

POTTERY AND PORCELAIN: TECHNIQUES AND MATERIALS

The possibilities of a lump of clay are almost limitless. It can be used to create objects of practical use or ritual purposes, or pieces of great beauty. The techniques involved can be very simple, requiring only a potter, a lump of clay, and a small kiln, or much more complex, as in the factory system in which each piece is crafted in stages by many people. Ceramic wares may be modeled by hand, formed on a wheel, or made in a mold. The possible designs and decorations are almost limitless.

Earthenware

Earthenware is the earliest and most basic type of pottery. This type of pottery, which is still manufactured today in China, is formed of coarse, often unrefined clay mixed with sand (silica) for added strength. Earthenware is fired in a kiln at a relatively low temperature, 800°-1,000°C. The finished product is thick, porous, brittle, and easily broken. When glazed, the ware gains a hard coat which is impervious to liquids.

Stoneware

Stoneware is created when more fusible materials, such as feldspar and quartz, are added to refined clays and then high-fired at kiln temperatures from 1,100° to 1,250°C. The result is a stronger, harder, nonporous, and vitrified ware. Although experimentation with feldspathic clays and glazes in the production of stoneware eventually led to the development of porcelain, stoneware has retained its own distinction and characteristic design. "Porcellaneous stoneware" is high-fired and fine bodied, derived from a formula close to that of porcelain. The principal difference is that stoneware is opaque, while porcelain is translucent.

Porcelain

Porcelain is a thin, hard, and translucent white ceramic made from a combination of highly refined white plastic clay called kaolin mixed in almost equal proportions with a white powder of the same basic feldspathic composition called petuntse or "China clay." The word kaolin comes from the Gaoling Hills near Jingdezhen, where this type of clay was found in vast quantity. Petuntse is derived from the Chinese term *bai*

CLAY: THE BASIC INGREDIENT



Rural potter at work



Making molds for stoneware figurines



Ying-qi white porcelain,
Northern Song dynasty

dun-zi, meaning "white briquettes," describing the state in which the refined white powder was received at the kiln site. Petuntse has a lower melting point than kaolin, and its addition makes kaolin less brittle. The proportion of kaolin to petuntse varies with the quality of the ceramic—the finer the porcelain, the greater the amount of kaolin used. Porcelain is glazed with a liquid mixture of the same feldspathic formula as the body and then high-fired at a kiln temperature of 1,300°C or more. At this heat, body and glaze fuse and become totally vitrified. Porcelain is the unique achievement of the Chinese potter, and indeed "china" is the Chinese ware par excellence. Porcelain is thought to have been named by Portuguese sailors after the word "porzella," a smooth, shiny cowrie shell. Porcelain has a clear ringing sound when tapped.

Bisque or Biscuit

Ceramics may be fired without a glaze, and the resulting ware is called the biscuit. High-fired without a glaze, porcelain will have a matt instead of a glossy finish. The biscuit may then be glazed or decorated with enamels requiring a lower temperature and refired. In many small figurines the faces may be left unglazed to accent the sharp modeling of the features, while the bodies are painted in glossy enamels.

Slip

Slip is a thin, liquid, clay mixture applied to the ware as a base before glazing. The mixture is "slipped" on, either to conceal defects in the color or shape of the body or to provide a base for painted decoration. Parts which have been separately molded, such as high reliefs and cup handles, are fastened (luted) to the clay body by means of a slip.

Potter's Wheel

In addition to molding or modeling the clay, a potter's wheel is used to build a form. One of the earliest human inventions, the wheel is a flat, horizontal, disc-like table, which can be spun by means of a foot pedal, thus leaving the potter's hands free to shape the spinning clay.

Kilns

The two basic types are *oxidation kilns* and *reduction kilns*. In an oxidation kiln the air is allowed to circulate

freely, while the oxygen in a reduction kiln is cut off, and the oven closed as tightly as possible. The colors derived from metallic oxides vary depending on these kiln conditions. Thus iron oxides fire brown or yellow in an oxidizing atmosphere, but the same pigment turns green or blue in a closed reduction kiln. Even slightly varying conditions will produce green, lavender, gray, or turquoise. Splashy and mixed colors are achieved by varying the kiln atmosphere.

When ceramics are put into the kiln, they must be boxed to protect them from ashes and other impurities. The boxes are called "saggars," and their design demands great skill, much like mold-making, so that the vessel fits exactly within the sagger.

