Machine and Symbol: between Tradition in the Execution and Technical Progress. The Erection of the Marian Column in Piazza Santa Maria Maggiore in Rome (1613-1614)

Nicoletta Marconi

INTRODUCTION

In August 1613, Pope Paul V Borghese (1605-1621) carried out a project started by Sixtus V Peretti (1585-1590), and aimed at making the entrance to villa Montalto more imposing. He assigned to Carlo Maderno (1556-1629) the task of transporting and erecting the last of the eight stately columns of the Basilica of Maxentius in the centre of Piazza Santa Maria Maggiore (Orbaan 1910, p. 309). It gave a renewed stature to the façade of the basilica while reducing the pre-eminence of the apsidal front marked by the obelisk erected in 1587, at the behest of Sixtus V, by Domenico Fontana (1543-1607) in collaboration with his brother Marsilio and the young Maderno (Mercati 1589, p. 313).

Fontana's epic technical feats stemmed from experiments carried out in remote times and already perfected by Imperial Roman engineers. It was Fontana's long experience on the job, the finely tuned sequence of operational steps that he had developed to optimize time and resources while, simultaneously, reducing the risk of accidents that allowed him to add the erection of the Vatican obelisk (April-September 1586) to the array of most striking achievements completed during the pontificate of Sixtus V. Biographers attribute much of Fontana's professional fortune precisely to the technical aspect of his work as an architect (Baglione 1642, Baldinucci 1681). This was forged, as Hibbard suggests, by his tough apprenticeship in the ranks of the Lombardy master craftsmen, from whom he also learned the secrets of sound business management (Hibbard 2002, p.46). By combining these lessons with his intuitive operational pragmatism, Fontana developed major construction support devices that, at first glance, may appear to be a "swarm of machines and equipment" (Bellori 1672, p. 162), but actually proved to be authentic wonders of mechanics, able to breathe new life into the process of architecture.

The procedure developed for the removal, the transport and the erection of granite obelisks, be they monolithic or in sections, was based on the careful coordination of the operative stages, on the use of efficient provisional scaffolding and above all on a flexible operational sequence that could be adapted also to routine operations (Fontana D. 1590; Dibner 1952). The procedures adopted in Rome between the seventeenth and the nineteenth centuries to raise obelisks and monumental columns were similar to the one used for the obelisk at Saint Peter's, whose materials, tools and "traglie" were also reused (Marconi 2004). The term "traglia" was used to indicate a block made of

a metal (or wood) case that contained one or more pairs of pulleys, through which a single rope was passed various times. In contradistiction to, a “tackle”, the mechanical lifting gear made of two blocks, one standing, fixed to the scaffolding, and the other running, linked to the load to be lifted.

The obelisk project required a considerable financial effort on the part of the pontifical administration, Suffice it to say that it took around 10 000 pounds of molten metal to make the blocks and the pulleys, considerable amounts of firewood to supply the foundries, 139000 pounds of rope and hundreds of thousands of pounds of timber (Pellegrini 1881, p. 132; D’Onofrio 1965, p. 475) all of which had to be purchased. This outlay of money was already partly amortized thanks to the erection of the other Sistine obelisks (1587–1589), for which the materials and tools used to erect the obelisk at Saint Peter’s **(fig. 1)** were adapted so as to meet the specific needs of each of these subsequent operations.

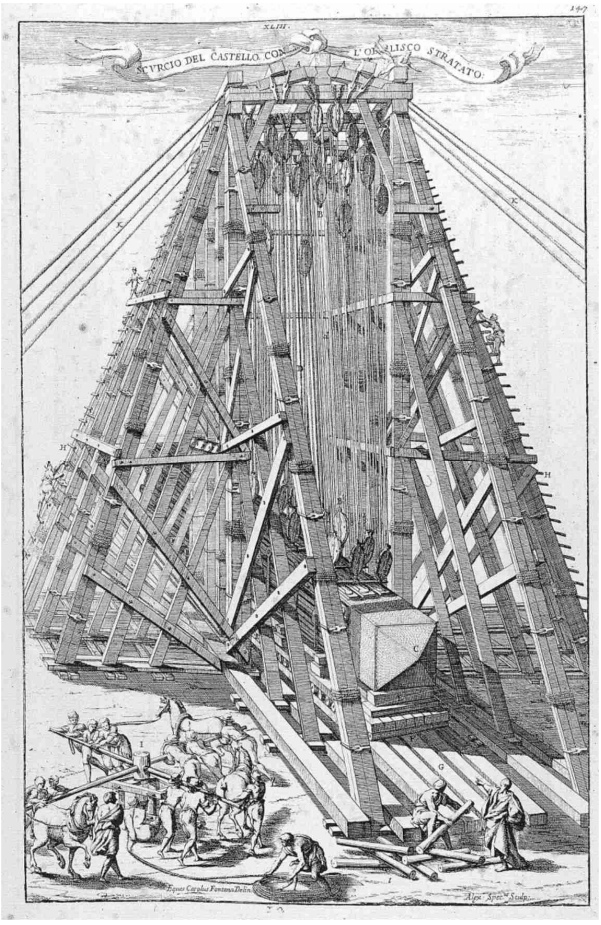

Figure 1. Large wooden scaffold used to raise the Vatican obelisk (Fontana D. 1590, p.20)

Thus this technology and these operational procedures were handed down to various workshops throughout the eighteenth and nineteenth century and they remained basically unchanged despite the introduction of new materials, going so far as to actually reuse the same Vatican equipment. Just as the Sistine obelisks had been raised "as the spoils of idolatry placed by the triumphant religion before the main churches of Rome" and showed "the power of the true God" (Mercati 1589, p. 294), so the Santa Maria Maggiore column acted as a tribute to antiquity as well as exorcising the pagan symbol. In fact, on the one hand it served the same urban function as the San Giovanni in Laterano obelisk, with which it had direct visual contact, on the other, it celebrated the Virgin Mary whose statue stood on its capital.

