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James W P Campbell
2015

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unprecedented structure such as Apollodorus’ Trojan baths in Rome, Brunelleschi’s dome in Florence, or Arup’s timber lattice in Mannheim (see “Timber lattice roof for the Mannheim Bundesgartenschau” by E. Happold and I. Liddell in The Structural Engineer, 1975, Vol.53, No.3, pp. 99-135.)


[10] This view of the power of geometry to give justification dated back to classical Greece when geometry was seen as the earthly manifestation of the rules the gods had used to create the universe and, in a manner that we emulate in our use of modern science, geometry provided an explanation of how the world behaved. See The Gothic Cathedral: Origins of Gothic Architecture and the Medieval Concept of Order by Otto Georg Von Simson. New York: Pantheon Books, 1956. (3rd edition Princeton University Press, 1988).


[12] A good example is the heliocentric model of the solar system which replaced the many geocentric models used until the 16th century.


Understanding Roman construction before A Choisy: Piranesi and his influence on Rondelet

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Introduction

Experts on the works of G.B. Piranesi (1720-1778) have repeatedly illustrated the value and unique character of the etchings in his Antichità Romane from an archeological standpoint [1]. Nonetheless, an in-depth study has yet to be carried out examining the true impact of Piranesi’s renderings of ancient Roman construction on researchers studying the subject throughout the 19th century [2].

Various reasons exist to explain why such a study has yet to be rendered, among them a lack of recognition of Piranesi’s work due to a perceived absence of scientific rigor, as his illustrations have been considered to be excessively rhetorical and the abiding effect of critical voices has failed to recognize the value of his work. For example, the influential William Chambers, who in his Treatise Civil on the Decorative Part of Civil Architecture stated that Piranesi’s “composition, on paper, has seldom been equalled,” but went on to assert that Piranesi had minimal knowledge of ancient Roman architectural techniques, proclaiming that he “knew little of construction or calculation, yet less of the contrivance of habitable structures, or the modes of carrying real works into execution, though styling himself an architect.” These assertions perdured even in the 1825 edition of this book [3].

This paper is an introduction to a more extensive article that attempts to demonstrate that throughout the 19th century Piranesi’s work was regarded as a valuable and reputable reference on ancient Roman construction. His influence can be detected in the work of his early successors and even in the first, ever published book that displayed a systematic approach to representing the history of Roman construction by A. Choisy. The article argues that contrary to what some critics have believed, Piranesi’s drawings were perfectly understood as bonafide scientific illustrations within the cultural and conceptual context of the Late Baroque period. It further contends that the generations following Piranesi drew on his models as an inspiration for begetting new forms of illustration, effectively redrawing, modifying, and rearranging his images in a format called “parallelly”.

In light of this argument, this essay will introduce some early evidence of Piranesi’s influence, such as Jean Baptiste Rondelet’s Traité théorique et pratique de l’art de bâtir (1743-1829), in which he evokes Piranesi’s work, rearranging aspects of the drawings to impart new interpretations of ancient Roman construction. Such influence has been virtually overlooked even in exhaustive studies like those carried out by R. Middleton and M.N. Basdón-Manzarek (2007) [4].
Piranesi’s Roman construction, an empirical Vitruvius

Piranesi’s "archaeological" collection of books – specifically Le Antichità Romane, Le riviste del Castello dell’Acqua Giulia, and Descrizione e disegno dell'Emisario del lago Albano, among others which will be further mentioned – was mainly concerned with monumental architectural constructions and machinery that were scarcely discussed by treatise writers at the time, such as aqueducts, Roman walls, aqueducts, hydraulic systems and baths [5]. In his pursuit to include accurate representations of the ancient ruins, Piranesi felt he needed to experience ancient Roman construction directly. Through on-site examination and copious research on previously hypothetical drawings produced to illustrate Vitruvius’s texts, Piranesi forged an understanding of Roman technology, and perhaps without originally intending to, created a revision and reappraisal of the Roman architecture presented in Vitruvius’s Ten Books on Architecture.