Dotted over the southern Chinese landscape are centuries-old "dragon kilns," tunnels built on the hill-sides, each higher than the one connected below. Some had as many as ten or twelve chambers, varying from very hot to cooler temperatures, and could fire five thousand pieces of pottery at the same time. A different kiln arrangement was seen in northern China, where single kilns were placed close to each other, but not connected. These are called "beehive" kilns. Modern kilns are often computerized and continuous, making them much easier to fire, but for certain effects only the old dragon kilns will do. A muffle or enameleer's kiln is used to fire at 750°-800°C, and the enameled pieces are encased for protection from the direct source of heat.

Earthenware, stoneware, and porcelain are usually embellished by the application of a glaze. Glaze is a liquid mixture applied to a clay object, producing a glossy coat after firing. Glaze may be applied with a brush, by blowing through a bamboo tube with gauze on one end, or by dipping a pottery piece in the mixture.

The Chinese potter can choose between a clear glaze or a glaze with color. Variegated effects such as splashed colors, mottles, streaks, and crackles are produced by the variation of metallic colorants and kiln conditions. There are two basic types of ceramic glazes: those requiring high temperature to fuse and those with a low melting point.

The Chinese potter chose from a variety of metallic pigments to create beautiful and unique ceramic works. But for high-fired glazes and underglaze painting on porcelain, only cobalt, iron, and copper oxide colorants could maintain their color at the high temperatures necessary for firing.

GLAZES AND



Adding the fin



Modern piece from Longquan with crackle glaze

Crackle occurs in the glaze of a piece when the body and glaze cool at different rates. The crackle was probably produced at first by accident, as seen in Han dynasty stoneware, but potters learned to control the technique to produce varied effects. Such pieces were very popular in the Song, and the technique is still used in fine art pieces today.

Feldspathic or "Hard" Glazes

Feldspathic glazes requiring high temperatures to vitrify were developed very early in Chinese ceramic history. The gray-green glazes of the late Han, forerunners of the famous Song celadons, were of feldspathic composition. These are the only glazes which may be used on the raw (unfired) porcelain body. In the eighteenth century an array of beautiful colored glazes was achieved when potters completely mastered kiln conditions and temperatures.

Lead Glazes

"Soft" glazes of lead silicate (glass) are fired at low or moderate temperatures (900°C). First seen during the Warring States period, and more abundantly on Han wares, they were perfected in later dynasties. In the Tang, metallic oxides were added as colorants, producing the brilliant *san-cai* polychromes of green, white, yellow, brown, and blue. Colorful lead glazes were used during the Ming dynasty on the porcelain biscuit for wares also termed *san-cai* or, more usually, *fa-hua*. In these, slip partitions were built to separate the colors, as in cloisonné. Lead glazes on the biscuit were also popular in a variety of monotonies. After application of the glaze, the porcelain piece then had to be refired.

Enamels

Enamels are similar to lead glazes in requiring a very low firing temperature, about 800°C. They can only be applied to porcelain after the object has been high-fired, and a second firing is necessary to fuse the enamel.

Underglaze Painting

Underglaze painting is the technique of painting directly on a raw (unfired) porcelain body, applying a thin layer of clear glaze, and then firing. The resulting painted design appears to float between the glaze and the body, and the colors then glow through the glaze with an iridescence superior to that of any other



Early example of blue-and-white underglaze porcelain

lain. In addition, the underglaze technique assures that colors cannot wear off, and there is no possibility of lead poisoning.

The technique has been known since the Tang dynasty. During the Ming and Qing dynasties, the most famous Chinese underglaze was cobalt blue, called Mohammedan blue when it was first imported from the Near East. Later, deposits were discovered in China and native pigments were used. Copper oxide provided the "underglaze red" of Ming porcelains, and both colors retained their distinctive quality even after high-firing.

A beautiful family of eighteenth century glazes was the copper red group. Produced with varied amounts of copper and under varying kiln conditions, the colors ranged from a soft, pinkish-red "peach bloom" to the deep red of "oxblood" and the streaked red "flambé." The red glazes were shiny and heavy, in contrast to the many hues of the softer cobalt blues.

The soft, gray-green celadons—one of the loveliest groups of Chinese ceramics—derived their distinctive shade from iron-tinged glazes. Shiny "mirror black" was achieved with iron and a pinch of cobalt. Qing potters produced these new colored glazes by experimenting with endless mixtures of metallic oxides.