THE SANTA MARIA MAGGIORE PROJECT

Originally, the column stood in the Basilica of Maxentius, or Templum Pacis, completed around 312 AD, whose 82 metre-long and 25 metre-wide nave had a vault that was initially supported by eight columns made of Proconnesos marble extracted from the quarries of the Isle of Marmara in Turkey (Nibby 1819). In the mid 1500s two of them were still in situ, but only one still had a capital to display **(fig. 2)**.

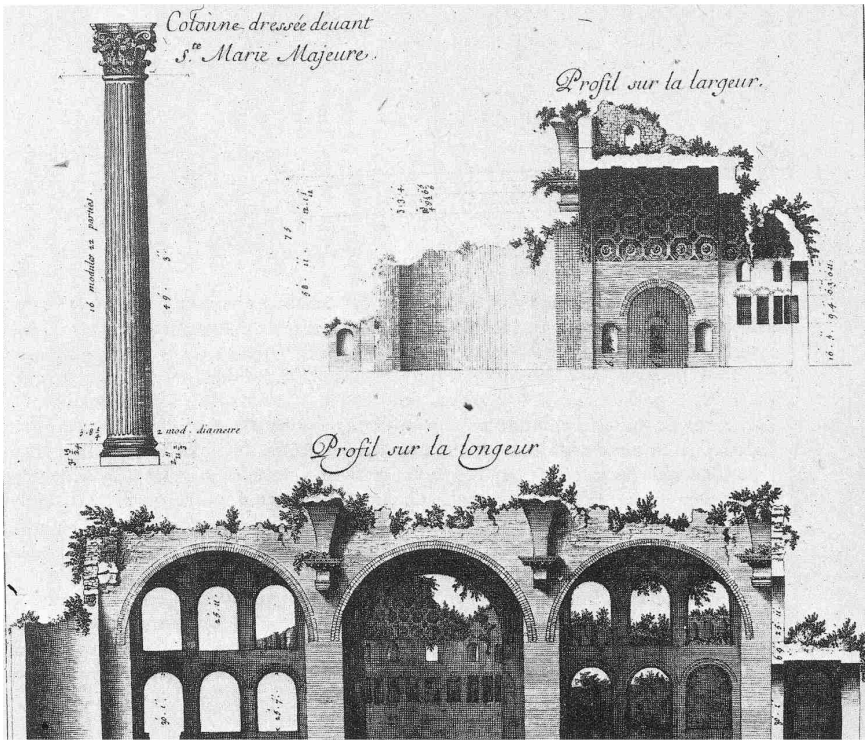

Figure 2. The Basilica of Maxentius and the column now in Piazza Santa Maria Maggiore (Desgodetz 1682)

As reported by Giovanni Antonio Dosio (1533-1609), Antonio da Sangallo il Giovane (1483-1546) reused the base of the column for work that began in the Fabbrica of Saint Peter's in 1520 (Dosio 1569). In 1580, Etienne Du Pérac (1525-1604) included a view of the Basilica of Maxentius in his collection of drawings of Roman antiquities and stated that the column was made of very fine veined marble and stood 15.6 metres tall and 2.7 metres on diameter (Wittkower 1960, p. 79; Gigli 1994, p. 19).

The erection of the column, which was the perspective focal point of the Piazza di Santa Maria Maggiore **(fig.3)**, is just one of the elements of Paul V's urban development, and is considered one of the most significant manifestations of the technical expertise of the early 1600s. Maderno owed his being chosen for this job to his concurrent role as architect at the Fabbrica of Saint Peter's, but also to his technical training, acquired during his long apprenticeship in the Sistine workshops under the management of Fontana, to whom he was related on his mother's side. This experience included also the Sistine chapel workshop in Santa Maria Maggiore, where Maderno contributed to the transfer of the Nativity scene (1586-1587), as well as spectacular technical feats such as the transfer of the colossal statues of the Dioscuri to piazza del Quirinale and the erection of obelisks, first among these the Vatican obelisk.

