Frits Scholten

Technical aspects of Verrocchio's Candelabrum

In a certain sense the fifteenth century is the period of the rebirth of the art of bronze casting in Western Europe, for it was then that in Italy, or more precisely in Tuscany and the Veneto, monumental bronze sculpture was produced on a large scale for the first time since Antiquity, while the production of small 'studiolo' bronzes for the collector simultaneously assumed enormous proportions. However, partly because of the absence of detailed written sources, our knowledge of Quattrocento bronze-casting techniques is still very incomplete. Thus new technical data are of great importance.[1]
The documented bronze candelabrum of 1468 by Andrea del Verrocchio (c. 1435–1488) in the Rijksmuseum (see Fig. 1 in the article by Butterfield on p. 121) invited a technical examination of the casting process used in making it on various counts. Verrocchio belongs with Ghiberti and Donatello among the key figures in the fifteenth-century history of bronze sculpture, above all for his group of Christ and St Thomas (Florence, Orsanmichele, 1467–1483) and the equestrian statue of Colleoni (Venice, Campo di San Giovanni e Paolo), which was completed after his death. His candelabrum in the Rijksmuseum is an early work, which immediately precedes the recently restored and extensively analyzed Christ and St Thomas group.[2] Thus a comparison of the casting techniques was obviously desirable. Moreover, the candelabrum is not a free-standing sculpture, but an exceptionally good example of decorative, applied sculpture and in that connection it seemed interesting to discover whether the unusual character of this work – applied art made by an artist working mainly in the figurative fine art tradition – influenced its genesis from the technical point of view. A limited technical examination was carried out in October–November 1995 by Arjen Smolenaars, one of the Rijksmuseum's Metalwork Restorers. His findings, supplemented by observations by Robert van Langh (Metalwork Restorer, Rijksmuseum) and the writer, are presented below in a provisional form.

The candelabrum was examined macroscopically, X-radiographs were made over its full height and the composition of the bronze alloy was established by X-ray fluorescence spectrometry (XRF) on the basis of samples from the base.[3] In addition a start was made on cleaning the candelabrum by the removal of the old layers of wax and dirt concealing the original patina.
It was already possible to establish with the naked eye that on the underside of the base a square wrought iron rod with bevelled corners ran upwards from each of the three claw feet. The three rods, on average 20 mm thick, come together in the stem of the candelabrum (Fig. 1). Also visible with the naked eye is the wrought iron spike protruding from the drip pan, which is of course the

pricket for holding the candle. The x-radiographs showed that the three iron rods continue on from the foot in a single rod, which runs up the entire length of the candelabrum and ends in the pricket. This heavy rod constitutes the skeleton around which the rest of the bronze is built up.

The x-radiographs and observation with the naked eye showed that the candelabrum is composed of at least three, but probably even as many as six separate parts (Fig. 2). In the x-radiographs joins can be seen above the first, plain, knop and the fifth, cable, knop. The drip pan may also have been cast separately, since there appears to be a welded join immediately below it. In addition at least two breaks can be detected with the naked eye, just under the first, plain, knop and above the second, cable, knop (Fig. 3).

Fig. 1. Andrea del Verrocchio (c. 1435–1488), Candelabrum, 1468; detail of the underside of the base with the wrought iron rods cast into the claw feet. Rijksmuseum, Amsterdam, inv.nr. BK-16933 (photograph: A. Smolenaars).