Overglaze Painting

Overglaze painting is the technique whereby enamels are applied to a glazed porcelain piece, which is then refired. This technique led to the *wu-cai* and *dou-cai* polychrome porcelains of the Ming dynasty, which combined underglaze blue with overglaze enamels. The "famille verte" and "famille rose" wares of the Qing used translucent enamel colors especially suited to porcelain painting. Copper-based green, with the addition of purple, yellow, and coral, makes up the "famille verte" palette, while rich pink derived from gold, with added colors of black, blue, yellow, and gold, makes up the "famille rose." These colors maintain their delicacy and brightness only when fired at low kiln temperatures, however. Enamels used on porcelain are exactly the same as those used for cloisonné.

After the fourteenth century painting provided the main source of decoration for porcelain. Colored glazes of all kinds had been a popular decorative element for stoneware and porcelain for centuries, and the "true" ceramic modes of decor are incising, carving, stamping, impressing, modeling, and molding. These are all decoration of the clay itself; along with glazing, the



Large mei-ping vase, decoration in under

DECORATION

were considered to be the most refined and classic decor. Elegant shapes of the vessels were in themselves classic decorative elements. Celadons and other wares of the Song emphasized pure form, as well as the color, luminosity, and transparency of the glaze.

One example of a ceramic incising technique is *an-hua* or "secret decoration," in which the thickly applied slip is faintly carved in a pattern often invisible except when held to the light. Many porcelains, especially in the eighteenth century, combined techniques of carving and painting. A well-known example is the "rice grain" pattern: little perforations are carved in the biscuit (like rice grains), and after underglaze painting, usually in cobalt, the piece is glazed and fired. The perforations are filled with glaze, thus forming a translucent pattern which adds to the blue-and-white decor. Other decors included elaborate high reliefs which were luted to the body, as in a teapot which sprouted a whole bamboo branch as a decoration. Pierced or open work, where the porcelain was carved completely through, was another decorative form.



Porcelain bowl with Three Friends motif, Qing dynasty

The array of motifs found in painted porcelain covers the entire repertoire of designs common to all the arts of China: the ever-present dragon appears in his many manifestations, and the "three friends"—prunus, pine, and bamboo—are seen frequently.

The Ming and Qing pottery painters were skilled in emphasizing the curves of a vase with bands of design, or framing a motif on a plate with scrolls of peonies or lotus. Rhythmic cloud or wave abstractions were sometimes painted on the collar of a vase, and the lower curve of the urn decorated with "lotus panels," a stylized leaf design which provides neat frames for a flower or other motifs. Sages and beauties are often found in porcelain landscapes. Designs were copied from other crafts and from models, but they were reinterpreted again and again with seemingly limitless individuality and variation.

THE KILNS, YESTERDAY AND TODAY



Hand-painting porcelain at Jingdezhen

O'er desert sands, o'er gulf and bay,
O'er Ganges and o'er Himalay,
Bird-like I fly, and flying sing,
To flowery kingdoms of Cathay,
And bird-like poise on balanced wing
Above the town of King-te-tching,
A burning town, or seeming so, —
Three thousand furnaces that glow
Incessantly, and fill the air
With smoke uprising, gyre on gyre,
And painted by the lurid glare,
Of jets and flashes of red fire.

"KERAMOS"

Henry Wadsworth Longfellow, 1877

The King-te-tching of Longfellow's poem was in reality Jingdezhen, the porcelain capital of China in the Ming dynasty and again today. The exquisite porcelains which graced the courts of Chinese emperors, Arabian princes, and European kings have been created in this remote city for over a thousand years. Jingdezhen is located on the banks of the Chang River in the hills of northeast Jiangxi Province. Its busy harbor is filled with riverboats unloading kaolin and petuntse from downstream hills, then ferrying the precious finished cargo downriver and through Lake Boyang up to the Yangzi or on down to Nanchang. Until recently, overland transportation was hazardous, and no railroad existed

JINGDEZHEN:
PORCELAIN CAPITAL
OF THE WORLD

until about six years ago. An eighteenth century missionary, Père D'Entrecolles, described Jingdezhen this way: from the harbor at night, the town looked like a vast city of flame, a great furnace smoking from its three thousand kilns. D'Entrecolles noted that the city was unwalled (*zhen*), which made security difficult, but this was necessary to permit the constant in-and-out movement of raw materials and finished goods. Strict surveillance and regulations were necessary to protect the valuable porcelains, and strangers were never permitted to sleep at Jingdezhen unless they stayed with acquaintances who would be responsible for their conduct. Poverty was widespread, and even the skilled artisans were poorly paid.

