A New Process of Casting Iron and other Metals upon Lace, Embroideries, Fern Leaves, and other Combustible Materials.*

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The art of making charcoal—if, indeed, so crude a process is worthy of being dignified by the name of an art—dates back to a remote antiquity, and has been practiced with but little change for hundreds of years. It is true that some improvements have been recently made, but these relate to the recovery of certain volatile by-products which were formerly lost. Every one is familiar with the appearance and characteristics of ordinary charcoal, yet I hope to show you this evening that we still have something new to learn about its qualities and the unexpected practical uses to which it may be applied.

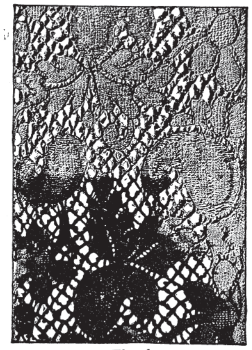

Fig. 1.

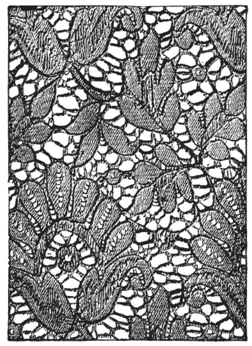

Fig. 2.

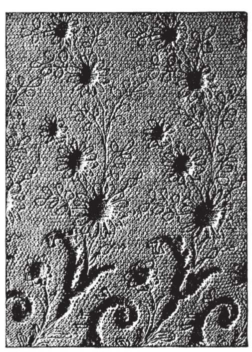

Fig. 3.

Fig. 4.

Fig. 1 is photographed from a white-iron casting made upon carbonized coarse lace, the lower portion of the plate showing the lace imbedded in the iron. Fig. 2 is a casting in gray iron upon lace laid on an iron plate. Fig. 3 is a casting in hard iron upon lace laid on sand. Fig. 4 is a casting in gray iron upon a piece of thin summer dress goods with machine embroidery.

We commonly regard charcoal as a brittle, readily combustible substance, but we have before us specimens in which these qualities are conspicuously absent. Here is a piece of carbonized cotton sheeting, which may be rolled or folded over without breaking, and, as you see, when placed in the flame of a Bunsen burner, the fibers may be heated white-hot in the air, and when removed from the flame the material shows no tendency to consume. Here, again we have a piece of very fine lace, which has been similarly carbonized, and displays the same qualities of ductility and incombustibility.

These carbonized fabrics may be subjected to much more severe tests with impunity, and when I tell you that they have been exposed to a bath of molten iron without injury, you will readily admit that they possess some qualities not ordinarily associated with charcoal. When removed from the mold in which they were placed after the iron casting had cooled, not a single fiber was consumed, but upon the face of the casting there was found a sharp and accurate reproduction of the design, thus forming a die. This die may be used for a variety of purposes, such as embossing leather, stamping paper, sheet metal, etc., or for producing ornamental surfaces upon such castings.

Some of the carbonized fabrics displayed upon the table are almost as delicate as cob-webs, and one would naturally suppose that when a great body of molten metal is poured into a mold in which they are placed, they would be torn to fragments and float to the surface, even though they were unconsumed, yet such is not the case. I have found in practice that the most delicate fabrics may be subjected to this treatment without danger of destruction, and that no special care is needed either in preparing the mold or in pouring the metal.

By the aid of the megascope, the enlarged images of some of these castings, showing the delicate tracery of the patterns, will now be projected upon the screen, and you can all see how perfectly the design is reproduced.

In these experiments the mold was made in "green sand" in the ordinary manner, and the fabric laid smoothly upon one face, being cut slightly larger than the mold, in order that it might project over the edge, so that when the molding flask was closed the fabric was held in its proper position. As the molten metal flowed into the mold, it forced the fabric firmly against the sand wall, and when the casting was removed, the carbonized fabric was stripped off from its face without injury. In this way several castings have been made from one carbonized material.

These castings are as sharp as electrotypes, whether made of soft fluid iron or of hard, quick-setting metal. This peculiarity is owing to the affinity between molten iron or steel and carbon, the molten metal tending to absorb the carbon as it flows over it, thus causing the fabric to hug the metal closely. It is somewhat analogous to the effect of pouring mercury over zinc. You know that when mercury is poured upon a board, it runs in a globular form—it does not "wet" the board, so to speak, but when poured upon a plate of clean zinc, it flows like water and wets every portion of the zinc; or, as we say, it amalgamates with the zinc; so when molten iron is poured into an ordinary sand mold, which has been faced with this refractorily-carbonized fabric, it wets every portion of it, tending to absorb the carbon, and doubtless would do so if it remained fluid long enough, but as the metal cools almost immediately, there is no appreciable destruction of the fibers.

The casting which I shall now exhibit represents a very interesting and novel experiment. In this case, the piece of lace, having open meshes a little larger than a pin's head, instead of being laid upon one face of the mold, was suspended in it in such a way as to divide it into two equal parts. Two gates or runners were provided, leading from the "sinking head" to the bottom of the mold, one on each side of the lace partition; the molten iron was poured into the sinking head, and flowing equally through both runners, filled the mold to a common level. The lace, which was held in position by having its edges imbedded in the walls of the mold, remained intact. When the casting was cold, it was thrown upon the floor of the foundry and separated into two parts, while the lace fell out uninjured, and the pattern was found to be reproduced upon each face of the casting.

The question naturally arises, Why did not the iron run through the holes and join together? The answer may be found in the fact that the thin film of oxide of iron, or "skin," as it is popularly called, which always forms on the surface of molten iron, was caught in these fine meshes, and thus prevented the molten metal from joining through the holes. I have repeated the experiment a number of times, and find that the meshes must be quite small (not over one-fiftieth of an inch) otherwise the metal will reunite.

I think that this observation explains the cause of many obscure flaws found in castings, sometimes causing them to break when subjected to quite moderate strains. We frequently find little "cold shot," or metallic globules, imbedded in cast iron, or steel, impairing the strength of the metal, and it has long been asked, "What is the cause of this defect?" The pellicles have been carefully analyzed, under the supposition that they might be alloys of iron and nickel, or some other refractory metal, but the analysis has failed to substantiate this theory. Is it not probable that in the process of casting, little drops of molten metal are sometimes splashed out of the stream, which immediately solidify and become coated with a skin of oxide, then, falling back into the stream of rapidly-cooling metal, they do not remelt, neither do they weld or amalgamate with the mass owing to this protective coating, thus forming dangerous flaws in the casting?

The process of carbonizing the delicate fabrics, leaves, grasses, etc., is as follows: The objects are placed in a cast-iron box, the bottom of which is covered with a layer of powdered charcoal or other form of carbon, then another layer of carbon dust is sprinkled over them, and the box is covered with a close-fitting lid. The box is next heated gradually in an oven, to drive off moisture, and the temperature slowly raised until the escape of blue smoke from under the lid ceases; the heat is then increased until the box becomes white hot; it is kept in this glowing condition for at least two hours; it is then removed from the fire, allowed to cool, and the contents are tested in a gas flame. If they have been thoroughly carbonized, they will not glow when removed from the flame, and the fibers may even be heated white hot before consuming.

Of course, the method employed to carbonize the materials is susceptible of variation, but the scientific principles involved are unchangeable—namely: 1. Partial exclusion of air and sustitution therefor of a carbon atmosphere. 2. Slow heating to drive off moisture and volatile elements. 3. Intense and prolonged heating of the partly charred objects to

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eliminate remaining foreign elements, and to change the carbon from the combustible form of ordinary charcoal to a highly refractory condition.