

## Review of Roberto Gargiani, Concrete from Archeology to Invention 1700–1769: The Renaissance of Pozzolana and Ro...

Lynne Lancaster

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expands the range of possible prototypes to include not only Tuscan and Roman sources but also Gothic-style models from Lombardy. His discussion of Lombard models, including Milan Cathedral, San Petronio, Bologna, and especially Santa Maria del Carmine, Pavia, is particularly strong and provides an important contribution to a growing scholarly awareness of regional influences beyond Florence and Tuscany. The second part of the chapter turns to the model of Santa Maria del Fiore in Florence. Cohen's new survey of the cathedral reveals key dimensions whose patterns imply a proportional system, one that could have provided the "seed numbers" for the proportions used in both San Lorenzo and Santo Spirito (239). Yet, encountering significant irregularities, he also explores a different approach to precision in the medieval period and further investigates number theory in the following chapter.

Chapter 6 returns to the book's opening premise and to several aspects of Wittkower's arguments. Where Wittkower found stark period distinctions, Cohen, in emphasizing both a medieval interest in number and an enduring Renaissance reliance on geometry, instead identifies continuities. The development of fractional arithmetic was, nevertheless, a Renaissance innovation, marking a significant turn toward greater precision. Cohen engages recent scholarship, including that of Alfred Crosby and Lon Shelby, that recognizes the significance of applied mathematics as a point of intersection between theoreticians and practitioners, important both for advancing mathematical knowledge and for introducing complexity into architectural design.

Cohen seeks a broad understanding of the mathematical qualities of San Lorenzo's design. Medieval and Renaissance observers believed, he argues, that proportional systems could visually symbolize order and represent both strength and beauty. He advances an important proposal for the place of proportions in an age before structural calculations. Understood to convey structural stability, proportional systems played a rhetorical rather than functional role, serving as "invisible bearers of meaning and objects of belief" (275). Cohen then dwells further on his own methodology, which draws upon the disciplines of archaeology, art history, and architectural history. He situates his observation-based research as a rebuttal to Wittkower's inattention to the

object. This would be a strong conclusion to the book, but Cohen includes an epilogue in which he reiterates his argument against connecting proportional systems and beauty, and he rebukes modern observers for maintaining an illogical, mystical belief in the aesthetic qualities of proportions.

True to the book's title, Cohen's primary subject is architectural proportion. The author presumes a readership already well informed about San Lorenzo's history or ready to set aside many attendant issues, such as the construction chronology and the role of patronage. The book's structure requires patience, since, particularly with his meticulous analysis of dimensions, Cohen often reveals the direction of his arguments only at their conclusion. Not all aspects of the book equal the rigor of its metrical analysis. Cohen makes plain his reliance on earlier scholarship, but the historiographical context is not always clear; a lack of publication dates in the notes challenges the reader's ability to understand how the scholarly arguments have unfolded. A four-page appendix offers measured drawings of San Lorenzo and the Old Sacristy; however, the website offering Cohen's comprehensive survey results for San Lorenzo and Santo Spirito is inaccessible due to an outdated URL.

Cohen's rigorous and focused study suggests both the merits and the challenges of his methodology. His close attention to medieval and Renaissance mathematics brings added nuance to traditional periodization, contributes to a growing area of research, and offers important insights into the role of mathematics in early Renaissance design while enhancing our understanding of major monuments in the history of Florentine architecture.

ANN C. HUPPERT  
University of Washington

## Notes

1. Rudolf Wittkower, *Architectural Principles in the Age of Humanism* (London: Warburg Institute, 1949); Rudolf Wittkower, "Brunelleschi and 'Proportion in Perspective,'" *Journal of the Warburg and Courtauld Institutes* 16 (1953), 275–91.
2. The James Ackerman Award, administered by the Centro Internazionale di Studi di Architettura Andrea Palladio, recognizes excellence in the first book by a young scholar in architectural history.
3. Howard Burns, "Building against Time: Renaissance Strategies to Secure Large Churches against Changes to their Design," in *L'eglise dans l'architecture de la Renaissance*, ed. Jean Guillaume (Paris:

Picard, 1995), 107–31; Marvin Trachtenberg, *Building-in-Time: From Giotto to Alberti and Modern Oblivion* (New Haven, Conn.: Yale University Press, 2010).