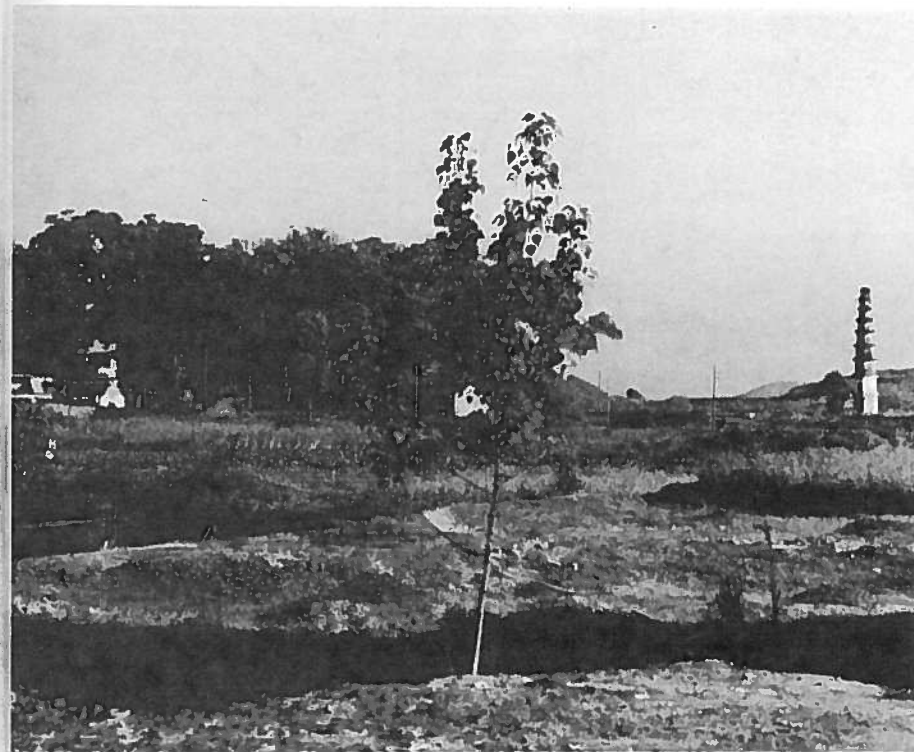
In his letters, D'Entrecolles also described how porcelain was made. It was from his copious notes that the preparation of the clays and the actual methods of production became known in Europe. The porcelains he described were made by as many as seventy workers, from mold makers to glazers. Even the painting was divided—one painter did outlines and another filled in the washes. No painter or potter signed the work. Rather, it was the collective skill and artistry of the Jingdezhen craftsmen, as seen in sculpting, carving, painting, and incising, which was renowned.

Jingdezhen received its present name in the Song dynasty when a collection of porcelain was commissioned for the court. The kilns date back at least as far as the seventh century, and both legend and recent archeological discoveries indicate a pottery center near this location as early as the first century AD. The first famous Jingdezhen wares were the fine bluish-white *qing-bai* or *ying-qing* porcelains made during the Song. During the Yuan, underglazed blue-and-white wares were first made at Jingdezhen. The pigment had probably been brought to China by Persian traders. Although local cobalt was also used, the imported pigment, called Mohammedan blue, produced a deeper, richer color.

The Ming Imperial Kilns

In 1369 the first Ming emperor set aside kilns in Jingdezhen solely for imperial use, and from that time all the porcelain for the Ming and Qing courts was supplied by these imperial kilns. The city soon eclipsed all the other potteries in China, and in the early years of trade with Europe, almost all export porcelain came from this small city as well.

In China, porcelain played a vital role in the daily



Old kiln sites dotting the countryside

of the mandarin class and the growing class of urban merchants. No banquet was complete without these exquisite dishes and bowls, often celebrated in poetry, and a home without porcelain accessories was deemed poorly furnished. The imperial court alone demanded huge shipments: palace records show that one hundred thousand pieces were ordered in the year 1546. Many imperial dinner services had specified designs, and paintings were often sent to the potters by the court to be copied in porcelain.