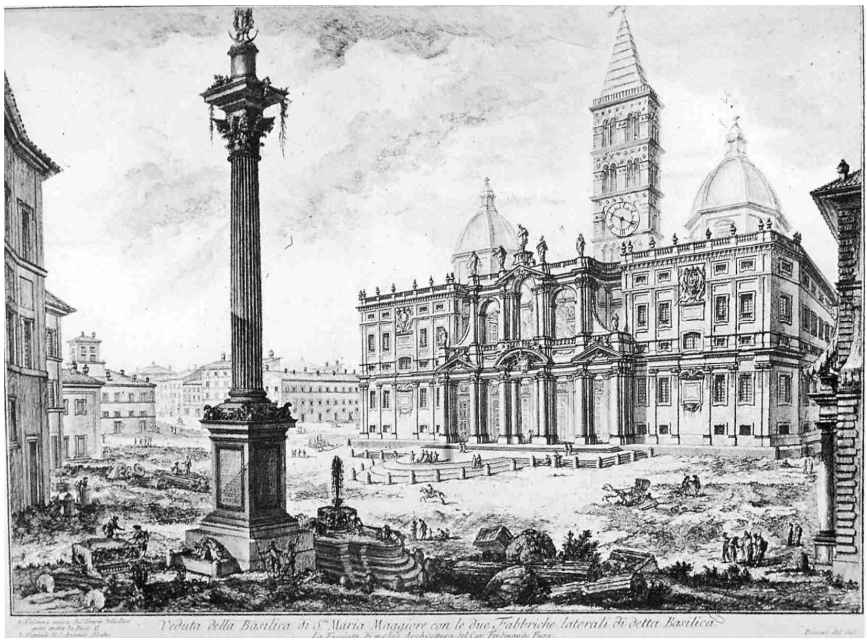

Figure 3. Piazza Santa Maria Maggiore in Rome and the column of the Virgin Mary (Piranesi 1748, fig.7)

This experience allowed Maderno to devise and complete one of the most spectacular achievements of the early 1600s, thanks to the rational organization of the work of all those involved and to the

use of well-tested technical apparatus. The organisation of the workers, on this building site as on the others managed by Maderno, was based on the Fontana business management principles. It was thanks to the decisive contribution of this family of technical and management experts that the so-called "Roman construction system" was developed. It was an efficient method for construction management and organization, which made it possible to optimize each building stage and to break down and synchronize the well- structured operational plans.

The Pope's decision to erect the Templum Pacis column in piazza di Santa Maria Maggiore was ratified by a notice dated 3 August 1613 (Orbaan 1920, p.210). The first records of payments for the transfer of the column from Forum area to Santa Maria Maggiore are dated mid August 1613 and the last in June 1614, and the overall cost was 11 427 scudos (ASR ref. 1, pp. 250-309). The transport and lifting operations, as well as all the related consequential work, were carried out by the brick masons Alegrante Fontana, Pietrantonio Falconieri, Giovanni Angelo Quadri and Giorgio Staffetta, with the help of stone masons and sailors belonging to the pontifical fleet who were in charge of manoeuvring the ropes. The lifting gear was, as usual, built by these same brick masons, helped by carpenters and smiths, whereas others were in charge of the minor consequential jobs and the decorative elements; among these, the smelters Ferreri and Giacomo Laurenziani who were paid respectively for casting the bronze statue of the Virgin and for casting the heraldic emblems of the Borghese family placed on the pedestal. The sculptor Francesco Antonio Mori is the author of the commemorative medals placed in the foundation and the epigraphists Fabrizio Abadesso and Fabrizio Baldelli are the authors of the inscription on the pedestal (ASR ref. 2).

Maderno organised the workers in teams according to their skills, and structured the work so that it followed a rigid plan and schedule marked by the skilful coordination of synchronous operations. The master stonemasons Pietro and Antonio Falconieri were recruited with their teams of masons to remove the column from the Basilica of Maxentius. In December 1613, the Lombardy stone mason, Tullio Solari, who was also the supplier of the marble in the workshop of the Paoline Chapel in Santa Maria Maggiore, was paid for the supply of the stone necessary for the restoration the capital – taken from the Basilica of Maxentius and from the baths of Diocletian – and for the sculpting of all the missing elements (ASR ref. 1, pp. 260-273). Not even the metal used for the sculpture ensemble was new; it came from the cannons of Castel Sant'Angelo and from the *Symmachus* fountain, which formerly stood in the atrium of the Basilica of Saint Peter's. The bronze statue of the Virgin Mary that topped the capital, was made by the French sculptor Guillaume Berthélot (1570-1648), assisted by Orazio Censore, while the gold overlay is the work of the gilder Annibale Corradini.

The mode and route of supply of materials varied. In October 1613 draymen began to supply the construction site with freestone (travertine and tuff), hardware and hemp for the ropes while the supply of wood for the scaffolding was organised directly by Maderno through resellers of the Fabbrica of Saint Peter's, the Vatican institution in charge of overseeing the Basilica site. Indeed, in

the sixteenth century, the Fabbrica of Saint Peter's became the experimental laboratory for construction technology, as well as a training centre for skilled workers and a powerful means of disseminating technical know-how. It played a major part in the construction of Rome thus creating very close links with other Roman workshops, even private ones, to whom it supplied material, equipment, machinery and skilled workers (Marconi 2004). Indeed, not only did the Fabbrica of Saint Peter's hire out and sell part of the material and the equipment necessary to lift the column, but, once the work was finished, it also appropriated the excess timber and equipment, which then became part of the so-called Vatican stock-in-trade, that is the stocks of building material stored all about the labyrinthine basilica grounds (AFSP ref. 1).

