

THE CASTING OF ART BRONZE.

Bronze is the oldest known of all metals. We see it appearing at the dawn of humanity and following civilization step by step in all the phases of its development. It is upon it that man, scarcely having got beyond the stone age, made his first experiments in metallurgy, and the numerous objects of bronze that have come down to us make known to us quite accurately the processes in use at these remote epochs.

During this long succession of ages, the only process of any importance discovered was that of casting statues in a single piece, and which dates back to the end of the seventh century before our era. The methods that we now employ are almost exactly those used by our ancestors, the inhabitants of the lacustrine cities.

The manufacture of art bronze is divided into two parts—moulding and casting.

Moulding is the more delicate part of the operation, and upon it depends principally the success and proper execution of the piece. We are acquainted with three kinds—moulding in clay, especially employed for large bells, moulding in dry sand, the most usual process, and finally, moulding in wax, the most perfect but most costly process.

Now, these three processes were already in use in pre-historic times, as we know from objects and tools found in making excavations.

The principal drawback to moulding in sand is that in a statue the floating drapery, hair, arms and legs form as it were so many corners in the sand that interfere with the removal of the object from the mould. In most cases, therefore, it becomes necessary to divide the object of art into sections, to mould the different parts separately and afterward to unite them. This business is intrusted to the trimmers, chasers and bronze mounters. But the intervention of these different trades has the effect of injuring the artistic value of the work, since scraping produces differences in the color that can be got rid of only by the aid of a bronzing of varying thickness with glaring reflections which completely modify the value of the half tints reserved by the artist. Moreover, the chaser, often too zealous, emphasizes with his graver certain parts that the statuary had purposely left somewhat vague for the sake of concentrating attention upon the principal points of his work.

It is for this reason that wax, despite its high price, is infinitely preferable, it permitting of obtaining a casting in a single piece almost without joints.

At the epoch of the Renaissance, as in antiquity, the artist did not consider it beneath him to do the material part of the work himself. He gave the general outline by means of a clay core provided with strong bracings. This core was covered with quite a thick layer of wax in which the artist modeled the details. This wax was afterward covered with numerous coats of slip, at first very dilute and then thicker and thicker, so as to inclose the wax in a sort of gangue, both fine grained and resistant.

This done, a moderate heat sufficed to melt the wax, which, upon flowing away, left empty the space that the bronze was to occupy. After removal from the mould, one had in bronze a faithful reproduction of the work that the artist had modeled in wax.

Unfortunately, it too often happened that for various causes the bronze did not completely fill the space reserved for it, and the statue was then lost or at least much damaged. In admitting, even, complete success, there could be but one specimen of the work, without the possibility of obtaining an absolutely identical reproduction of it.

The needs of modern industry could not accommodate themselves to long and costly processes such as this, and it became necessary at any cost to substitute the workman for the artist in order to expedite matters and do the work more cheaply, although not so well. So the

idea occurred to employ partial moulds for the production of small sheets of wax, which, afterward applied to a clay core and fastened together, gave, for a large number of specimens, the wax image to be reproduced in bronze. But this discovery, which was doubtless very interesting, was nevertheless inadequate to give absolutely satisfactory results. It was left to

gelatine envelope in two pieces which is detached with the greatest ease and gives moulds of extraordinary fineness. Consequently, instead of an assemblage of elements, he obtains wax in a single piece. This done, he, by the ordinary processes of moulding in wax, covers the statue to be reproduced with slip, melts the wax and casts the metal.

In order to manufacture the gelatine moulds, one begins by taking two moulds in plaster and working upon these so as thus to leave the original absolutely intact. One of the two moulds is scraped down superficially to a proper thickness so as to form a core that serves for obtaining a "core box" absolutely like those used in sand moulding. The second cast in plaster serves for making the mould. To this effect, one begins by covering it with a thick layer of clay, which entirely envelops it. Then there is cast over it a plaster shell, A, in two pieces. One of the halves of this having been taken off, the clay is carefully removed, so that half of the statue is thus exposed. It may be easily seen that if at this moment the half shell be put in place, there will remain between the latter and the statue an empty space, B, corresponding to that occupied by the clay just removed. This space is then filled by



Fig. 1.—MOULDING OF A WAX STATUETTE BY THE LE BOURG PROCESS.



Fig. 2.—HALF MOULD, SHOWING THE DIFFERENT ELEMENTS.

A. Plaster Shell. B. Gelatine Mould. C. Layer of Wax. D. Clay Core.

M. Le Bourg, a French statuary, to devise, in the same order of ideas, a process that was infinitely superior, from the standpoint of the results obtained, as well as from that of saving in manual labor.

This process, briefly described, is as follows: The fact is well known that gelatine, although hard and dry when in contact with the air, softens and swells up when immersed in water, and becomes hard again upon losing its humidity. But if instead of water we employ glycerine and glucose, the elasticity will be preserved for a long time. By means of this soft gelatine, M. Le Bourg, instead of moulding the elements of a statue, moulds the latter in its entirety, surrounding it with a

which, owing to its extreme elasticity, may, at the proper moment, be taken out without ruining the model. (Fig. 2.)

Proceeding with the second half of the shell as with the first, there is obtained a gelatine impression of the second half of the statue. If, at this moment, the shell in two pieces, lined internally with gelatine, be put together, it will be seen that an exact and hollow impression of the statue to be reproduced will remain in the middle of the mould.

Let us now take a core, D, made in advance and properly dried and introduce it into the cavity in the middle of the mould. This it will occupy almost entirely and leave merely an annular space, C, that corresponds to the thickness to be given the metal. It is into this space that the melted wax is run, after which all that is to be done is to carefully remove the half shells in plaster and then the gelatine coverings in order to expose a statue that will be identical with that which an artist would have been able to model. (Fig. 1.) As may be seen, the Le Bourg process differs from the wax one only in the method employed for obtaining the wax cast, but with the advantage that the old process permitted of making but one casting, while now it is easy to have a large number absolutely identical and as delicate as those obtained by the classical wax process.

It is to be remarked that of all the operations that we have just described, none requires professional skill. Therefore, no more moulders, chasers, or mounters; and it is precisely one of the original features of the process that a bronze statue may be made without the intervention of any of the trades hitherto employed. The result is, besides, that the casts obtained have the rare merit of being an exact reproduction of the work of the statuary, whose artistic feeling is faithfully respected at every point.

We are indebted to 'La Nature for the engravings and particulars.

A SINGLE RAIL MOUNTAIN RAILWAY.

A mountain railway built on quite a novel plan was tested last year on a small scale, and is to be shortly opened in a different locality for regular service. The principal feature of the new system is that the force of traction is directed vertically upward, and is derived from a balloon. A single rail is used for the only purpose of directing the course of the train and keeping the balloon with its load captive. To this end the rail is made T-shaped, and the car runs on it, gripping it from the sides and from below. The rail is anchored to the ground at distances of about 15 feet. In the



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