To uphold the integrity of his “archaeological” collection, Piranesi considered it crucial to create accurate illustrations that drew directly upon measurements taken from floor plan, elevation, and section drawings. He wanted the inner workings of the construction process to be visible: “…representandone molti non solo nel loro prospetto esteriore, ma anche in pianta, e nell’interno: distinguiendone le membra per via di sezioni, e profiti: e indicandone i materiale, e tavo la maniera della loro costruzione.” There is no doubt that this collection, with its empirical approach to architectural construction, expresses its intention to supplement the previous work done by Vitruvius. After “molto anni da infaticabili esattezze osservazioni, cavi, e ricerche” he made observations “che possono servire particolarmente alla discescuzione de’ proprii di Vitruvio, relativi al riparo, che si dimostra resistenza, maestà, e venuta delle fabbrichie sull’esempio degli avanzamento, como nella presente Opera” [6].

Following in Vitruvius’s footsteps, Piranesi published a compendium with a thorough, though randomly selected, array of drawings of Roman Architecture, which entailed a study of foundations, walls, arches and vaults and also explained methods of transport and placement. Emulating Vitruvius, Piranesi broached the subject of foundations, which had only been conveyed in previous works in a conventional manner rather than as a result of observation. He also incorporated drawings never before depicted of entire sections of temples, theaters, and bridges, representing the visible parts of these structures in such a way that he stayed true to their original form, while resorting to estimations based on theory and observation to represent the unseen, underground sections [7].

Piranesi also endeavored to analyze the design of Roman walls with their concrete (opus caementicum) core and distinctly constructed masonry (opus incertum, quadratum, reticulatum, latericum), giving special attention to the methods that were used for joining the walls. He rendered noteworthy representations of the opus latericium from the Aurelian Wall and another wall on the Via Appia, in which he addressed the complexity of constructing corners and of the opus reticulatum of structures, such as the Mausoleum of Augustus, in which he depicted the quadrati di naff true to size. He also included drawings of naums from the condotto dell’Acqua Abietina” which showed the remains of different layers of construction so as to demonstrate how it was possible to build structures of extraordinary thickness from blocks of travertine, such as the tomb of Cecilia Metella (Fig.2) [8].

Sometimes Piranesi was afforded the opportunity to collect evidence from the same location, which allowed him to create drawings that were the empirical counterpart of the conventional illustrations of various types of walls depicted in Vitruvius’s editions. This is evident for example when we place side by side Gallianni’s version with Piranesi’s illustrations of structures like the Emissario del lago Albano and the burial chamber outside the Porta San Sebastiano of the Via Appia [9].

What was of particular interest to Piranesi, which is not usually a feature of Vitruvius’s illustrated volumes, was the study of Roman Stereotomy, which encompassed a set of techniques intended to strengthen the joint system in the construction of stone walls or steps. A close look at his work reveals carefully delineated representations of the interlocking tiers of steps at the Theatre of Marcellus and the Theatre of Pompey. In drawings of other structures, he was particularly meticulous in showing the metal joints linking the stones, such as the metal dowels used to construct Trajan’s Column, which he drew true to size, or the dowel cramps that hold the tomb outside the Porta San Sebastiano intact. He also articulated in great detail the system of interlocking stone blocks and metal joints used to form the pillars of the Ponte dei Quattro Capi and the Porticus Octaviae [10].

Fig. 1 (left) Analytical views of roman brick arches in the Castello dell’Acqua Claudia; G.B. Piranesi 1761, pl. XI; (right) section of a roman vault in Scipione sepolcre, (G.B. Piranesi 1784, vol.2 pl. XXXVII) showing how dowels and interlocking voussoirs contributed to its stability.

Illustrations depicting the construction of Roman arches also appear in Piranesi’s work, although he often chose to present those of unusual design, as can be seen in an engraving of the sepulcher of Scipione, whose stereotomy of stone voussoirs, joined in a wedge-like shape from where the arc begins (later lightened with brick), is reinforced for greater stability by the presence of metal dowels [11]. Or in his rendering of the Castello della Aqua Giulia, where he showed how the space between successive tegolone planar bricks, arranged in a circular arch converging at one central point, were filled with horizontal layers of “tuffa e mattoni” (Fig.1) [12]. Concrete vaults, which are completely absent in Vitruvius’s work, are also addressed in Piranesi’s renderings. Ashlar vaults are represented by the Cloaca Maxima and by the conical section of the emissario del lago Albano. Vaults of brick and concrete can be seen in a plate of images of the Castello dell’Acqua Giulia, which also includes the waterproof facing that was employed and images of the construction of an opus reteccasum wall viewed from below [13].

