The Making of the Glass

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It is some twenty-eight years since I first stood at the side of a hot furnace. Watching a molten, half-liquid mass, ladled out of a crucible and poured on to an iron table, to become a "cake" or "lump" of glass. Watching an iron rod plunged into a crucible to "collect" a small, round ball of molten fire, and see it speedily placed into a small steel mold, to be pressed to become a salt-cellar or perhaps a sugar bowl of glass. Watching a long iron pipe, previously heated, dexterously dipped into first one, then another crucible, carefully turned to hold its load, then withdrawn, and see the glass-worker blow down the pipe till the hot, shimmering mass, expanded under the pressure to become a bottle of glass. And watching these various articles for a few moments till some of the color appeared as the intense heat partly subsided, and they were quickly consigned to the annealing kiln to remain for twenty-four hours gradually to cool.

The "cake" or "lump" was of some dark, dull color, which did not show itself till it was broken up for "jewels." The salt-cellar or sugar bowl was solid "milky" opaque, like porcelain. The bottle was transparent, exhibiting curious spherical markings of brilliant colors and changing tones, together with loose, wayward pencillings of opal, and possibly a flicker of gold or silver, as though of fine dust sprinkled on the surface.

All this happened in England at "Sowerby's Glass Works," Gateshead-on-Tyne.

The elucidation of the subject is beset with difficulties, still there are a great number of minute historical and archaeological facts. Witness the public libraries and museums, where we see glass, opaque, semi-opaque, translucent, transparent, as material for drinking vessels or other domestic utensils, beads for personal adornment, and mosaics for decoration. Analysis of the fragments show them to consist of precisely the same chemical compounds that form part of the mixture used in glass manufacture to-day. Take a Roman bead from savage England, dug up in say Leicester or Bath, crush it, and what do we find? That the oxides of cobalt have produced the blue, oxides of copper the red tones. Window glass existed in Roman times, fragments and some large
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panes were found in England at Dareuth, Kent, in the ruins of a Roman villa. Rough one side, smooth the other, as though poured on a slab of marble or stone. But the wondrous, sparkling iridescent quality noticed on the surface of many of the "tear bottles," "gods," small figures, beads—what not—is very largely due to decomposition, atmospheric influences incident to a long exposure to moist air, underground acids, gases and other unmeasurable and unaccountable causes.

The process of decomposition, as shown on the Roman and Assyrian glass bottles, is singularly beautiful, film after film is formed, till perhaps twenty or thirty, measuring only a tenth of an inch in thickness, in shape resembling a section of a pearl or an onion. When examined in a polarizing microscope, the group of films exhibited a beautiful circle of polarized light with edges of color, yet when a drop of alcohol or water is applied to any of these specimens, the fluid entering between the films and the polarized light, these splendid colors disappear.

This letter gives a vivid glimpse of the intense value of the glass-worker in early days.

In 758 Cuthbert, Abbot of Jarrow, and a disciple of Bede, wrote as follows on Lullus, Bishop of Mayence: "If there be any man in your diocese who can make glass well, pray send him to me; or if by chance he is beyond your bounds, in the power of some other person outside your diocese, I beg your fraternity that you will persuade him to come to us, for we are ignorant and helpless in that art; and if it should happen that any one of the glass-makers through your diligence is permitted, D. V., to come to us, I will, while my life lasts, entertain him with benign kindness."

As to the making of the glass, here is a brief extract from the formula:

Thirty parts of lime, and forty of soda, to every hundred parts of sand, fused in the ordinary way in the customary glass furnace with coloring matter added at different stages, varying with the nature of the material.

Emerald green is the product of a mixture of oxide of copper, while small quantities of manganese or very small quantities of cobalt
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produce violet shades. The addition of still more cobalt produces the dark indigo blue, of which William Morris was so fond and struggled so hard to reach for dyeing wools at Merton Abbey. Some grades of purple and peacock blue are a product of copper. The best greens are produced by a mixture of chromium with the copper, the shades of green that are seen in sea-water off the coast of Maine,—not that near New York. Golden yellows and orange are secured by a judicious mixture of several metals—here are some of them: The higher oxide of iron gives an orange color, to avoid reduction manganic oxide or some other oxidizing agent can be used. Oxide of lead produces pale yellow and the pale yellow stain that has for ages past spent a large part of its existence crawling over glass surfaces, leaving a permanent common look wherever it goes, shows the presence of the oxide of silver. Manganese produces red and pink. The lower oxide of copper gives the fine blood red of Bohemian glass. Gold oxide, by the way, which is necessary for the formation of dark red and is very expensive, when united with an opal mixture, makes a lovely salmon color. The crowning glory of the enthusiasts was reached when it was discovered that a mixture of an oxide of tin, arsenic or lime, produced glass of the opal quality, extracted from native—that is American—minerals or from fluorite or cryolite of Greenland.

