PORCELAIN AND POTTERY.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY PROFESSOR CHARLES F. CHANDLER, OF COLUMBIA COLLEGE, NEW YORK CITY.

The object of the present lecture is a brief description of the potter's art in its various branches. The word pottery, which is of Latin origin, is frequently replaced by ceramics, a word derived from the Greek, and having a more comprehensive meaning. The material used in this art is chiefly clay, a hydrated silicate of alumina; and the product differs from glass partly in composition and partly in the mode of preparation. Glass is readily fusible, and can be worked only in a fused condition. Pottery, on the contrary, receives its final form before the fire is applied, and it is then baked only to harden it.

When the molten mass of the earth became solidified, the outer crust was composed chiefly of silicious rocks, such as granite. Granite is composed of three different substances: quartz, which is almost pure silica; felspar, a silicate of alumina and potassa; and mica, a silicate of lime and alumina. After a time the high temperature prevailing on the earth's surface decreased, moisture was precipitated, oceans were formed. These oceans were acid, containing hydrochloric acid, by which the rocky crust was attacked and decomposed. The disintegration of the silicious rocks is still going on, though only on a much reduced scale, and the products of their disintegration maintain the fertility of our soil. The felspar and mica are thus converted into clay, in which the quartz remains imbedded, the whole retaining the original shape of the parent granite until it is washed away by the action of water. Then the heavier and coarser particles of quartz are deposited near by as sand, while the finely suspended clay is carried to some distance into quiet water, where it has leisure to settle. By further chemical action the clay may then be cemented together to form slates and shales, and the sand to form different kinds of sandstone.

Clay is found nearly everywhere on the surface of the earth. It is valuable to us on account of its plasticity, by virtue of which it may be easily molded, rolled in sheets, and worked liked dough, and because it may be baked together to form a solid, compact mass. In its pure state it has the disadvantage of shrinking considerably in the baking, and other substances must be added to counteract this tendency. Sometimes the proper mixture is found ready made in Nature. The purest of all clays is known as kaolin, china clay, or porcelain clay. It is indeed perfectly pure and white, and was formerly found only in China. For this reason the manufacture of porcelain was so long impossible in Europe. Clay containing carbonate of lime is called loam, and, colored with oxide of iron, ocher. Other names are potter's clay, brick clay, marl, etc.

The ware manufactured by the potter varies with the nature of the clay and of the substances added to it. We may classify it under the heads of porcelain, stoneware, and earthenware.

Porcelain is dense, hard, and compact; it emits a ringing sound on being struck, cannot be scratched, and is more or less translucent when held up to the light. When broken, the fracture shows no porosity, and it does not cleave to the tongue. There are three varieties: the hard or real porcelain, in which the glazing is of the same material as the body of the ware, differing only in proportions; the soft or tender French porcelain formerly made at Sèvres, which is not a true porcelain but a semi fused glass-like substance; and the English soft porcelain, which is made with the addition of phosphate of lime or bone ashes to render it more fusible.

Stoneware, in its more common forms, is dark, more or less imperfect, partially fused, and covered with a thin glaze The characteristic of earthenware is its porosity; it is not fused at all.

True porcelain came originally from China and Japan. Its manufacture, according to their traditions, extends back to the remotest antiquity. It was found there by travelers as early as 2,000 years ago. For a time the secret was lost; but about 485 B. C. it was recovered. The first attempt to imitate it in Europe was made in 1695, when they succeeded in making the tender porcelain at Sèvres. In 1703, true porcelain was invented in Germany. Böttger, a Berlin apothecary, somehow acquired the reputation of possessing the secret of making gold. So valuable a person could not be suffered to remain at large by a needy government, so he was kept in confinement and provided with all the materials he asked for. His gold making proved a failure, but he succeeded in producing a red stoneware having the properties of porcelain; and in 1709, when kaolin was found at Schneeberg, he at last produced the true white porcelain and became the first director of the works at Meissen. A history of the early potters and their hardships would be very interesting, if the time permitted. Take, as an example, the case of the Frenchman Palissy, who had sacrificed all he had in his endeavors to make the kind of ware known as *faïence*; and when on the point of succeeding, he made firewood of his furniture and tore up the floor of his room to keep up the heat of his kiln.

After a time the secret of the art leaked out; works were established in Berlin in 1751, and in Nymphenberg, Bavaria, in 1755; and in 1765 they gave up making soft porcelain at Sèvres, and began the manufacture of the true hard variety.

If kaolin alone were used, it would shrink considerably in the baking, and would furnish a very porous product. To prevent excessive shrinkage, quartz is added, while felspar is used to fill up the pores. The kaolin is first washed by suspending it in water, allowing the coarse particles to settle in the first tank, then drawing off to a second, and so on, until the deposit is of the requisite fineness. This process is called elutriation. In the next place, the felspar and quartz are calcined, dropped red hot into water to disintegrate them, and passed through a crushing mill. Fineness of the product is essential to success. Then all the materials are mixed up wet, in a rotating apparatus containing a number of knives. As the mixture would settle unevenly if allowed to stand, it is run into a number of flat bags placed between boards, and the water is readily filtered off. By allowing the mass thus obtained to stand some time before working, it becomes more mellow and plastic.