Roberto Gargiani

## Concrete from Archeology to Invention 1700–1769: The Renaissance of Pozzolana and Roman Construction Techniques

Lausanne, Switzerland: École Polytechnique Fédérale de Lausanne (distributed by Routledge), 2013, 404 pp., 300 color and 16 b/w illus. \$115.95, ISBN 9782940222643

This book is part of a series titled *Treatise on Concrete*, which is edited by Roberto Gargiani and published by his university, the École Polytechnique Fédérale de Lausanne. *Concrete from Archeology to Invention 1700–1769*, authored by Gargiani, is the first of a group of works within the series that focus on the development of concrete during the eighteenth and nineteenth centuries in Europe. In the preface, Gargiani states that the book's goal is to document the evolution of construction techniques through archival research. Indeed, he presents a tremendous amount of material from treatises, old journals, personal letters, and state entities that are otherwise not easily accessible. In fact, large portions of the text consist of quotations (translated into English) from the archival sources. On the one hand, this is a useful service, but on the other, any sort of narrative is lost in the minutiae. The author's interest in the people who wrote the documents is reflected in his choice to index only proper names and not places or subjects. Nevertheless, the volume contains a wealth of valuable information if one is willing to mine for it.

The book begins with an exploration of the period when researchers were trying to discover the secret of the longevity of Roman concrete. Vitruvius's treatise offered a starting point, with its formulas for creating hydraulic mortar with *pulvis* (powder) from the Bay of Naples (Pliny the Elder's *pulvis Puteolamus*, powder from Puteoli—i.e., volcanic ash), but many people at the time believed that ancient craftsmen long before Vitruvius had created a type of mysterious artificial stone, *pietre fondue* (11–14). Gargiani notes that developments during the eighteenth century were marked by "an extraordinary mixture of scientific research and fantastic interpretation of sources and

ruins” (11). One might even see these competing approaches as a reflection of the contemporary conflict between faith and reason that was permeating European society.

An example of the mystical approach is that of Richard Holt, who firmly believed that both Egyptians and the builders of Stonehenge had invented artificial stones.<sup>1</sup> In 1722, he began to file patents for methods of creating artificial stone, which he called his “secret composition.” Gargiani reports from Holt’s treatise that the secret method involved a blast furnace, clays, glass, ores, and vitrified stone, which were used to create a substance that was poured into molds (225–30). Gargiani devotes five pages to this mysterious product, yet the reader is ultimately left with no explanation as to what it actually was. This is an early example in the book where a critical evaluation (and rational explanation) of the substance under discussion would have been valuable as a means of elucidating the understanding of material properties at that time.

In the second chapter, the author presents information on the various ingredients found in Europe and imported from afar that were used to produce hydraulic mortar, but he provides no explanation of the basic chemistry involved. Today we know that hydraulic lime mortar is created when slaked lime (calcium hydroxide) is combined with an additive containing soluble silica that reacts to form calcium silicate hydrate (C-S-H). A variety of materials can be used as additives (e.g., volcanic ash, terracotta, siliceous earths). Ironically, the chapter contains a section headed “Chemistry Research on Lime” (144–59), but it does not include this fundamental information. Another problem is that there is no coherent discussion of the terminology used, such as *cement*, *mortar*, and *concrete*. This is a complicated issue, because similar words have different meanings in different languages. The difficulty of translating cognates between languages is exacerbated by the fact that Gargiani wrote the book in Italian, many of his resources are in French, and someone else translated the manuscript into English. The unfortunate result is that the terms above are simply used interchangeably throughout the text.

These problems aside, the second chapter sets up the context of the pozzolana (volcanic ash) trade in western Europe during the eighteenth century. The two major

sources were pozzolana from central Italy and trass from Germany. Central Italy had two main products: red pozzolana from Rome, which was shipped from the port at Civitavecchia (under papal control), and gray pozzolana (*pulvis Puteolanus*), which was shipped from the Bay of Naples (under control of the Kingdom of Naples). In spite of the superiority of the Naples product, the pozzolana from Rome was the dominant Italian export and a major source of income for the Papal State (338). Trade was very much affected by politics. For example, the English navy was involved in trying to prevent the French, the largest importer, from acquiring the pozzolana needed for their building works. Gargiani traces some of the intricate deceptions undertaken by the French in their efforts to acquire what they needed (55–58). The second source, the German trass, a consolidated volcanic ash (tuff), was mined along the Rhine. Much of this stone was sent downriver to Holland, where windmill power was used to grind the stones to a powder that could be used to make hydraulic mortar. The Dutch then exported this powder to England, France, and Denmark, and even back to Germany. It is not surprising that some of the major researchers looking for alternative methods of making hydraulic mortar lived in countries like France (Jean-Étienne Guettard, Jacques-Germain Soufflot), England (John Smeaton), and Sweden (Axel Fredrik Cronstedt), which had to import the Italian and Dutch materials.

