

*LAPIS GABINUS:*  
TUFO AND THE ECONOMY OF URBAN CONSTRUCTION  
IN ANCIENT ROME

by

Jason Michael Farr

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy  
(Classical Art and Archaeology)  
in The University of Michigan  
2014

Doctoral Committee:

Professor Nicola Terrenato, Chair  
Professor Elaine Gazda  
Professor David Potter  
Professor Christopher J. Ratté

## **Dedication**

This dissertation is dedicated to my brilliant, patient, and supportive partner, Dana, and to the memory of my grandfather, Harry Bott, who first inspired my interest in history and archaeology.

## **Acknowledgements**

First, I would like to acknowledge and thank my advisor, Nicola Terrenato, for his support and encouragement over the years; without his assistance this dissertation would not have been possible. I would also like to thank the other members of my dissertation committee, Elaine Gazda, David Potter, and Christopher Ratté, for their helpful feedback and guidance, as well as Fabrizio Marra, who assisted with the collection of tufo samples and interpreted the results of their geological analysis. This work has been financially supported by the Interdepartmental Program in Classical Art and Archaeology, the Rackham Graduate School, and the Gabii Project.

## Table of Contents

Dedication.....	ii
Acknowledgements.....	iii
List of Figures.....	vii
List of Tables.....	x
Abstract.....	xi
Chapter 1: Introduction.....	1
Introduction.....	1
Aims.....	3
Summary and Methods.....	7
Terminology.....	9
Chapter 2: History and Archaeology of Gabii.....	11
Introduction.....	11
The View from Rome: Gabii in the Textual Sources.....	13
Archaeological Research at Gabii.....	38
Conclusions: Stone Extraction and the History of Gabii.....	48
Chapter 3: Quarries and the Roman Economy.....	51
Introduction.....	51

Methodological Approaches to the Quarry Economy .....	52
The Roman Tufo Industry.....	80
Conclusions: The Economy of Tufo.....	103
Chapter 4: <i>Lapis Gabinus</i> : The Stone, the Quarries, and Related Archaeological Features .....	106
Introduction.....	106
Geological Background and Stone Identification .....	107
The Quarries.....	108
The Gabii Project Excavations.....	115
Conclusions.....	122
Chapter 5: Building with Lapis Gabinus: Catalogue of Ancient Monuments .....	125
Introduction.....	125
Lapis Gabinus at Rome .....	127
Lapis Gabinus in the Eastern <i>Suburbium</i> .....	146
Lapis Gabinus at Gabii.....	158
Conclusions.....	163
Chapter 6: The Operation of the Quarries .....	169
Introduction.....	169
The Extraction Process .....	169

The Transportation Process.....	172
Labor .....	182
Seasonality and Cyclicity.....	190
Ownership .....	196
Chronological Development .....	199
Conclusions.....	207
Chapter 7: Conclusions .....	210
Lapis Gabinus and Rome: The Economy of Urban Construction .....	210
Lapis Gabinus and Gabii: Suburban Economic Development and the Decline of a Latin Town .....	212
Appendix: Discussion of Sampling and Trace Element Analysis of <i>Lapis Gabinus</i> .....	215
Figures .....	218
Tables.....	251
Bibliography .....	253

## List of Figures

Figure 1: Location of Gabii and other quarries in relation to Rome.....	218
Figure 2: Aerial view of Gabii from the south.....	219
Figure 3: Denarii of C. Antistius Reginus and C. Antistius Vetus. ....	220
Figure 4: The “forum” discovered by Hamilton in 1790’s.....	220
Figure 5: Temple of Juno Gabina, Gabii .....	221
Figure 6: Santuario Orientale, Gabii.....	221
Figure 7: Photomosaic of Gabii Project Excavations .....	222
Figure 8: Results of the magnetometry survey of Gabii.....	222
Figure 9: Chronological tufo use according to Frank (1924). ....	223
Figure 10: Map of the <i>lapis Gabinus</i> quarries created by F. Piccarreta (1981).....	224
Figure 11: “Corner” quarry along the edge of the crater .....	225
Figure 12: Indications of large block removal at the quarry in figure 11. ....	226
Figure 13: Quarry faces within the crater .....	227
Figure 14: Road cut into the bedrock north of the city.....	227
Figure 15: Small outcrop in northern quarry zone, with visible pick marks. ....	228
Figure 16: A typical quarry face. ....	228
Figure 17: Steps cut into quarry faces reveal the manner of extraction.....	229
Figure 18: Trenches outline emerging blocks.....	230
Figure 19: Extraction of blocks on an angle, to preserve more of the remaining stone. ....	231