The cranes and provisional auxiliary machinery that lifted the structures and allowed them to take form were also important features of Piranesi’s engravings. He represented the Pons Cestius bridge as projecting stone
Understanding Roman construction: A Choisy: G.B. Piranesi and its influence on J. Rondelet

formations that support falsework and revealed the tensile in segments of the load-bearing arches of structures like the Mausoleum of Adrian and the Tomb of Cecilia Metella, while including details such as perforations in the stone, which were used for lifting the blocks comprising the tomb with machines like those described in Vitruvius’s work [14].

Piranesi’s palimpsest and Late Baroque ways of envisioning science and technology

A great deal of the technical knowledge that appears in Piranesi’s works is shrouded in a powerful and detailed language that uses intricate, but subtle techniques to provoke an emotional response. Often the subject within a disjointed composition takes on the form of a palimpsest, which was made by carefully superimposing fringed pieces of parchment paper with additional drawings (sometimes illusory floating over deep perspective) so that the layers create a multilayered image, conveying also multilayered levels of information. In these complex images, dramatic uses of chiaroscuro, distortion of scale, point of view placement, and the effect of degradation on ancient ruins can be seen. Piranesi ingeniously applied these techniques when rendering his work. At the same time, he paradoxically created objective representations of monuments that often appeared to be dissected images that allowed sections, plans, and elevations of a structure to be observed up close. These details allowed his work to be simultaneously interpreted from both a scientific and artistic perspective.

A close look at the works of Rondelet reveals a sweeping change in style compared to the prior generation, characterized by a more sober style, and although it was not voluntarily progressive, it lacked emotional depth. While works from previous generations could be seen as rhetorical and lacking in scientific rigor, works from Rondelet’s generation were easily recognized as scientifically valuable and radically different from what came before [15].

But was this true? It is worth noting that Piranesi’s palimpsests, which specialist Susan M. Dixon called “multi-informational images”, which he considered to be “quintessentially Piranesian” and were, in fact, artistic representations that could very easily be considered scientific, as a review of some significant works before Piranesi’s time may show. Dixon rightly emphasized that previous examples can be found in cartography made by Du Péré, and also recognized Piranesi’s precedents in the engravings of Pietro Santi di Bartoli (1697), which was already observed by Wilton-Ely, and in the works of architects such as Carlo Fontana (1704), Johann Fischer von Erlach (1721) or in the drawings rendered by Juarra for a contest held at the Accademia di San Luca [16].

However, looking beyond the examples presented by Dixon, we can find this palimpsest illustration in a wide range of scientific and technical literature of high quality, crassly blending art with science. Some could be pointed out in treatises such as Antoine de Ville’s book, Les fortifications (1640); in fundamental books on perspective as Marinus Universelle de Desargues (1648), in practical geometry in the treatises of Sébastien Le Clerc or Messonier; in natural sciences such as the anatomical drawings of Claude Perrault in Mémoires pour servir a l’histoire naturelle des animaux (1676); in other natural science publications such as R. Bradley’s A philosophical account of the works of nature (1721); and in the volumes of Comte de Buffon’s great work, Histoire naturelle générale et particulière with the description du Cabinet du Roy (1749-1789). Lastly, in the astronomy depicted in Leonardo Ximene’s book Del vecchio e nuovo gnomone forestiero e delle osservazioni astronomiche fisiche ed architettoniche fatte nel verificare le costruzioni, (1757), and in cartography created at the end of the 18th century by pupils at the French polytechnical schools.