Throughout the rest of the book, Gargiani examines methods of using hydraulic mortar, with particular attention to the shift from using cofferdams (wooden structures built on riverbeds or seabeds and pumped dry) to caissons (floating wooden boxes that are sunk into place). He traces the developments through numerous case studies in Italy, France, Spain, and England. The one that reappears throughout the book is the project at Venice to protect the lagoon with levees (81–100, 186–205, 251–56). The techniques used before the eighteenth century involved wooden pilings and rocks, but with the invasion of the “shipworms” (*teredimidae*), which destroyed the wood, the Venetians began searching for new methods. Following experiments with earlier prototypes (81–100), in 1735 Bernardo Zendrini advocated for caissons filled with hydraulic mortar

(188), but first he had to find a mortar that would harden underwater. After trying local materials (“Vincenza pozzolana” and “Padua lime”), he realized that higher-quality pozzolana from Rome or Naples was required (191–92). Given the success of the project, the Venetian Republic set up administrative procedures to acquire the vast amount of pozzolana needed, most of which came from Civitavecchia (200–204). The exportation of Roman pozzolana increased so much during this period (1740–70) that the pozzolana quarry tunnels beneath Rome itself began to cause building collapses (51).

In 1756, John Smeaton was making his own mortar experiments with his friend William Cookworthy, a chemist, in preparation for rebuilding the Eddystone Lighthouse on the English Channel. They devised a method of testing various mortar recipes by employing different varieties of lime together with different types of pozzolanitic additives, including trass and pozzolana from Rome. The latter was a product rarely shipped to England, but by chance a merchant had purchased a load of pozzolana to sell in London (54–55, 309–17), and when his venture was unsuccessful, he sold it to Smeaton at the same price as the trass. Ultimately, Smeaton discovered that the Roman pozzolana and hydraulic lime from the local blue Lias limestone created the most effective hydraulic mortar. The lighthouse, completed in 1759, was the first major structure in England built with pozzolana mortar.

At the same time, Giovanni Battista Piranesi published *Le antichità romane* (1756), in which he first began to document Roman construction details. As Gargiani notes, “It is only with Piranesi that the *veduta* genre converges with the tradition of technical drafting of architects,” and this led to an even broader interest in ancient Roman construction techniques (258). The author also points out that Piranesi had worked in the office of the Magistrato alle Acque at Venice, headed by his uncle, where he gained direct knowledge of Zendrini’s work on the lagoon project, and proposes that many of Piranesi’s *vedute* in *Le antichità romane* were “secret commemorations” of what he had learned about concrete in Venice.

These are samplings of the narratives that I was able to tease from the text. I learned much, but the reading was difficult. Overall, the book lacks coherent organization and consists of impenetrable prose awkwardly translated from the Italian. Even more frustrating is the lack of critical commentary on the archival material, which is simply presented at face value, often leaving the reader with the impression that the opinions quoted, especially regarding chemistry and archaeology, are true in cases where we now know them to be wrong. The book is heavily illustrated with nicely reproduced color images of the archival drawings, but unfortunately the images are not referenced in the text. This volume provides a valuable resource, especially for those who already know the subject and the period and who are looking for documentary evidence, but readers of all types will find that extracting the information is a challenging endeavor.

LYNNE C. LANCASTER  
*Ohio University*

## Note

1. Gargiani points out that the desire to attribute the invention of artificial stone to the ancients can still be seen today (11n2). For example, as recently as 2008, Joseph Davidovits proposed that the limestone blocks of the Great Pyramid were artificially produced. Joseph Davidovits, *Geopolymer Chemistry and Applications*, 4th ed. (Saint-Quentin, France: Institut Géopolymère, 2008), 367–86.

Matthew M. Reeve, ed.