The process of shaping the plastic mass was illustrated on the platform by a professional potter, who made a number of objects on the potter's wheel, an horizontal disk of wood rotated by means of a larger horizontal metallic disk placed on the same axis and kicked by the foot. Another plan is to mix up the material with water to the consistence of cream and pour it into plaster of Paris molds, a number of which were exhibited. The plaster absorbs the water, and then the very fragile vessels of clay may be taken out and completely dried previous to baking. They require a temperature rather higher than a bright red heat. For this purpose large kilns, two or three stories high, are constructed, the rooms of which are large enough to walk about in. This is necessary, because the greatest care is required to avoid breaking the unbaked vessels, or green ware, as it is called. For the best quality, each object is separately placed on an infusible mold or seggar of the same shape. For inferior articles one seggar is made to serve for many objects, which are then kept apart by little bits of clay. Hence we often see two or three little defects in the glazing. When the vessels are baked, they come out as biscuit ware, which is compact and strong enough to bear handling.

They are next glazed by means of the same mixture with the addition of more felspar, which renders it more fusible. The vessels are dipped into the mixture, dried, and put back into the furnace, first taking care to remove all the glazing mixture from the bottom to prevent their being cemented to the seggars. The decorations are painted on with metallic oxides ground up with oil of turpentine, oil of lavender, or a solution of gum, and burnt in by placing in a small muffle furnace. Chromium produces a green, cobalt a blue, and gold a purple color.

Specimens of porcelain from different works were exhibited, the American specimens being from the Union Works at Greenpoint. The latter were made more durable than ornamental, to suit the demand, though some were quite as thin and delicate as Berlin ware. Samples of artificial teeth of porcelain, purely an American enterprise, were also shown.

Stoneware is made from certain natural clays which contain the constituents of the porcelain mixture, but are more or less colored. It is thinly glazed by means of lime, soda, or potassa fluxes. Ordinary salt is often used for this purpose.

Granite ware is an English and American combination of stoneware clay and the porcelain mixture, for ordinary table china. To conceal the natural color, an opaque glaze of borax, lime, and oxide of tin is laid on. Instead of being decorated by the artist's brush, the design is printed on paper, stuck on, and burnt in. This ware is sometimes tinted blue with oxide of cobalt, or buff with oxide of iron.

Earthenware is merely baked without fusing, hence it is very porous and well suited for flower pots and water coolers for warm countries. The red color is due to oxide of iron. Some earthenware is glazed with oxide of lead; but this should never be used, as the glazing is poisonous. Acids readily attack it. It is easily recognized by its very glassy appearance.

Formerly the most famous pottery was the *faïence* (originally from Fajenza, Italy) and majolica (from Majorca), which consist of a cream-colored, porous earthenware covered with a thick glaze.

The lecturer concluded by exhibiting a large number of screen pictures, representing the manufacture of porcelain among the Chinese, the Egyptians, and the moderns, together with some of their choicest productions. C. F. K.

Useful Recipes for the Shop, the Household, and the Farm.

An excellent process for coloring gold is based on the use of the following materials: Nitrate of potassa 6 ozs., common salt 3 ozs., sulphate of zinc 3 ozs., alum 3 ozs. These are reduced to powder and allowed to dissolve slowly in the color pot over a fire that can easily be regulated. The mixture should be well stirred with an iron rod; and as it dissolves it will rise, when the work must be at once suspended in it and kept in continual motion until the liquid is about to sink down in the pot. The objects are then taken out and immersed in clean muriatic acid pickle, which will remove the adhering color. The color in the pot will rise again after the withdrawal of the work, and this opportunity may be taken advantage of for a fresh dip.

The following four recipes for dyeing goods at home are contributed to *Inter-Ocean*:

For orange on cotton goods, take 1 oz. bichromate of potash, 2 ozs. sugar of lead; dissolve in soft water enough to cover the goods, put in goods, simmer a few minutes, rinse in cold water, and dry. For blue, for 10 lbs. of goods, dissolve 10 ozs. copperas in water to cover the goods, put the goods in soak ½ hour; heat soft water boiling hot, and put in 6 ozs. prussiate of potash; put in the goods; let remain half an hour; air a few minutes, then add more prussiate of potash; put in the goods, let remain a short time; air again, and add ½ oz. oil of vitriol; put goods back; let them remain 3 minutes, stirring them, then rinse in cold water. If wanted very light, do not allow the goods to remain in the dye after adding the vitriol but a moment; the shade can be made darker or lighter by the time it is left in the last time.