Written records of materials purchased by the Saint Peter's warehouses and receipts for payment issued by the Apostolic Treasury allow us to identify not only the technique and the equipment used, but also the succession of operations carried out for the transfer and the erection of the column. The registers of Paul V's Depositeria Generale or main warehouse tell us that on 17 November 1614, overall expenditure amounted to approximately 12 000 scudos, spent for the most part on timber for scaffolding. The amount of wood supplied in other words, was substantial: there were hundreds of chestnut beams and elm planks, some of which were even 11 metres long; they were used as roofing and walkways for the scaffolding, for auxiliary apparatus, flooring and other apparatus. An order was put in for about one hundred *curli*, wooden rollers or large cylinders made of elm wood banded with iron at both ends, some of which had a diameter of approximately 2 metres (ASR ref. 2, p. 4). Some of these rollers, as well as various cuts of timber, appear to have been delivered by Cosimo Ghetti, Foreman of the Fabbrica of Saint Peter's, to Staffetta and Benedetto Drei, on the order of Carlo Maderno for the column in "Campo Vaccino", the term used to indicate the Imperial forum area where the Basilica of Maxentius stood. In July 1613, 1 151 planks, 109 thick elm boards, 200 oak planks, and also hemp, iron and lead left the warehouses of Saint Peter's (AFSP ref. 2). Further hemp was supplied by Rocco Rocchi, one of Saint Peter's masons, and measured by weight as usual. This included one 1 010 pound (342.4 kg) hemp rope and two 725 pound (245.7 kg) "ventole" needed as bracing for the large scaffolding that raised the column (Pellegrini 1881, p. 45). The term "ventola" was used to indicate the heavy hemp ropes with a large cross-section used to brace the scaffolding and the lifting gear. Once the work was completed, all the ropes were sold to the shipyard of the Port of Civitavecchia, while part of the timber was taken to Fiumicino where it was used to reinforce the protection piling of the harbour.

The account of moneys paid for the transfer of the marble column in Campo Vaccino to Santa Maria Maggiore, 1613-1614 (ASR ref. 2, pp. 1-6), signed by Treasurers of the Apostolic Chamber, shed light on the species of tree used: strong ones such as oak, chestnut and elm; as well as on the substantial nature of certain lifting equipment and machinery. This included five hoists, various pulleys used to rewind the ropes and a "scaletta", which was a small "capra" used to lift and stack stone material. In Roman technical jargon, the term "capra" was used to indicate a lifting device: a wooden trestle or tripod gin linked to a hoist with a tackle.

Although not attested in any documents, it is likely that very expensive and mechanically powerful lifting gear was used in the Santa Maria Maggiore column workshop, the kind that was used at the Fabbrica of Saint Peter's. In fact, the use of five hoists leads us to assume that as many pairs of powerful metal blocks were also used, two of which would be linked to the upper end of the column, a further two to the middle and one to the lower scape. To these were added the blocks for the so-called "tiri morti"**,** the ropes used to adjust the tension of the *ventole* and of all the ropes needed to keep the lifting gear stable. This assumption is confirmed by the re-use of equipment forged for the erection of the Vatican obelisk in the foundries of Saint Peter's, over many centuries. An example of this is offered by the "traglioni" – double blocks, approximately one metre long - entirely made of iron with six metal pulleys arranged in two rows one above the other, designed by Fontana himself and illustrated by Nicola Zabaglia in the eighteenth century (Fontana 1590, p. 6; Zabaglia 1743, fig. 5). Fashioning this extra-ordinary equipment, paid for by the Fabbrica of Saint Peter's, was certainly very useful but also very costly. It is for this reason that the "traglioni" were closely guarded in the warehouses of Saint Peter's for about two centuries, though they were repeatedly hired out for particularly demanding operations (Marconi 2004).

Along the lines of what was done for obelisks, to protect the shaft of the column against blows and scrapes, the shaft of the column was bound with boards of wood, held by metal straps and stirrups and was wrapped in layers of approximately 3.5 cm diameter rope wound snugly around the shaft and pulled tight by a single line winch operated by 12 men and set in place manually with a wooden beetle. The binding was arranged so as to create four sections along the length of the shaft and once this protection was in place, the loops that tied the running blocks of the tackle were prepared. The lower scape of the column was protected by an iron band held in place by other longitudinal bindings; thus protected, the column could be removed from its original housing with the force of various hoists operated by 60 horses. By releasing the ropes slowly and gradually, the column was lowered and laid on a large wooden sledge – called "strascino" or "nizza" – made of four chestnut beams held in place by iron pins. It lay on five oak "curli" that allowed it to move along the ground more easily **(fig.4)**.

Once the column lay on the sledge, it could be moved to Santa Maria Maggiore (Gigli 1994, p. 19). It was transported along a route with well-tamped ground, covered with wooden planking that allowed the rollers to roll more easily.

Slopes were overcome thanks to a wooden ramp, whose inclination did not exceed 10%, set on a robust frame of vertical beams that were assembled, braced diagonally and reinforced with nails and clamps, on which planking was laid to allow the sledge to move along it. It was pulled by hoists and tackle, whose running blocks were linked to the front end of the sledge, while the standing ones were secured to robust pegs driven into the ground at the foot of the ramp and all along the route. Once the sledge was at the foot of the ramp the fore rope was replaced by two lateral ropes, secured to a horizontal crosspiece of the wooden scaffold. These, were manoeuvred by two hoists, each of which was operated by 16 men.