### **Tributes to Pierre du Prey: Architecture and the Classical Tradition, from Pliny to Posterity**

London: Harvey Miller, 2014, 288 pp., 129 b/w illus. €100, ISBN 9781909400122

“The classical tradition meanders in and out of the history of architecture, sometimes looping back upon itself as if to suggest that time has stood still,” Pierre de la Ruffinière du Prey notes at the opening of *Hawksmoor’s London Churches: Architecture and Theology*.<sup>1</sup> In that book, du Prey explores how the buildings of the early Christians, although known to Nicholas Hawksmoor only through texts and drawings, inspired the idiosyncratic Anglican churches that Hawksmoor designed in the early eighteenth century. The question of renewed

relevance that underpins du Prey’s Hawksmoor study, as well as much of his other work, also ties together the sixteen essays of *Tributes to Pierre du Prey*, edited by Matthew M. Reeve. One of the strengths of this Festschrift is its coherence.

An opening essay by Mark Wilson Jones lays out the stakes by posing a dual question: Why do the orders have the forms that they do, and why has that problem proven so intriguing for writers from Vitruvius to the present? He then surveys the various possible origins of three architectural elements—fluting, the Ionic capital, and the Doric frieze—to argue for a multivalent understanding of the orders. Although no single justification for the architectural form of the orders has been produced, Wilson Jones asserts that contradictory explanations can reinforce each other rather than cancel each other out.

The title of Guy P. R. Métraux’s essay, “Some Other Literary Villas of Roman Antiquity besides Pliny’s,” recalls du Prey’s book *The Villas of Pliny from Antiquity to Posterity*, a magisterial examination of the influence of Pliny the Younger’s letters on country house design.<sup>2</sup> Métraux supplies context for Pliny’s letters, which describe Tuscan and Laurentine villas, by describing the letters of Seneca the Younger, written about forty years before Pliny’s, and of Sidonius Apollinaris, written four centuries later. In placing Pliny within a broader ekphrastic tradition, Métraux shows how his letters belonged to but also criticized an epistolary genre. Mistakes of historical interpretation have fascinated architectural historians for so long that they have become their own genre: the Florentine Baptistery, an eleventh-century building that was believed in the Renaissance to be an ancient Roman temple, is the canonical example. In “The Tempietto del Clitunno and San Salvatore near Spoleto: Ancient Roman Imperial Columnar Display in Medieval Contexts,” Judson J. Emerick considers two other early medieval Christian buildings that have been similarly misinterpreted as ancient, including by Antonio da Sangallo the Younger and by Francesco di Giorgio. But Emerick does not end his story in the Renaissance; he discusses more recent efforts to place (or misplace) the buildings near Spoleto within particular historical contexts, in order to critique the practice of periodization itself as the most fundamental

type of misinterpretation. Eric Fernie’s essay, “Romanesque Historiography and the Classical Tradition,” reinforces this point. Fernie charts the meanings of the terms *romanesco* and *romanesque* as they have been applied variously for half a millennium.

The next two essays examine cases of formal recircling, or episodes in which specific architectural tropes have been deployed as explicit references to their own historical legacies. John Beldon Scott’s “Uses of the Past: Charles V’s Roman Triumph and Its Legacy” traces the route of the Holy Roman emperor’s entry into Rome that took place on 5 April 1536. Modeled on an ancient triumph, the event is the last one counted in Onofrio Panvinio’s 1557 chronology of Roman triumphs, a list that begins with Romulus. Scott shows how after the city of Rome was reshaped around the particular event of Charles V’s entry, the practice of the *possesso*, the papal triumph in which a new pope proceeds from Saint Peter’s to the Lateran, developed in response. Examining a set of events that took place on a single site over the next four centuries, he demonstrates how physical strata also accumulate the metaphorical weight of political overtones. For Scott, the *possesso* becomes the “living link” between Charles V’s triumph and Hitler’s entry into Rome in 1938. In “Classicism in a Rococo World: Steadfastness and Compromise in Late Colonial South America,” Gauvin Alexander Bailey considers how the orders themselves constituted another kind of link when certain forms popular in sixteenth-century Roman architectural practice were reused in seventeenth- and eighteenth-century South America. Focusing on projects by Giovanni Andrea Bianchi (1676–1740), who traveled from Rome to Argentina, and Giovanni Battista Primoli (1673–1747), who worked on the Paraguay Reductions, or mission towns, Bailey asks why models that were by then out of date in Rome, such as Serlio’s Doric order, were applied to new church façades. He argues that these models, rather than referring to specific historical moments, refer to “a more generic Golden Age,” that is, to Augustan Rome at the time of Christ’s birth (107).