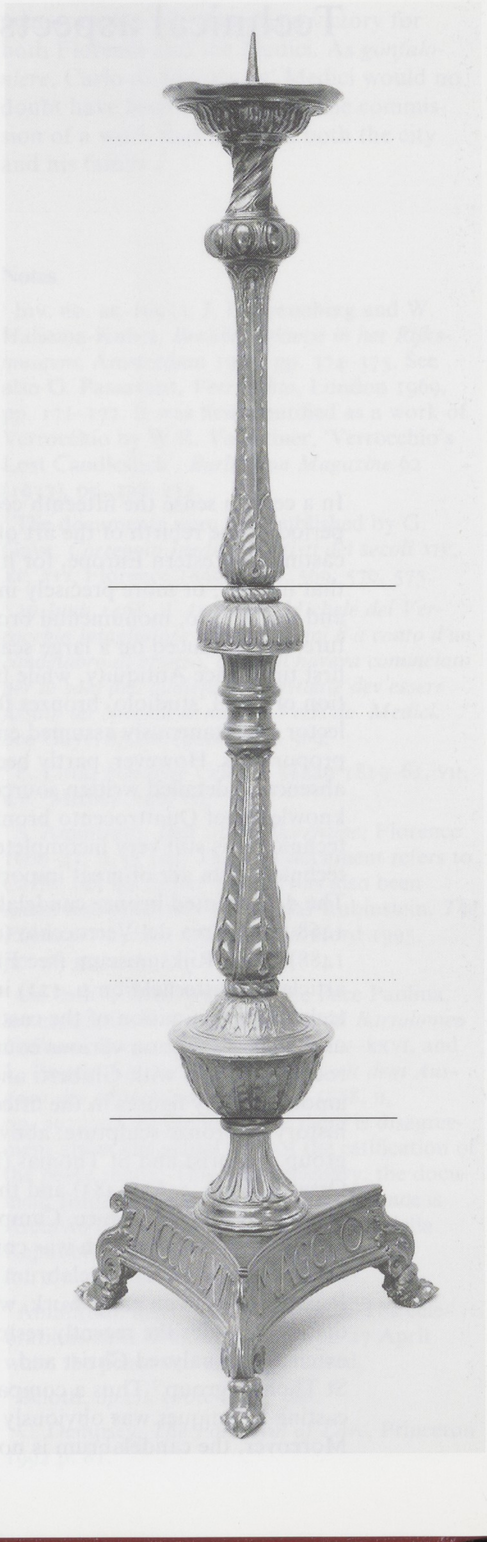

Fig. 2. Andrea del Verrocchio, Candelabrum, 1468; the solid lines indicate the separately cast segments of which the candelabrum is composed, the dotted lines possible joins.

Fig. 3. Andrea del Verrocchio, Candelabrum, 1468; detail of the stem with breaks under the plain knop and above the cable knop.

Fig. 4. Andrea del Verrocchio, Candelabrum, 1468; detail of the stem with breaks above the cable knop and a possible smoothed-over join in the undecorated, concave section.

Fig. 5. Andrea del Verrocchio, Candelabrum, 1468; x-radiograph of a detail of the stem.

Fig. 6. Andrea del Verrocchio, Candelabrum, 1468; detail of the inside of the drip pan with the ring round the pricket (photograph: A. Smolenaars).

The second crack probably runs over or along a welded join, since the surface of the bronze gives the impression of having been soldered here. The relatively wide band of smooth, undecorated bronze in the centre of the stem also seems a logical place for a soldered join, but there is no way in which this can be seen directly. However, the surface here looks less smooth, which could also indicate some reworking after soldering (Fig. 4).

The provisional conclusion is that in constructing the candelabrum Verrocchio worked on the basis of relatively short segments, which were easy to handle and cast. He must have modelled these segments in wax over a core of clay or similar material. In the x-radiograph various layers can clearly be distinguished in the build-up of a part of the slender baluster (Fig. 5): first the wrought iron rod, then a core of clay or similar material, which is strengthened by an armature of spiral iron wire wound round the iron rod.[4] Round the clay core comes the bronze, which replaced the modelling wax during casting. The average thickness of the bronze is 5 mm. There is no reason to suppose that the other balusters were not made in the same way, although it proved impossible to bring out the contrast between the bronze and the core material even with high voltage x-radiography.

After the separate segments had been cast, they were soldered together and pushed over the cast iron rod. It is not clear whether they were joined together before being placed over the rod or afterwards. Any remaining space between the rod and the core of the segments will have been filled up with clay or a comparable material to obviate movement. There is certainly no space to be seen in the x-radiograph between the rod and the clay core (Fig. 5). The pile of baluster-shaped segments was secured by a small iron ring to be found on top in the drip pan (just under the pricket) (Fig. 6). In the last stage there certainly followed the standard procedure of the cleaning of the cast, the removal of the protrusions of metal left by the casting channels, the chasing and finally the patination. In a recent test relating to the removal of dirt and remains of old wax, a deep olive green to brown patina was revealed, which gave the impression of being the original finish of the candelabrum.