Once the sledge reached the square, it was positioned at the foot of a wooden platform placed in the proximity of a large wooden scaffold, similar to the one used to raise the Sistine obelisks. The platform was higher than the ground, in order to make it possible to install the pedestal and remove the protective cladding with enough room to manoeuvre. The scaffold was made of a frame of 12 long "candele" (long vertical wooden columns made of at least nine squared wrought chestnut beams) joined together with wooden clamps, ropes and iron straps and its ground plan showed its Greek-cross shape. It was partially interred, its first section at least, so that it became an integral part of the ground and it was made more rigid by two sets of horizontal trusses, pendant posts and diagonal rafters. The four central "candele", designed to support much of the weight of the column during manoeuvring operations, were in turn braced by bowed beams and countered by other posts. The horizontal trusses of the scaffold placed at various levels were made of pairs of stiffened beams, which were needed to support the combined compressive and bending stresses produced by the action of the blocks.

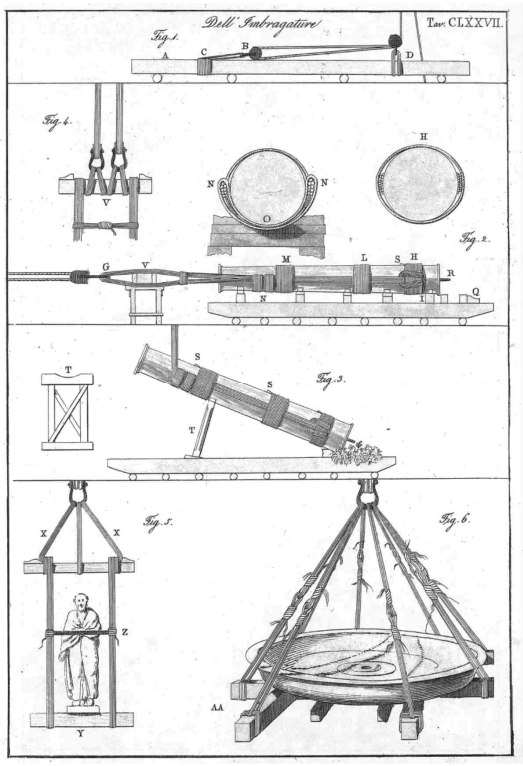

Figure 4. Equipment used to lift and move monolithic columns (Valadier 1832, III, fig. CLXXVII, detail)

The scaffold had to be used again to set in place the capital and the statue of the Virgin Mary and this meant that it had to be made higher in the mid section, where it reached a height of 20 metres. The whole of the scaffolding was further reinforced by a lattice of "ventole" and hemp ropes of

varying sizes, secured on the one hand to the summit of the scaffold and on the other to the so-called “omini morti”, wooden pegs driven into the ground to contrast lateral oscillation. The “ventole” helped to protect the scaffold from oscillation due to sudden overloads caused by the beams holding the blocks suddenly breaking. For this reason, the latter were secured to the most robust beams. On the roofing of the scaffold, which was made of a lattice of robust chestnut beams, were placed the standing blocks of about ten tackles, which were positioned in such a way as to leave a space wide enough to insert the capital and the statue **(Fig.5)**

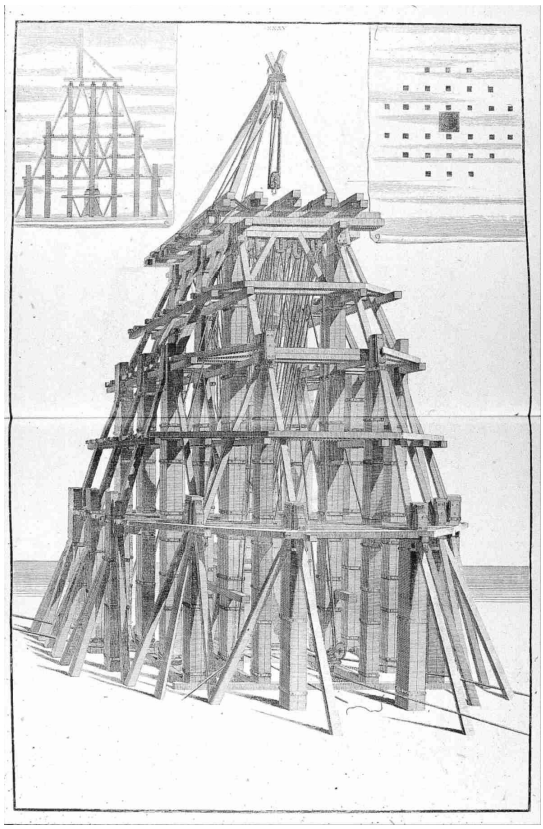

Figure 5. Wooden scaffold used for the erection of large monolithic columns (Zabaglia 1743, fig. XXXV)

Further tackles were rigged respectively on the roofing of the scaffold and on the upper column cladding, on the intermediary scaffold trusses and on the mid-column binding, on the lower crosspieces of the scaffold and at the base of the column. Each pair of blocks was operated by a hoist, placed in such a way as to ensure the correct movement of the hemp ropes; the hoist had four arms operated by sixteen men, who worked in unison with other apprentices in charge of controlling the hemp rope around the spindle and winding up the free end to avoid knots forming. Various snub pulleys, secured to the foot of the “candele”, made sure that the tension of the ropes was correct at

all times during operations. They were rigged with approximately 7 cm diameter ropes, braided into Viterbo hemp and warped with four sixty seven-strand ends.