Sally Hickson considers another shift in meaning in “Girolamo Porro: Engraver and Publisher in Venice,” which addresses the aims of sixteenth-century Venetian cartographic practices. Her point of departure is

Roman concrete is based on use of Pozzolana (volcanic ashes, in Latin language Pulvis Puteolana, so called because originates from Pozzuoli, Campi Flegrei near Naples, volcanic area). Other elements used are lime and (very important) sea water. Roman concrete technique is also much more labor intensive than modern techniques, which both require more time and cost significantly more. Finally, we have a broad range of concrete mixes these days, suitable for a variety of different applications. Roman concrete "good Roman concrete" basically has one good set of properties. From Roman Empire to Renaissance. 300-500 AD "Roman architecture." Roman concrete is not just waterproof; it's been found to actually become stronger when in contact with seawater. Scientists surmise that microscopic crystals grow in the ancient concrete when it's submerged in water, making it even less vulnerable to weathering. Though they still haven't fully pieced together the lost recipe, researchers know that volcanic ash pozzolana was fundamental to the strength of ancient Roman concrete. A recently announced project will experiment with similar volcanic ash off the coast of California to try reverse-engineer the process that created the most durable concrete. Construction - Roman achievements: It was from the Etruscans, who lived in the northern part of Italy, that the Romans derived much of their early building technology. The Etruscans, probably influenced by a few rare Greek examples in southern Italy, developed the true arch in stone. A late specimen of the 3rd century BCE is the Porta Marzia, an arched city gateway with a span of about 6 metres (20 feet), in Perugia. When mixed with lime, pozzolana forms a natural cement that is much stronger and more weather-resistant than lime mortar alone and that will harden even under water. These and other great Roman public spaces spanned by concrete domes and vaults made a major advance in scale over the short spans of the stone frame.

Roberto Gargiani (born September 1956) is an Italian architectural historian and a full professor at the [École Polytechnique Fédérale de Lausanne \(EPFL\)](#). [1]. Contents. In the mid-1990s he also focused his research on techniques, materials and structures of European Renaissance architecture, which resulted in a book on Italian architecture of the 15th century. In the early 2000s his research on contemporary architecture, in particular on Rem Koolhaas, Archizoom Associati and Superstudio, resulted in several monographic essays and an exposition. [3] In 2008, he was awarded with the ERC Advanced Grant for a research entitled "The surfaces of cement and reinforced concrete. Concrete, from Archeology to Invention 1700-1769, EPFL Press, Lausanne, Treatise on Concrete, 2013. The fascinating role that concrete played at the turn of the century, swinging from its unskilled applications to the birth of an architectural modernity, can be comprehensively described in the small case study of the history of Icelandic construction. Iceland's centuries-long physical and political isolation, together with its harsh climate, is reflected in a lack of an ordinary history of architecture. The first decades of the 20th century were a slow and non-violent struggle for autonomy and independence from Denmark, together with abrupt processes of modernisation and urbanisation of society, and introduced an essential debate into the country on how and what to build in order to represent itself. Concrete, from archeology to invention 1700-1769. R. Gargiani. Lausanne: EPFL Press. " Construction of a Vision " addresses the principles of construction from antiquity to the 18th century: the construction sites from Pharaonic Egypt to Gothic cathedrals; the principles of construction in antiquity and Renaissance; the history of architecture from the 16th to the 18th century. History of architecture III. The course covers the history of architecture between the 18th and 19th centuries, its greatest architects and its most important buildings, and highlights the technical and artistic issues involved. History of architecture V/VI. Concrete, From Archeology to Invention, 1700-1769: The Renaissance of Pozzolana and Roman Construction Techniques (Treatise on Concrete) 1st Edition. by. Roberto Gargiani (Author). Visit Amazon's Roberto Gargiani Page. Find all the books, read about the author, and more. See search results for this author. Editorial Reviews. About the Author. Roberto Gargiani obtained his degree at the University of Architecture in Florence in 1983 and completed his Ph.D. on the history of architecture and urbanism in 1992. He has taught the history of architecture in Florence, Rouen, Paris, Venice and Rome. He is now Professor of history of architecture and construction at the [École Polytechnique Fédérale de Lausanne \(EPFL\)](#). Product details. Hardcover : 404 pages.