggested that they were used as healing avatars for curing disease and injury. The size is typically 10cm. to 30cm. high.

FIG. 1.3

Red-Figure Calyx-Krater (Mixing Vessel): Medea in Chariot (A); Telephos with Baby Orestes (B)
c.400 B.C.
Ceramic
Diameter of mouth: 49.9 cm. (19 5/8 in.); Overall: 50.5 cm. (19 7/8 in.); Diameter of foot: 22 cm. (8 11/16 in.)
Collection of The Cleveland Museum of Art, Ohio

The representational vase is based on the famous Greek tragedy, Medea.

In his 1872 book *The Birth of Tragedy*, Friedrich Nietzsche objects to Euripides's use of Socratic dialectic in his tragedies, claiming that the infusion of ethics and reason robs tragedy of its foundation, the fragile balance of the Dionysian and Apollonian.

Susan Sontag writes about Nietzsche's book in her *The Death of Tragedy*:

> MODERN discussions of the possibility of tragedy are not exercises in literary analysis; they are exercises in cultural diagnostics, more or less disguised.
>
> Art is seen as a mirror of human capacities in a given historical period, as the preeminent form by which a culture defines itself, names itself, dramatizes itself.[7]

To produce the characteristic red and black colors found on vases, Greek craftsmen used slip (a liquid clay) as paint and employed a three-stage firing process. First, the temperature was slowly raised to about 800°C with vents allowing for an oxidizing environment. At this point, the entire vase turned red in color. Next, by sealing the vents and increasing the temperature to around 900-950°C, everything turned black and the areas painted with the slip slightly vitrified. In the last stage, the vents were reopened and oxidizing conditions returned inside the kiln. At this point, the unpainted areas of the vase became red again while the painting with vitrified slip retained a glossy black hue. Through the introduction and removal of oxygen in the kiln and the increase and decrease in temperature, the slip transformed into a glossy black color.

Stoneware

FIG. 1.4

Shino Teabowl with Bridge and House, known as “Bridge of the Gods” (Shinkyō)
Late 16th century
H. 4 1/8 in. (10.5 cm.); Diam. 5 1/2 in. (14 cm.)
Collection of the Metropolitan Museum of Art, New York

Shino-ware emerged in the 16th century; it is stoneware, originally from Mino Province, in present-day Gifu Prefecture, Japan. Shino-ware is known for high feldspathic white glaze with iron-oxide brush paintings.

This teabowl has a linear design of a bridge and a Shinto shrine under the white glaze. Historical Shino-ware's textured surface of pinholes and crackles was greatly esteemed by tea ceremony practitioners.

"Living national treasure" Suzuki Osamu fires Shino-ware with a gas kiln in Japan. His work broke the preconceived notion that "good Shino cannot be made without firewood."

In his youth, he studied many of the local ancient kilns and throwing methods that trace their origin to the 16th century. He believes that he can best present his ideas of contemporary Shino using a gas kiln with his modern firing theories and scientific methods.

He mentions that Shino is a unique creation born in Japan, and condensed the most basic of Japanese sensibilities and aesthetics; his inspiration comes from the direct drawing of nature, but also Matsuo Basho's haiku and Zeami's plays; i.e., poetry and theater. In the process of developing this non-traditional methodology for producing Shino-ware, he struggled immensely. But by firing insufficiently fired shards found from the ancient period in his gas kiln, little by little he started to understand. It is, therefore, surprising to hear that he believes that "Tradition is innovation." This is especially noteworthy coming from a "living national treasure," a designation reserved for those individuals certified as Preservers of Important Intangible Cultural Properties in Japan. But if we look back in history, the first Shino-ware was developed during the Momoyama period (1568-1600 A.D.), in kilns in the Mino and Seto areas. Wares decorated with Shino were fired in the Anagama kilns (single-chambered kilns) used at that time. The Anagama kilns were replaced by the multi-chambered noborigama kilns during the first decade of the 17th century, after a brief revival in the 19th century, but then faded into obscurity until Arakawa Toyozo, who developed his modern Shino glaze in the 1930s and was the first living national treasure for Shino-wares, revived them. Tradition is, paradoxically, dependent on the practices of predecessors and only continues through innovation. It is never a static practice.

Porcelain

FIG. 1.5

Small vase
Chinese, Qing Dynasty
18th century
Chinese
Porcelain with Sang de Boeuf glaze.
Dimensions:
Height: 4 1/4 in. (10.8 cm.)
Collection of the Metropolitan Museum of Art, New York

This kind of red glaze for porcelain was extremely hard to produce, and the success rate was very low. During the Ming Dynasty (1368-1644 A.D.), Emperor Xuanzong ordered the Jingdezhen kiln to use red porcelain to worship the sun god. After many attempts, if the craftsmen could not produce satisfactory porcelain, as the emperor desired, they were thrown into prison.

The daughter of an elderly kiln worker was very upset when her father was jailed. Furious at the atrocity, she jumped into the fiery kiln. When the kiln was opened two days later, the porcelain inside had a deep, silky crimson hue. This is why it is known as "Sang de Boeuf glaze."[6] Copper glazes in reduction firing create a distinctive red and have been highly prized, in history, with the related copper glaze "peach-bloom glaze."