As was done in antiquity, some hours before the beginning of operations, the column cladding was drenched with water so as to improve its adherence to the shaft. However, this expedient increased the weight of the load to be lifted, which meant a heavier load for the hoists, which were therefore increased in number, to more than a dozen. These were arranged in the large basilica foreground according to the dimension of the ropes and they were numbered according to the position of the tackles on the scaffolding. This established easier and more secure transmission of orders to the apprentices in charge of handling the hoists. Indeed, the orders issued to coordinate the lifting of the column were expressed by trumpet blasts that marked the timing and the movements of operations, in line with the teachings of Domenico Fontana.

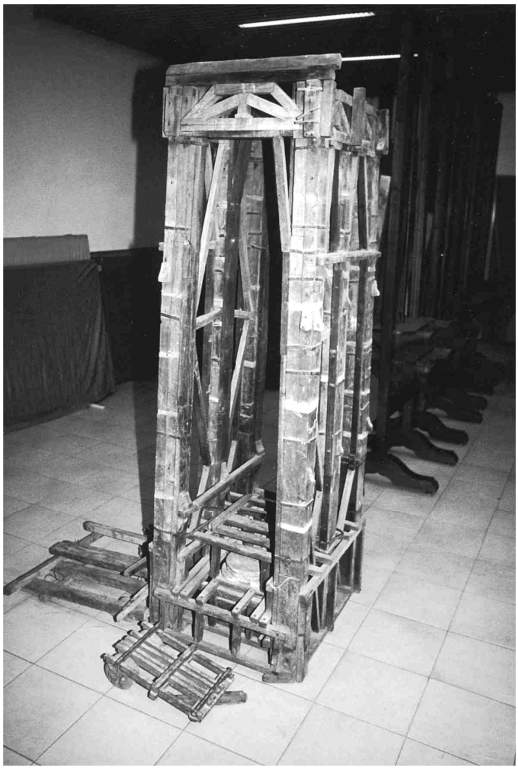

Figure 6. Model of a wooden scaffold used to lift columns (Archives of St. Peter's, Rome)

The column was first lifted horizontally thanks to the simultaneous activation of the ropes; then, by blocking the hemp ropes at the lower scape and activating the middle and upper ones, it was made to pivot slowly on its barycentric cross section, situated in the lower half of the shaft because of the

tapering and the entasis. Then, by gradually slackening the ropes and guided by the use of plumb lines, the column was set upright. The column was thus suspended from the scaffold, at a distance of half a meter from its base. This expedient allowed the ropes to be slackened and made it possible to remove the metal band protecting the base of the column, to achieve a perfectly vertical position and to place the shaft correctly on the pedestal with the use of wooden wedges and ropes looped around the shaft and secured to the scaffold "candele". The column was solidly fastened to the pedestal with iron pins welded to the stone with molten lead.

Written records relating to the work offer information about the construction of the foundation which began in February 1614, when a certain quantity of bricks, iron bars for the welding, slate for the cornice, lime and pozzuolana was purchased (ASR ref. 2, p. 5). Work continued until 15 April 1614 when a ceremony with the presence of eminent figures marked the erection of the column onto its pedestal. The event was described in a notice of 16 April 1614: "on Monday morning, in front of Santa Maria Maggiore church, work began to raise the column upon which will be placed a gilt metal statue of the Virgin Mary " (Orbaan 1920, p. 217). A large number of people came to see and the operation became a truly mediatic event. The work, made even more fascinating by the magnificently powerful lifting gear positioned in the square, was carried out with apparent ease, the only hitch being the incident of a Pontifical Swiss guard who fell from the scaffolding, without serious consequences, fortunately. On 29 April, another notice reported that the "column of the Templum Pacis with a wondrous artifice of hoists and a scaffold all of wood, was raised onto its marble base" (Orbaan 1920, p. 218). Then came the finishing and cleaning stages, followed by the positioning of the capital and the setting in place of the gold plated bronze statue of the Virgin Mary.

In fact, the additional cost of the wonderful wooden scaffold used to raise the column was in part amortised by its versatility which allowed it to be used for the positioning of the capital, the raising of the statue and the carrying out of the finishing and the decoration work. Indeed, in order to set the capital in place, it was necessary to create adequate room to manoeuvre inside the scaffold. This was done conveniently by raising the roofing. The capital was set in place from the front, by shifting the hemp rope bindings in the upper scaffold blocks backwards asymmetrically, thus leaving much of the inner space under the roofing free. On 24 August 1613, a chirograph by Paul V addressed to Cardinal Luigi Serra, Treasurer General of the Reverend Apostolic Chamber, ordered the supply of 20 000 pounds of metal needed for the casting of the statue of the Virgin Mary. To these were added, the following year, a further 3 100 pounds of metal given by the Fabbrica of Saint Peter's, to be melted down in order to make the Eagles and the Dragons for the Column in piazza di Santa Maria Maggiore (AFSP ref. 3). The making of the statue began in September 1613 with the preparation of Berthélot's model.