The advantages of working with separately cast segments mainly related to the casting technique. Should there have been any faults in the casting, it would not have been necessary to recast the entire candelabrum. Moreover, the risk of failure was not so great in the case of parts relatively difficult to calculate, such as the undersides of the thicker parts of the stem. The casting of an object over one and a half metres long is relatively complicated: the molten bronze has a long way to travel and there is a risk of it's hardening halfway. The bronze-founder would also need to have a relatively large quantity of molten bronze at his disposal in

Fig. 7. Domenico Beccafumi (1486–1551), A bell and cannon-foundry, woodcut, 185 x 125 mm, c. 1530–1535 (after exh. cat. Sienna, Domenico Beccafumi e il suo Tempo, Milan 1990, p. 503).

order to be able to cast the piece in a single operation. Verrocchio and his bronze-founder thus opted for the safer method of casting in separate parts.

No indications were found of Verrocchio having worked by the indirect method, i.e. by employing moulds and re-usable models. Direct casting, whereby the wax model was lost during the process, was the standard method in Florence until late in the 16th century.[5] Anyone who examines the candlestick closely can see at once that the bronze appears as it were to be modelled: the rather nervous surface is a direct rendering in metal of the original modelling in the wax, which could be kneeded and cut. The candelabrum is a good illustration of Richard Stone's comment that Florentine bronzes of this period seem almost to be carved rather than cast.[6]

The results of the analysis of the composition of the bronze alloy came as a surprise. In contrast to what is customary in Renaissance bronze sculpture, the bronze of the candelabrum proved to contain a remarkably low proportion of copper (71%), but a great deal of tin (15.5%), zinc (7.3%) and lead (7.2%). Such an alloy tallies most closely with the composition of bell metal, the mixture used for casting bells and mortars. The high percentage of tin and lead yields a compactly structured bronze of a rather greyish tinge. An illuminating comparison is that with the bronze of the life size group of Christ and St Thomas, on which Verrocchio had just begun at the time when the candlestick was made. This contains over 90% copper, 7% tin, a negligible amount of lead and no zinc. These proportions are more or less standard in bronze sculpture of this period.

The unusual composition of the bronze of the candelabrum seems to indicate that Verrocchio had it cast at a bell-foundry. There could have been various reasons for this. Bell-founders (who could also supply mortars, hand bells, candlesticks and cannons) generally had the best technical knowledge of casting and that would have been of great advantage to the still relatively inexperienced Verrocchio. A woodcut of c. 1525 by Domenico Beccafumi (1486–1551) gives an idea of such a bell-foundry (Fig. 7). The choice of bronze with a relatively high percentage of lead and tin was probably also dictated by the fact that it made the bronze easier to work up. Working up was necessary, for example, in the wavy leaves, which seem to stand away from the stem thanks to undercutting (Fig. 4). The irregular waviness of the drip pan, probably caused by a fall, confirms the suppleness of the metal (Fig. 8). In a harder alloy a crack would have been the more likely result.

Translation: Patricia Wardle

Fig. 8. Andrea del Verrocchio, Candelabrum, 1468; detail with the drip pan.

Notes

[1] For a good introduction to this subject see Richard E. Stone, 'Antico and the development of bronze casting in Italy at the end of the Quattrocento', *Metropolitan Museum Journal* 16 (1981), pp. 87–116. See also Massimo Leoni, 'Casting techniques in Verrocchio's workshop when the Christ and St. Thomas were made', in Loretta Dolcini (ed.), *Verrocchio's Christ and St. Thomas, a masterpiece of sculpture from Renaissance Florence*, New York 1992, pp. 83–99, and Francesca Bewer, 'Del formare e del getto, vom Modellieren und vom Giessen, Die Herstellung von Bronzestatuetten im 16. Jahrhundert', in Volker Krahn (ed.), *Von allen Seiten schön, Bronzen der Renaissance und des Barock*, Berlin 1995, pp. 82–91.

[2] See L. Dolcini (ed.), *op.cit.* (note 1).

[3] The x-radiographs were made by the Röntgen Technische Dienst, Rotterdam, with a voltage of 180 Kilovolts, 2 milliAmpères and an exposure time of two minutes. The XRF examination was undertaken by the Centraal Laboratorium in Amsterdam with an Omega-5 instrument.

[4] It may also be noted that on the underside of the hollow base of the candelabrum there still protrude little bits of this reinforcing wire, which served to hold the clay core, that has now disappeared here, firmly in place.

[5] Stone, *op.cit.* (note 1), p. 94.

[6] *Ibidem*, p. 94.