If we confine our attention to the field of antiquarians and architecture, we may add, apart from the aforementioned Ferramenta sepulcrala by Bartoli and Belleri (1702), numerous contributors to this way of featuring images. Examples include Johann Georg Graevius’s publication, Theoraurus Antiquitatum Romanorum (1664-1699), the architectural renderings of Carlo Fontana’s Il Tempio Vaticanus, as well as in Claude Perrault’s Histoire de Claude Perrault [17]. Also relevant is Zábálja’s book on supporting structures and scaffolding titled Castelli e Ponti (1741), as well as Giovanni Poleni’s Frontinus (1722), a publication that Piranesi especially studied. There are countless examples that support the notion that the palimpsest strategy conveyed persuasively scientific and technical information (Fig.2).

Fig. 2 (upper, from left to right) Examples of “palimpsest” compositions from different sources (B. Galliaini’s Vitruvio, 1758, J. Goeree, c. 1700, P.S. Bartoli 1702, C. Perrault’s Vitruve 1673, (bottom) G.B. Piranesi’s similar composition illustrating (left) an opus reticulatum wall in the Mausoleum of Augustus, G.B. Piranesi 1784, vol. 2, pl. LXXI and (right) the tools and machinery he assumed to be involved in erecting the roman ashlar wall of Cecilia Metellia’s tomb. Id., vol. 3, pl. XLVII.

The conclusion is that both the mind and the perception of the educated masses were well equipped to understand the message behind Piranesi’s illusionistic and rhetoric palimpsests as a serious scientific contribution. As a result of having used it to render his depictions, Piranesi serves as an excellent communicator of scientific and technical knowledge, a skill that he displayed to utmost perfection [18].

The reason behind the longevity of palimpsests, which have endured for at least a century and a half, seems to lie in their profound entrenched in the Baroque mentality. However, at the start of the 18th century, it was easy to detect a general shift in the ways scientific and technical information were being shared as graphic illustrations and consequently used to incite rational deductions. Palimpsests almost abruptly ceased to be used, and were quickly replaced by the “tableaux” and parallel, such as in the work of Durand and Sévres d’Agen. If Piranesi’s purpose was to harness knowledge, which he achieved by exploring spatial and symbolic depth incessantly on the same object, then the trend was changing to use more natural techniques such as establishing and comparing drawings of different samples. This challenged the validity of Piranesi’s work and propelled others to “deconstruct” his palimpsests. They were able to achieve this by unravelling the different elements that composed his previous illustrations. This resulted in a flatter, less dynamic product and lacked the depth of his previous works. This important observation helps understand the
rise of Rondel’s influence on architecture, as his techniques often masked and overshadowed the techniques used by Piranesi.

Jean Rondet’s Roman construction after Piranesi: from palimpsest to “tableaux”

Over the years, Piranesi’s contributions have become widely accepted as a valuable source to help understand classical Roman architecture and construction. Nowhere is this more evident than in Rondel’s treatise titled, *Treaté théorique et pratique de l’art de bâtre*. It is interesting to note that Rondel’s recognition of Piranesi’s influence scarcely appeared in early editions of his treatise, but rather in a later edition that was published in 1830. It can also be noted that research conducted by Middleton and Baudouin-Matuszek concluded that Rondel did not possess any books written by Piranesi in his library. As a result, Piranesi’s influence on Rondel’s work is surrounded by mystery [19].

Referring back to Rondel’s 1838 edition of his treatise, he is effective in acknowledging Piranesi’s contributions: “Le mérite des constructions romaines n’a peut-être jamais mieux apprécié que dans les magnifiques ouvrages de G.B. Piranesi” [20]. Rondel celebrated the pioneering approach of Piranesi and his ability to envision Roman construction, while those before him had only focused on a structure’s exterior. Rondel writes: “Depuis l’époque de la renaissance des arts jusqu’au temps de G.B. Piranesi, tous les auteurs qui ont publié les antiquités de Rome s’étaient exclusivement attachés à faire connaître les formes et les proportions des œuvres grecques et romaines, sans tenir aucun compte de l’appareil, non plus que de ces moyens cachés que les anciens mettaient en œuvre, pour procurer aux constructions suspendues, qui formaient le couronnement de leurs temples, l’union e la stabilité dont elles n’avaient que l’apparence” [21].