The papal chirograph also enjoined Giovanni Franchini, Superintendent of Castel Sant'Angelo, and Cristoforo Ramuschi, custodian of the Vatican gardens, to deliver metallic objects of no further use

kept in the warehouses of Saint Peter's to the smelter Domenico Ferreri, who, between September 1613 and July 1614, was paid for the contracted job of making the metal statue of the Virgin Mary (ASR ref. 3, p. 19 and ref. 1, pp. 254-295). Among the objects destined to be melted down there were several demi-cannons and other types of guns from Castel Sant'Angelo which were no longer in use (given by Cosimo Bertolani, who was in charge of supplying tin and copper for the bronze alloy), but also part of the old grate that protected the Pigna fountain in the atrium of the ancient Basilica of Saint Peter's (Corbo and Pomponi 1995, p. 28). At the same time, Giacomo Laurenziano moulded the metal Borghese eagles and dragons, from Berthélot's model. The work was carried out partly in Saint Peter's foundry, where the recovered metal was cast and worked, and partly in the foundry of San Paolo alla Regola. As suggested by the supplies of wax, turpentine, plaster and softwood paid to the Milanese drayman Bernardo Belini, it was here that the statue, the Borghese dragons and eagles and even a bell for the very Basilica of Santa Maria Maggiore were made. Indeed, documents from the workshop confirm the purchase of approximately 800 pounds of wax and 200 pounds of turpentine (31 October 1613) used for the mould, a considerable amount of softwood to melt the metal (7 November 1613) and plaster for the statue (20 February 1614) (ASR ref. 1, pp. 264, 277, 314). On 18 July 1614, the statue of the Virgin Mary was placed on the capital. The same scaffold made to lift the column was used here, again; it served as scaffolding yet again when the inscription on the pedestal, suggested by the scholar Fabrizio Baldelli, was tinted black. Once the installation was complete, the scaffold was completely dismantled and all its wooden parts were taken to the warehouses of Saint Peter's. On 31 July 1614, Carlo Maderno handed over two "ventole" to the builder agent of the Reverenda Fabbrica, Giulio Buratti, who in turn lent them to Rocco Rocchi, to use for his boats, that were used to transport the travertine (AFSP ref. 4, p. 178). The gold plating of the dragons and the eagles, carried out by the goldbeater Marcantonio Pio and the gilder Giovanni Boiani, in December 1614, marked the end of the work and the site was definitively dismantled in February 1615.

LATER PROJECTS

It is surprising, although not unexpected, to see technology and practices similar to this one used by Maderno still in use right up to the second half of the nineteenth century. Despite the gradually improved theory, despite the birth of mechanics and the introduction of new materials, the architects in charge of raising large monoliths continued to use scaffolds and machinery that were identical to the ones designed and built by Fontana. This was undoubtedly the case for Rome, where the hegemony of the Fabbrica of Saint Peter's lasted until the first half of the nineteenth century, with inevitable repercussions on traditional working methods that remained basically anchored to the building practices of the late Renaissance. By way of example, one can quote the unfortunate case of the failed erection of the column of Antonino Pio in piazza Montecitorio carried out by Francesco Fontana from 1703 to 1704 (Marconi 1999) **(fig. 7)**, and the spectacular installation of the Immaculate Conception column in piazza Mignanelli carried out in 1856 by Luigi Poletti (1792-1869) at the behest of Pope Pius IX (1846-1878) **(fig. 8)**.

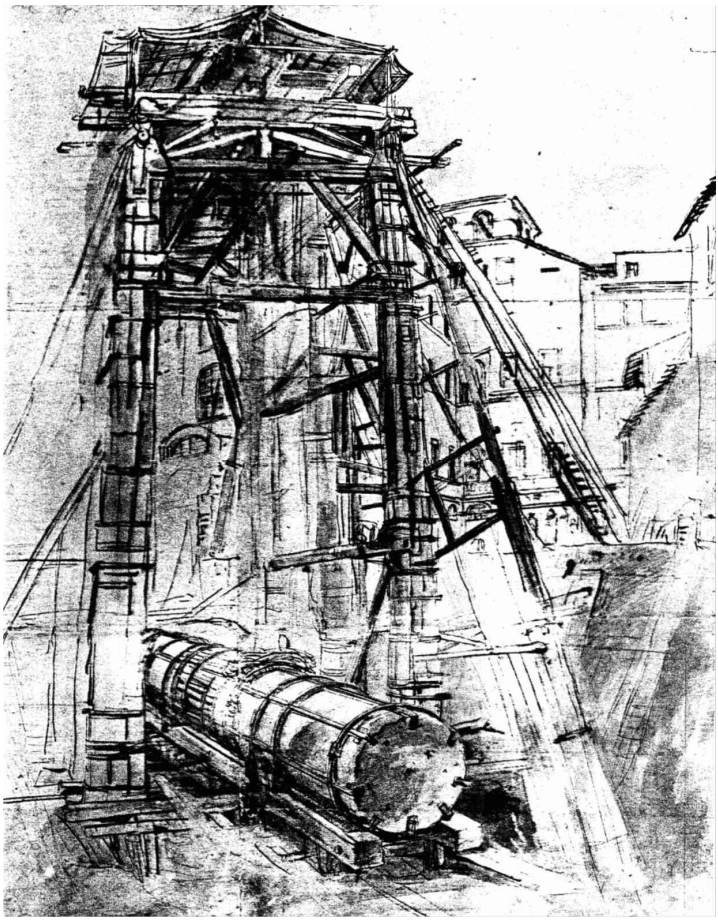

Figure 7. Gaspar van Wittel. Scaffold used to raise the Antonino Pio column, 1705 (Martinelli 1991, fig. IV)