Permanent green on cottons: First color blue; then dissolve 5 ozs. sugar of lead in 4 gallons of water. Dissolve in another vessel 4 ozs. bichromate of potash in 4 gallons soft water. Dip the goods first in the lead water a few minutes, then in the potash water; wring out dry; afterwards rinse in cold water. If you wish a dark green, first dye a dark blue; if light green, a light blue.

Permanent yellow and orange: For 5 lbs. goods, 7 ozs. sugar of lead, in which dip the goods 5 minutes. Make a new dye with 4 ozs. bichromate of potash; allow the goods to remain about 10 minutes, or until the color suits. For orange pass it through strong lime water.

Durable brown for 5 lbs. goods: Two ozs. copperas (or alum) in sufficient water to wet the goods. One pound japonica dissolved in water. Take as much weak lye as will wet the goods well (or 8 ozs. bichromate of potash—this is more expensive, but no better); put in the japonica water; dip the cloth first in the copperas water, then in the japonica water, having it hot. Care must be taken to use a weak lye; if it be too strong, the color will be too dark.

We cull the following practical suggestions relative to hop growing from the report of a meeting of the Hop Growers' Union, at Clinton, N. Y.: Hops should be planted on well drained high ground. Land which has been in cultivation at least one year is better than sward land. The hills should be made seven or eight feet apart. Inasmuch as an early start and vigorous growth the first year insures vigor during the second year, it is well to plant as early as possible. Make the holes with a hop bar and plant five pieces of root in each. Do not cut off the first year's growth if the vines spread inconveniently, but wind them about the stake. Always cover the hills with manure before the ground freezes. The vines should be tied as soon as they will reach the poles. Do not begin to pick too early; when fit to gather the seeds will be hard and brown. All hops should be picked within a period of eight days. Farm manure is preferable to prepared fertilizers.

A good and simple furniture polish consists of a little Castile soap scraped into a pint of warm water. Add three tablespoonfuls of sweet oil; heat, and apply while hot.

Ceilings that look very rough and manifest a tendency to peel should be gone over with a solution of 1 oz. alum to 1 quart water. This will remove the superfluous lime and render the ceiling white.

The green outer husks of walnuts contain a yellow brown and remarkably fast dye, which is well suited for dyeing woolen or cotton materials, staining wood, etc. Wool thus dyed requires no mordant, is very soft to handle, and not like that dyed with vitriol. The shades of color obtained are from bright to dark brown. The husks may be simply kept dried till used, or packed moist in tubs, by which means their coloring power is further increased.

During recent experiments on fireproofing materials at Vienna, the following mixtures of salts were successfully employed: To 20 parts by weight of water add 3 of borax and 2½ of sulphate of magnesia. This forms an insoluble borate of magnesia, which surrounds and impregnates the threads or fibers to which it is applied, and renders either the development of gases or the spread of flame very difficult. To 1 part liquid sal ammoniac, add 2 parts sulphate of lime. A single coating of this acts as an excellent preservative for wood structures against burning. Old roofing soaked with tar and oil failed to catch fire after being impregnated with this mixture.

A new waterproofing compound for fabrics is made as follows: In 14 parts of water, heated to 180° Fah., dissolve 10½ lbs. gelatin and 21 lbs. castor oil soap. Then add 10½ lbs. gum lac, shaking the liquid until the last is completely dissolved. Remove from the fire, and add in small quantities 21 lbs. powdered alum until the alum dissolves. This forms an insoluble alumina soap, closely incorporated with the gelatin and the gum lac. Apply with a brush.

A cement suitable for joining metals to non-metallic substances is prepared by dissolving in boiling water 2½ lbs. glue and 2 ozs. gum ammoniac, adding in small quantities about 2 ozs. sulphuric acid.

Exterminating Bedbugs.

Where all other means have failed to exterminate bedbugs, sulphurous acid gas has succeeded. Take everything out of the infested room, plug up all the windows tightly, close all chimneys, and empty about 1 oz. of powdered sulphur on a pan of hot coals, placed in the middle of the floor. Shut the doors and cover all cracks; let the sulphur burn as long as it will. Where the room is large, it is a good plan to fasten a bit of tin tube to the bottom of the pan, and to this connect enough small rubber pipe to lead out of the nearest door. By blowing into the end of the pipe with the bellows, the sulphur will be caused to burn more quickly by the draft created, and to give a denser smoke. After the sulphur has burned out, paint all the cracks in the floor and around the mop board with a strong solution of corrosive sublimate, and treat the furniture to the same before replacing it. We have seen a room frightfully infested completely freed by this plan.

To bleach leaves, mix 1 drachm chloride of lime with 1 pint water, and add sufficient acetic acid to liberate the chlorine. Steep the leaves about 10 minutes, and until they are whitened; remove them on a piece of paper, and wash in clean water.

C. T. S., of Rockland, Mass., claims that the nail-making machine, recently credited by us to the late Jacob Perkins, was the invention of Colonel Jesse Reed.

© 1876 SCIENTIFIC AMERICAN, INC.