When comparing Piranesi’s engravings with those of Rondel, it becomes apparent that Rondel would carefully select elements and constructive details from Piranesi’s illustrations and present them in a new arrangement together in one engraving. It is noticeable that Piranesi had focused on architectural features such as dovetails and metallic cramps that reinforced the strength of a complex structure made up of different sections. These features also captivated Rondel, who devoted a double plate to show how Trajan’s Column was assembled by using several drawings from Piranesi [22].

In Rondel’s edition, in the section dedicated to “masonry”, the conductive components of an aqueduct are taken from work by Piranesi, and redrews to reveal how they are connected “par des crampons en fer, scellés en place” [23]. Rondel was fascinated by the technical advancements achieved by Roman stonemasonry, as it allowed for the creation of strong and stable joints that at the same time helped support the structure. Once again, Piranesi can be seen as a point of reference, as he demonstrated how Romans could link two stones by placing them on top of each other, “sans les secrçois des crampons ni des clefs de bois, par la forme seule de leur appareil.” Rondel recognizes his indebtedness to Piranesi: “Cet exemple, cité par Piranèse, est du théâtre de Marcellus à Rome” (Fig.3)[24].

The series of drawings of Cecilia Metella’s tomb provides one of the most complex and interesting examples of a constructive analysis on a work by Piranesi. Rondel borrowes from these several drawings. For example, when Rondel speaks of “apparel double, formé de pierres d’égaless dimensions”, he does so by citing a drawing in a “tableau” of Roman altar walls, which happens to be a reinterpretation of one of Piranesi’s palimpsests. Also, the discharging arches at this tomb with their prominent “tenons” are redrawn and employed by Rondel in one of his parallels dedicated to jack arches (Fig.3). On the other hand, the conical vault mentioned in the book on the “Emissario del Lago Albano”, as well as the interior elevation of the chamber that sits next to the Claudio Maxima appears in another parallel devoted to Roman arches and vaults (fig.4) [25].

Ancient Roman domes were the subject of another Rondel parallel, in which he displayed a partial elevation of the inner side of the Pantheon showing its apparent construction “pris dans l'ouvrage que le dernier (Piranesi) a publié sur ce monument”, a work that could be considered highly valuable, as “la vue seule des Figures peut suffire pour donner une parfaite intelligence des procédés” [26].

The French pensioners, as a link between Piranesi and Rondel

Previously, it was mentioned that in the first editions of Rondel’s treatise, almost nothing was said of Piranesi. The question remains: why had Rondel taken so long to mention Piranesi? Rondel displayed a “parallel” of the construction of ancient entablatures and pediments (Fig.4). When Rondel analyzed the metal joints represented here in the Porticus Octaviae, he commented that such an analysis would have been “observés par Piranesi” throughout its restoration and, as usual, goes on to render his own drawing based on Piranesi’s interpretation. Though at the same time Rondel, commenting on his plate, stated that the advancement of knowledge on Roman construction is due to the input of the pensioned French architects in Rome: “C’est à l’importance donné à l’observation des détails de construction dans les travaux de MM. les architectes pensionnaires de l’académie de France à Rome, que nous devons, sans doute, de pouvoir rapporter aujourd’hui de nouveaux exemples de l’enchainement des pierres dans les temples antiques, puisés dans les plus beaux ouvrages de ce genre encore existante en Grèce” [28].

Fig.3. J.B. Rondel’s rearrangement of details of Roman construction from Piranesi’s “palimpsest” in his 1817 treatise edition; (upper left) pl. XXX, section and details from the Theatre of Marcellus and the Theater of Pompey; (upper right) tomb of Cecilia Metalla in parallel with other buildings; (bottom, left) Piranesi originals (G.B. Piranesi, 1784, vol. 4, pl. XXIX, figs. 11 y III and Pompeo’s Theatre in Id., vol. 4, pl. XXXIII).