As in the case of Maderno, the experience Poletti had acquired while reconstructing the Basilica di San Paolo fuori le mura, where he transported and erected 12 monolithic columns in the portico, was a very important reason for his being chosen to erect the column of the Immaculate Conception. The Immaculate Conception column was made of a single block of *marmor caristium*. It stood approximately 12 metres high and had a 1.45 metre diameter at its greatest entasis. For its erection a special scaffold was built, which was supported by "candele" made of three long squared wrought chestnut beams joined together and braced by horizontal binding and diagonal posts, the foot of which was secured to the ground by wooden socles. The outer "candele" were 20.5 metres tall, whereas the four central ones reached a height of 30 metres. Following the traditional seventeenth century working method, this difference in height was dictated by the need to create sufficient room to manoeuvre inside the scaffold to be able to set the capital in place and position the statue as well (Marconi 2004).

Figure 8. Scaffold used to raise of the Immaculate Conception column in Piazza Mignanelli (1856)

Moreover, word of Fontana's experiments and those of the Lombardy engineers subsequently reached even the most remote regions of Europe, as far distant as Russia. In fact, from the eighteenth century onwards artists and engineers from Italy and Ticino imported into Russia procedures and methods that were borrowed directly from the Renaissance practices, and that do not seem to have been influenced in any way by the contemporary progress of theoretical and applied science. As Nicola Navone's studies show, the machinery and the techniques, used by the Ticino architect, Antonio Adamini, in August 1832 for the erection of the Alexander column in Saint Petersburg's Winter Palace Square, were strikingly similar to the ones used by Maderno and Fontana. The latter procedure which, contrary to the Roman context, had at its disposal almost unlimited manpower and building timber, took on a technical and empirical connotation that resisted all the procedures developed in those intervening years by the polytechnic engineers (Navone 2003).

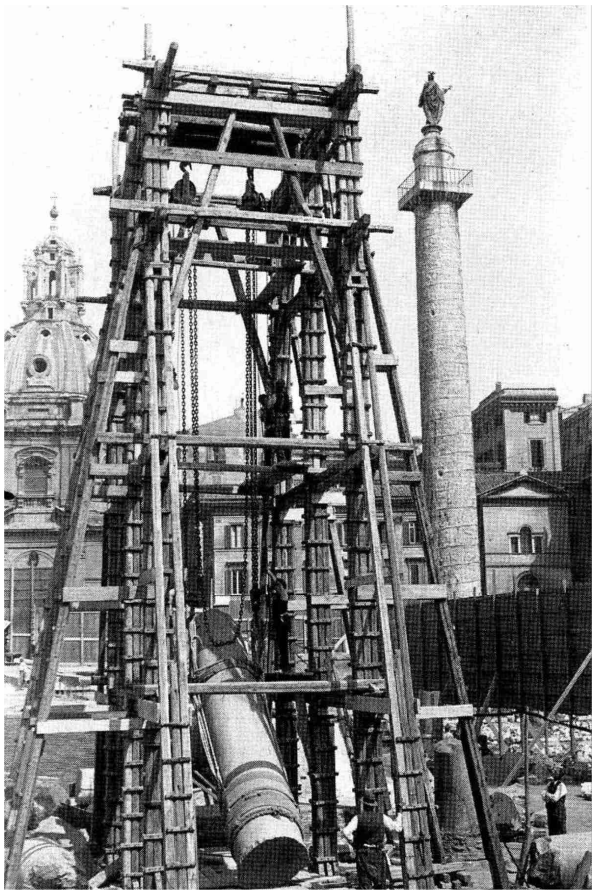

Figure 9. Scaffold used to lift one of the Forum of Trajan columns (May 1932)

Indeed, the work of the same Adamini in the porticos of the Cathedral of Saint Petersburg in 1835, where he set up a large multiple scaffold in order to raise three columns simultaneously, is also very similar to the procedure that Virgilio Vespignani (1808-1882), a pupil of Luigi Poletti's, used later, in 1890 and 1892, for the reconstruction of the pronaos of the Basilica di San Paolo fuori le mura, in Rome. Here too, the architect adopted an ingenious solution which meant that the scaffold could be reused and also enlarged progressively in order not to have to be completely dismantled and rebuilt every time. In this way, when the last corner column was installed, the scaffold ended up with a total of 60 "candele" and the only operations necessary when moving on from one column to the next were those relating to the transfer of the horses and the iron tie-rods to the new hoists (Gui 1901, p. 70).

Therefore, up to the twentieth century, methods, techniques, materials and the technology used for the raising and re-erection of ancient columns had changed only very marginally from the

traditional working methods of the sixteenth and seventeenth century. They echoed the reassuring glory of an age-old tradition and bear testimony to the efficacy of a method developed arduously over years of practice **(fig.9)**. Indeed, only the advent of alternative forms of energy and truly revolutionary materials succeeded in rendering these methods obsolete.

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