Hard-paste Porcelain

FIG. 1.6

Putto as Saturn Nymphenburg Porcelain Manufactory (German, 1747-present)
Modeler: Franz Anton Bustelli (Swiss, Locarno ca.1720-63 Munich)
Date: ca.1755-56
Hard-paste porcelain
4 1/16 in.
Collection of the Metropolitan Museum of Art, New York

Bustelli is widely regarded as the finest modeller of porcelain in the Rococo style. "If the art of European porcelain finds its most perfect expression in the rococo style, so the style finds its most perfect expression in the work of Bustelli."[8] As the ultimate expression of the Baroque movement, in the Rococo period, human figures were meant to be viewed from every angle.

Bone china

FIG. 1.7

Miniature Vase in the form of cactus or succulent
Moore Brothers
(British, 1870-1905) Date: ca.1870-80 Bone china with enamel decoration and gilding
2 15/16 × 2 1/2 × 2 7/16 in.
Collection of the Metropolitan Museum of Art, New York

Compared to general porcelain, the chipping strength of bone china is stronger. Since it is translucent, some manufacturers produce bone china lamps. With the use of bone ash, it has an ice-white color. The bisque of bone china is fired at a high temperature and the glaze firing is at a low temperature.[9] Therefore, colorants that may fade at high temperatures can be used and produce more diverse colors than porcelain. Because of this, intricate patterns and pictures are often imprinted on bone china.

2. Preparing Your Clay Work for Firing

In my class, after each session, people often ask me whether the sculpture needs a wet lug to cover the piece or is it okay to cover it with only a plastic bag for the drying process. Each case is different since the size and form of the sculpture is different; but all clay-based work needs to dry slowly to avoid cracks.

Clay becomes plastic when water is added. Plasticity is a characteristic of clay and when it dries, it becomes hard. Clay minerals have an extremely fine and thin hexagonal plate. The average diameter of this plate is 0.001mm.

The plasticity of clay increases as the size of particles decreases. Highly plastic clay consists of small crystals. When an appropriate amount of water is added to clay and kneaded, the plate particles line up flat like paper. Water gets in between the clay particles, and the cohesive force of water pulls the particles so that they do not separate and stand apart. Inside the clay, the water forms thin films between the faces of the clay plates. When the clay is wetter, the water films are thicker and the clay particles can be moved more easily. Continuous water films are created around particles, giving rise to an attraction between particles via surface tension due to overlap of water films between particles, this is traditionally called *Norton's theory of plasticity*.[10]

Drying and Shrinkage

Clay dries and shrinks as water is removed from the clay. After about 14% of the water is removed, and when the shrinkage stops, this is the most convenient moisture content for the finishing process of carving and attaching. When attaching separate parts with slip, if one side is in the middle of shrinking and the other is in a state where the shrinkage has ended, the joint part will be detached after being applied.

The amount of plastic water in clay generally ranges from 20% and 25%. The larger the amount of water, the more slowly it dries and the larger the drying shrinkage; as a result, this may increase the chance of a work cracking. It is difficult to use as a material if the drying shrinkage exceeds 12%.

Warpage

Warpage in drying thin ware is due to uneven shrinkage. This can be prevented by slow overall drying or retarding the drying of certain parts by covering. The question often comes up as to why warpage occurs when a newly formed piece has uniform water content and the dry piece has a low, but also even content. This can be explained by a drying tile resting on a smooth surface. The upper face will dry first and the tile will curl up because the upper face is smaller than the lower face. Later when the tile is completely dry the curl remains as the body is too rigid to completely straighten out.[11]

Throughout the history of ceramic processing, it is known that there are three primary factors in avoiding defects in drying.

First, the rate of drying during the first stage should be sufficiently slow to avoid stress development, which initiates cracks. The first drying stage is surface evaporation and moisture movement by capillary suction called *wicking*. The second factor is that the moisture level of clay affects drying shrinkage. The third one is the particle size distribution of the ceramic material has a significant effect.

The most common source of cracking is the ceramic part's surface attempting to shrink before the interior begins to shrink. This produces cracks called *craze* cracks or mud cracks. Fast-drying, low permeability to internal moisture movement, and high shrinkage, singly or in combination, favor this type of cracking.[12]

If the clay work is not in a homogeneous condition – for example, different thickness of wall, the persistence of agglomerates, granules in the clay or inconsistent water quantity – uneven drying parts within an object can be a source of cracking. Cracking occurs in the weakest portion of the clay body, and the intergranule zone provides the weak link. A healing attempt can be made by conditioning the clay under high humidity; in case of ceramic sculpture, cover the work with a wet rug or wet paper towels. Aging in the plastic condition increases the adhesion between particles and reduces the severity of cracking; however, it does not completely eliminate the structural weakness or cracking.[13]

Lastly, the initial drying period may take place in a dryer or in a separate process known as *pre-drying*. Pre-dryers typically employ air temperatures of less than 100°F (<40°C) and allow for high relative humidity (H_r> 80%). This would help avoid cracks.[14]

Glaze Shrinkage

Raw ceramic glazes contain clay to harden them upon drying and to suspend the slurry. The more clay there is, the more the glaze shrinks as it dries on the piece.