For a long time it was the custom for the American artists in glass—they were not then called craftsmen—to make their experiments in a little broken-down shed in the open districts of Brooklyn where the Dutch glass makers had a small furnace. There, at that time, grand pot ten inch crucible was mostly filled with glass metal. Into this the visitor put pretty well whatever minerals he wished, provided he paid for the stuff when turned out,—good or bad. And if the account books of those early struggles are to be accepted as evidence, the biggest part by far was bad—so bad that even the "cranky artist" could see but little value in it, and the dust heaps of that day testified to the serious inroads these experiments made into the pockets of the early "glass cranks" as they were called. Anyhow, it made good roads, as good as roads went in that part twenty years ago.
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The Dutch artisans are a curious folk, and the interviews between the cumbersome, bickering, noisy, common and stubborn bottle-makers, clumsily protesting against the quiet, quick, movements of the artist, eagerly thrusting his eyes or his fingers into danger in his desire to see the result of his trial, is a picture that I should like to see painted. To the one it was a weary, slow and thankless labor, meaning at the time but a few dollars to his little family; to the other it was a fight for life, knowledge and power—an effort to reach an ideal, a name, a kingdom. Skillful and ingenious: impatient and dissatisfied: rejecting any but good results; to-day up and to-morrow down; those were mysterious, anxious times for the artists. These experiments were often recorded by the blisters on hands and wrists from the hot iron blowpipe, or rod, from too clumsily rolling the liquid, pudding-like mass on an iron plate as it was spooned out of the firepot—and stamping quaint crosses and signs on its heated surface as it cooled. Later men were employed to make glass who claimed to have made it in France, in Vienna, in Venice, in Belgium, in Germany. One man produced a green of which he would never tell the component parts. It was the green of the emerald, a green of the old paintings, a green of the vine-leaf when the sun had dried it up, and the dust has formed a velvet bloom upon its sombre lustre; but it drove the glass cutters to despair, it was so hard, brittle, dense, and cranky. But while it filled the heart of the artist with delight, its life was short and it was mostly to be found on the floor, crushed with a hammer, wilfully broken by the workmen, whose patience was not equal to the task of using it. Again, in the struggle to find workers who should be chemists enough to recognize the virtue of the mixtures and able to determine how the changing color could be catalogued or controlled in some way, a fortune was spent. Many men were imported, full of promises of grand triumphs, who were finally paid to go away, lest they ruin all with their resultless, futile efforts to produce some decorative agent.

For a long time glass tiles were made three inches square, and half an inch thick, with a color that resembled old ivory, or
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bone. This was one of the earliest successes—hardly two tiles were alike—which was "success" or "failure" according as the purchaser was a member of the small band of art-lovers—or one of the Philistine public. Then it was found that by pouring the contents of two, three or even more pots of metal upon the iron table at the same moment, and dexterously mixing them together, the result was a blend of say red, yellow and blue, semi-opaque, transparent, and opaque, and varying in thickness and density. Drapery glass is made by rolling the metal on the casting table so that it shall resemble folds, passing the result through rollers and then placing it into the annealing closet for three to six hours, allowing it to cool, and that is all.

As glass making became a commercial success—a well-defined proportion of ingredients giving a well-defined result of so many pounds weight of glass to a given color—several people took up the making. The history, though full of interest, is too long to go into here. Let us note the condition of the sunlight as changing the aspect presented in Europe and America. We must remember while the former was engaged in trying to produce an agent thin, silky, luscious, golden, in a word, as translucent as possible to admit the rays;—hence antique, pot metal, and a sparing use of opal glass; the latter was devoting time, and much—very much—money to the development of an agent, the main object of which is to tone, soften, qualify and control the rays; hence the use, almost exclusive use, of opal glass. Of course, the artists on both sides of the Atlantic, insist on all the color which can be given them.

Yes, but has not this impetuous action of American artists led to grave indiscretions by very much over-doing things, till some people are tempted to consign "transparent picture windows" to a church or hall, rather than private residence, and even there to ask for more light, less "body," and a vestige at any rate of that glassy quality for which some of the old work is famous? The burden of the cry is that artists must be paid higher prices to justify and invite more study of material, of conditions of site. Undoubtedly. Still the strenuous efforts of experts are, as usual, wasted on desert air. Hot air. We have some made on some marvelously ugly glass. How many horrible examples do we all know!

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So, as we make the glass, let us think of the sunlight when the glass is part of the picture. And beware of the overdose of metallic oxides, and still more of the various mixtures that produce "leather" or "brick" or "stony" glass.