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Understanding roman construction before A Choisy: G.B. Piranesi and its influence on J. Rondelet

Fig. 4. Rondelet's rearrangement of details of Roman construction from Piranesi's "palimpsest" - the conical vault in Lago Albano from G.B. Piranesi 1764, (bottom left) and (bottom middle) details from Octavious portico from G.B. Piranesi 1784, vol.4, pl. XL, are respectively represented in Rondelet 1828-1830 parallels (vol.5, pl. XXXI and vol.7, pl. CXLIX) (upper left) depicting different Roman vaults and vaults and (upper right) ways of assembling lintels and pediments. (bottom right) Rondelet last "parallel" may partially be based on a similar parallel by Achille Leclère.

Rondelet specifically cites as sources for this parallel: the "envois" of Achille Leclère, J.F. J. Ménage and Vas Chempnutt [29]. If we look at the 1813 Achille Leclère's "envoi", that provided Rondelet with the details for the Pantheon portico, we see the usual rearrangement of a "modern" parallel. But also some reminiscence of Piranesi can be detected in the rendering of each individual building. In Piranesi drawings, every Roman-style building is defined by plans, elevations and cross-sections, usually accompanied by a three-dimensional architectural detail that focused a special feature of its method of construction (Fig.4).

This strategy is seen again in the drawing of Leclère in 1813 where he represented the elevation of the Pantheon as well as the three-dimensional piece that composes the corner of the pediment. Rondelet's own parallel also reproduces this feature.

In fact, the "envois" by some pensioned French architects in Rome often recall simplified versions of illustrations by Piranesi. Many of them seem to have had an interest in detailing Roman architectural construction and regarded Piranesi as a source. Some cases can be cited. One such example is Felix Duban's "Envoi" (1827), which depicts the Porticus Octaviae in a way that stays loyal to Piranesi's drawings (and at the same time recalls the Rondelet version). In 1831, Theodore Labrouste studied Piranesi's depictions of the Chora temple and replicated them almost exactly, and by doing so, stripped the images of any baroque tendencies, which resulted in putting more emphasis on the academic aspect where more control of light and shadow could be observed. All of these examples prove the theory that, indeed, the appreciation of Piranesi's studies of ancient Roman construction were spread throughout France in the beginning of the 19th century and esteemed by different architects, including Rondelet, and that Rondelet had documented these tendencies in the later editions of his treatise.

Summary

The main focus of this paper is to describe how the first stages of the studies on Roman construction implied a transferring of knowledge - from Piranesi to Rondelet - that had to cross a frontier between two cultural visions.

The first part will review how Piranesi, by contrasting Vitruvius's writings on ancient ruins with empirical evidence, was able to produce a fresh knowledge of Ancient Roman construction. Although this research was not very systematic, he provided to the eyes of his contemporaries a reliable, visual insight of many ancient works. This achievement may have been masked by his use of a complex graphical representation - drawings floating on deep illusionistic spaces, here called "palimpsests" - that, after an attentive examination, proved to be well adapted to late baroque culture and frequently used and well expanded since the middle of the 17th century in the scientific and technical literature.

In the second part of this essay, it becomes apparent that the findings of Piranesi on Ancient Roman construction were accepted and then later borrowed by Rondelet in his Traité théorique et pratique de l'Art de bâtir. This transfer of knowledge took place at the same time that the techniques in graphic representation of architecture shifted abruptly from palimpsests to a new "parallel" format, corresponding with a shift in scientific orientation - from baroque persuasive drawings focusing on the properties of a single object to neutral "tableaux" allowing the observer to compare and deduce.

References


[9] J. B. Rondelet, vol. 2, p. 8. "La Figure 1 de la Planche XI indique une manière de relier les pierres de taille les unes aux autres, sans le secours des crampons ni des clefs de bois, par la forme seule de leur appareil. Cet exemple, cité par Piranèse, est du théatre de Marcellus à Rome ". G.B. Piranesi, 1784, vol. 4, pl. LIX.

[10] Tomb of Cecilia in J.B. Rondelet, 1830-32, vol. 6, pl. LXV, fig. 1; discharging arch in Id., pl. XXIX, fig. 8; comical vault near Largo Albanese in Id., pl. XXXII, figs. 6-9; the inner wall of one of the chambers in Lago Albanese, Id., fig. 1, elevation of the Colonna Maxima, Id., fig. 8.