Figure 20: Quarry faces east and north of the medieval tower .....	232
Figure 21: Quarry face along the eastern edge of the extraction zone.....	232
Figure 22: Quarry face along the eastern edge of the extraction zone.....	233
Figure 23: Outcrop within large extraction zone. ....	233
Figure 24: Map of the quarries at Gabii indicating sample locations .....	234
Figure 25: Results of trace element analysis.....	235
Figure 26: Excavated quarry face. ....	236
Figure 27: Trial quarry pit.....	237
Figure 28: Quarry debris field within Gabii Project Excavations.....	238
Figure 29: Quarry Debris field.....	238
Figure 30: Extraction of blocks on an angle. ....	239
Figure 31: Iron wedge found in excavation of Area E.....	239
Figure 32: Crucible slag excavated from Area B.....	240
Figure 33: Tabularium façade facing the Roman Forum.....	240
Figure 34: Lapis Gabinus in the foundations on the north side of the Tabularium .....	241
Figure 35: Pons Fabricius. ....	241
Figure 36: The Porta Viminalis (in the foreground). ....	242
Figure 37: The Porta Viminalis, with a stretch of Servian wall which includes <i>lapis Gabinus</i> . 242	
Figure 38: The tabernae in the Forum of Caesar, with <i>lapis Gabinus</i> piers and flat arches.....	243
Figure 39: Results of trace element analysis of stone samples from Roman monuments.....	244
Figure 40: Pons Aemilius: Detail of eastern surviving arch with <i>lapis Gabinus intrado</i> .....	245
Figure 41: The Forum of Augustus and the Temple of Mars Ultor.....	245
Figure 42: <i>Lapis Gabinus</i> blocks in the apses of the Forum of Augustus .....	246



Figure 43: Lapis Gabinus staircase at Sant’Omobono.....	246
Figure 44: Distribution of sites with lapis Gabinus along the via Praenestina .....	247
Figure 45: The Ponte di Nona, constructed largely with lapis Gabinus. ....	247
Figure 46: The Ponte Amato, about 8 kilometers east of Gabii.....	248
Figure 47: Early structures in Area D, composed of local stone. ....	248
Figure 48: Mid-Republican retaining wall at Gabii composed of lapis Gabinus. ....	249
Figure 49: Mid-Republican retaining wall (right) with monumental staircase at left.. ....	250

## List of Tables

Table 1: Alleged <i>lapis Gabinus</i> use in and around Rome.....	251
Table 1: Large-scale projects using <i>lapis Gabinus</i> and the probable dates of associated stone quarrying.....	252

## Abstract

In this dissertation I consider the role which tufo quarries played in the economy of urban construction at Rome by analyzing, in detail, one such quarry just east of the city—that which produced *lapis Gabinus*, a building stone used widely at Rome in the first century BCE. The principal evidence for this analysis consists of the remains of quarry faces at Gabii, associated archaeological features, and the distribution of the stone in extant Roman monuments. Wherever possible, petrographic analyses were utilized to confirm the presence of *lapis Gabinus*, which has been misidentified in the past. I use this evidence to develop a picture of the scale, organization, and techniques of the production and transportation of *lapis Gabinus* blocks. In addition, I explore methods of quantifying the cost of stone quarrying, in terms of manpower, in order to assess the economic significance of the quarries more generally. I demonstrate that the use of *lapis Gabinus* was influenced by a number of factors, including the decline of the town of Gabii, Roman knowledge of the stone's physical characteristics, and the ease with which it could be transported by river to the capital. Moreover, processes of *lapis Gabinus* extraction and transportation played a large role in tying Rome to the countryside and highlight the intersection of stone quarrying with other industries in the wider economy.

While most studies of Roman stone quarrying focus on imperial involvement and on marbles and other fine decorative stone, by reconstructing the processes of extraction and transportation for the *lapis Gabinus* quarries I provide insight into the everyday working of a production site which is more representative of stone extraction across the empire. At the same time, *lapis Gabinus* appears in some of the most significant Roman monuments of the first

century BCE, and the organization of its production therefore has implications for Roman public architecture more generally. This approach exposes in greater detail the dynamics of the construction industry in the Late Republic and provides a unique lens with which to view the economic ties between Rome and its immediate hinterland.