Oh! the delights of glass making. And the cry of joy with which the news is hailed by the workers when once again a favorite color is produced. Behind that cry lies the history of a curious folk. For it is generations since the average glass-worker was a man of gentle observation. Delicate shades, naïveté and timidity-like credulous simplicity, are no longer found in this civilization. The glass-worker has "grown up." He is rich. And though his hand is still guided by the artist as he handles the mystic agent to produce the tones, the financial end of things leads to the pockets of the glass worker, who adds to his wealth. The artist adds to his—stock of glass!

One grave error which for a time imperiled the popularity of opalescent glass was the amount of daylight it consumed. When people saw that it required four or five thicknesses of dark glass to bring out some delicate quality to its proper value, or to show some half-hidden meaning by the strong light filtering through certain portions, they feared a disturbance in the relative values of the various features of the building where it was employed as a means of decoration; and this objection of the critics and Architects continued until artists produced other effects. Practical men—Architects and others—recognizing the trouble that this use of dark, light-exacting glass was likely to cause by contrasting with the surface color of other materials on the outside of buildings, continued the search for lighter shades, for a thinner and more brilliant glass—a glass with more fire in it—luminosity and sparkle with the peculiar iridescent quality of the pearl and the opal, and of a quality that should make it acceptable for windows—a glass in which bubbles, and what is termed "movement" by admitting daylight, and yet toning and softening it, should render the product available for common use. And in this quest they in time succeeded.

I love opalescent glass because I feel to know something about
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it,—because it has been so closely a part of my own personality, and because for a few years it was the material with which what thoughts I had found a ready means of expression. I remember well going from Boston to New York in answer to a letter asking that I study glass with a view of making it a material for design, and of how my correspondent filled me with amazement when we met by saying: "Any combination is possible to you with this opal glass, any thought,—terse, showy, vigorous, or even the most subtle and delicate value can be portrayed. Try to confine your efforts to the use of one color; in shades do not seek contrasts, but work in harmonies. Make a rough color key—a sort of map—of the scheme, and then go to the glass and pick it out."

Then he led me to a basement, long, dark and low—the shelves of which were filled with glass—glass in sheets, glass in round plate-like shapes—and there collecting an armful of a material—some of which resembled marble, but he said it was glass—we carried all we could to the end of the room where a small window gave us light enough to determine the color when we held the material against the light. Some was so dark, thick and stony that I had to use my hat or hand to make a screen around the fragment as a shade to compel the light to go through the glass; while other pieces were thin, crisp and brittle, semi-opaque with a texture like satin, and a feeling like thin shell—so thin that to handle it is to enjoy the liquid-like surface and I feared lest my fingers and thumb must meet as they crawled along the web-like channel between the thick ridges. Some of this is called drapery glass. It has a texture resembling silk, which materially increases the volume of daylight by forming a prismatic net-work which adds force to the light of the sun by spreading and multiplying it from many minute angles. There are two great secrets in the make-up of opalescent windows—one is the art of making the glass itself, the other that of selecting glass to express something, to tell a story, or convey a thought.

The hardest problem of all is to discover a piece of glass to represent the sky. To choose from say thirty or forty tons of glass a
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piece sometimes only twice the size of one’s hand, which should show the mysterious grandeur of a natural sky with the activities of a soft pearly cloud floating through a clear blue combined with certain wild, free breezy movements, to suggest wind, that shall lead to something dark for the sides; to connect with the landscape background or foreground—whatever it be—to avoid a hard line; that shall at the same time have an air quality, be thin in places, as though a rent were made in the sky, with a glimmer of vivid light to mark the soft veinings and delicate glitter; to give perspective play to the scheme—which governs all, for on that depends the climax of our hopes.

I love opalescent glass. I love it because it is big and because its bigness is constantly stimulating the imagination, and prompting the heart. I love opalescent glass because it has made the Artist free to work, with a freedom that knows no limit. He can be active, earnest, real; because he can give new life to the old glass Mosaics of Rome, Ravenna, Parezo, now perishing with old age, for opalescent glass has presented him with a material that makes reproduction possible, so that their beauty lives again to-day. Opalescent glass invites big themes, treatments and lessons, noble impulses, passions; it is the best medium to suggest the greatest moral and religious thoughts and, in spite of all prejudiced judgments of superficial observers, the strongest material to make a decorative scene that will live in the memory of people for all time, and retain its brightness by portraying the beauties of a delicate landscape of a size, and with a rugged expressiveness that defies all description.

I love opalescent glass because of the employment it gives to men and women, providing a distinct, quaint labor that stimulates gentle courtesies between them. It is a friend to the poor as well as to the rich. Its brightly arranged pictures thrill, soften or conceal at will. Many an artist has taken heart again and reached success with glass as a material with which to start work anew. And I love it because it has given one more chance to the dreamer and the theorist, the plodding painter, and the Craftsman, by its beauty and its power.