All this production required painstaking, unremitting labor. There was discontent among the workers due to production speedups and poor working conditions. In the mid-sixteenth century a petition was sent to the court explaining that due to floods and a bad fire, frequent in this "city of fire," one sizeable order simply could not be met. The difficult and sometimes perilous working conditions are also seen in the following account. During the Ming dynasty, the court sent orders for large "dragon fishbowls," some three feet in diameter and two feet high, whose size made their production extremely difficult. After successive produc-

reopened, but by 1949 most had again been closed for years due to war and lack of markets.

Jingdezhen Today

After 1949 Jingdezhen relit fires in its kilns and the ailing enterprises were revived. The revitalized city was described as follows in 1955:

The narrow streets of Chintehchen [Jingdezhen] are made narrower still by the rows of unfired pots that stand outside the houses drying in the sun. Down the middle of the streets, men push barrows loaded with clay, pinewood fuel for the kilns, or porcelain in various stages of completion. You have to step carefully here. Any unguarded movement might cause a breakage. . . . Go down any street, and you can watch the potters' wheels spinning as the clay takes on form beneath their practised fingers. Women sit busy with paintbrushes, their babies playing around their feet. Old grandmothers occupy themselves in putting the necessary 15 layers of glaze on the rice-pattern dinnersets—in which a design, resembling grains of rice, is stamped into the surface and the holes are filled with glaze so that they are translucent after firing. Smoke rises from the tall chimneys of the kilns and the markets are gay with colourful wares.²

Today Jingdezhen is once again the porcelain capital of China. The finest porcelains, pieces of extraordinary quality and artistic achievement, are created in the Fine Arts Porcelain Factory. The fine Jiangxi clays, second to none, are once again being shaped into tea sets, crockery, tableware, bowls, vases, and porcelain paintings, which are finished and painted by hand and require weeks or even months for completion. Underglaze painting is done in the old manner, on the unglazed, raw ware; costly "eggshell" bowls are still produced as modern treasures. Almost one thousand people work at the Fine Arts Porcelain Factory, and all of the work—enormously expensive—is for export. Another fine arts factory is devoted to small sculptures and turns out thousands of porcelain figurines each year. Other factories are fully automated for the mass production of porcelain dishes and household wares.

Jingdezhen is working to achieve the technological excellence of the West and has also established one of China's most advanced fine arts design and research institutes. Essentially a laboratory for advanced technology, the institute is also responsible for new designs, techniques, teaching, and overall planning for all the factories. It continues to research the past so as to preserve the history of this ancient art in modern reproductions.

²Mei Jianying, "City of Porcelain," *China Reconstructs*, February 1955, p. 14.

In every region of China there are thousands of kilns in operation, producing the fine ceramic exports so important to modern China's economy. Some of these kilns have been in operation since the time of the Ming, or even earlier in a few cases. Each kiln is famous for a particular type of ware.

Shiwan, Foshan, Guangdong Province

The "pottery capital" of south China is Shiwan, whose pottery has been used for centuries for the everyday needs of the people of south China. Food is reputed to taste delicious when cooked in pots from Shiwan, and flower pots and storage jars with brilliant glazes decorate homes and parks. The kiln center, the largest in south China, is known for its fine crystalline glazes, professional artwork, everyday cookware, industrial porcelain, and small sculptures.

The Shiwan Fine Arts Studio produces beautiful glazed stoneware and pottery figurines, boldly modeled and colored with vivid glazes. Original designs for the small figures are produced by the studio's sculptors, and molds are made from these. The replicas are finished and glazed by hand with brilliant colors, then fired and polished with great care. The works, although mass-produced, receive attention from artisans with high professional standards. Traditional sculpture themes include historical and legendary figures, modern workers, fishermen, peasants, animals, and birds. The boldness of style has a vitality and simplicity that looks modern, and the facial features are emphasized by leaving flesh areas unglazed.

Liling, Hunan Province

Traditional bird-and-flower paintings and scenes from the lush Hunan countryside decorate the bowls and vases of Liling. Design inspiration has also come from the ancient tomb objects found in 1971 in nearby Changsha, where several Han tombs were excavated. The varicolor underglaze, which has been achieved by extensive experimenting with pigments, is Liling's specialty. New colors have been developed here for underglaze painting. Mechanization is proceeding rapidly in the major industrial porcelain and mass-production factories in Liling, while the fine arts division remains one of the best in China. Liling is second only to Jingdezhen as a porcelain center.

OTHER MODERN KI CENTERS OF CHINA



Modern figurine, Shiwan



Liling's ceramic factory