# Chapter 1: Introduction

## Introduction

The study of monumental stone architecture has always been fundamental to the study of Roman archaeology. Yet, until fairly recently, far less attention had been paid to the sources of the most durable materials used for construction—stone quarries—and their role in the overall building industry. This is due in part to the lack of evidence for ancient stone extraction, a process which progressively destroys all traces of itself. In Italy, for example, Roman quarry faces at Carrara and Tivoli are few and far between, destroyed by Renaissance and modern extraction which continues to this day. Elsewhere in the Mediterranean, Roman quarries have fared somewhat better; the porphyry and granite quarries of Egypt, for instance, are well-published and have provided a great deal of information on the techniques and organization of stone extraction. At Mons Porphyrites and Mons Claudianus in the eastern desert, archaeological survey and the recovery of documentary papyri have revealed a vast and expensive imperial organization which extracted and transported tons of blocks and columns to Rome in the late first and second centuries CE.<sup>1</sup> However, these quarries (and others like them) provide a very lopsided view of the stone trade, one which is constrained chronologically and privileges state involvement over other economic forces. It also over-emphasizes the role of imported luxury stone in Roman construction, ignoring the more mundane, unpolished blocks which often

---

<sup>11</sup> Maxfield and Peacock 1997; 2001; Bülow-Jacobsen 2009.

constituted the bulk of ancient monuments and which were absolutely crucial in the construction industry.

In this dissertation, I examine the extraction and consumption of one such mundane stone: *lapis Gabinus*. *Lapis Gabinus* is a kind of tufo (known in English as tuff), a pyroclastic stone produced as a result of volcanic explosions which can be found throughout much of Italy. Tufo forms when great amounts of gas, magma, ash, and other materials flow down from volcanoes, settle, and eventually consolidate, forming mineral cements which harden the components into what is frequently a suitable building material. Tufo is therefore a composite rock made up of these various materials—ash, crystal, lava, mineral cements, and pieces of other types of rock. It is relatively easy to cut (compared to harder stones such as marble) yet still moderately durable and able to bear a great deal of structural weight, making it an ideal material for construction. It has been used for construction in many parts of the world and in various periods, and was especially significant in ancient Rome, where builders were able to take advantage of at least seven distinct tufo deposits in the region. *Lapis Gabinus* was quarried from one such deposit located in and around the Latin city of Gabii a mere 18 kilometers from the capital (see figs. 1 and 2). Gabii had come to prominence in the mid-first millennium BCE as a rival to nearby Rome, but over the subsequent centuries the city seems to have suffered a long, slow decline until the first century BCE, when Dionysius of Halicarnassus saw only a few inns and vast ruins.<sup>2</sup> It is around this same time, however, that *lapis Gabinus* became an important building material, appearing in large amounts in major public monuments at Rome such as the Tabularium and the Forum of Augustus. It has been identified in the cut-stone (ashlar) masonry of thirteen major building projects within the capital, several outside the city, and a number of smaller buildings and monuments in the region.

---

<sup>2</sup> Dion. Hal. 4.53. The history of Gabii is more fully presented in the next chapter.

In fact, various kinds of tufo had been instrumental in construction from the earliest periods of stone architecture in Italy. At Rome, most monuments of early or mid-Republican date were built almost completely with blocks of various types of tufo, and after the use of travertine, marble, and other decorative stones spread at the end of the Republic, builders continued to utilize the stone for structural elements and foundations, as can be seen in the *lapis Gabinus* piers of the *tabernae* in the Forum of Caesar.<sup>3</sup> Even with the adoption of concrete as the premier building material, tufo remained essential for wall facing and aggregate. The concrete walls of the immense Baths of Caracalla, for instance, contained an estimated 340,800 cubic meters of tufo, the production of which may have accounted for nearly 20% of total materials production costs.<sup>4</sup> In addition, while we have less evidence for private construction, tufo must have been relied upon for domestic architecture and other private projects, as a first century CE law mandating its use suggests.<sup>5</sup>

The tufo industry was clearly a vital component in the economy of urban construction at Rome throughout the history of the city. However, while recent research has highlighted the importance of such stone in extant monuments,<sup>6</sup> quarries themselves remain largely unstudied, and as a result, the tufo industry as a whole is not well-understood; we know very little concerning the techniques, scale, and organization of stone extraction and transportation. Who was involved in this industry? Did the state play a major role as it later did in marble extraction? How far was stone transported? How significant were individual quarries? What effects did Rome's need for tufo have on its hinterland? This was a crucial local resource, but the archaeological scholarship has all too often overlooked its production.

---

<sup>3</sup> Amici 1991; Jackson and Marra 2006; see further chapter 5.

<sup>4</sup> Delaine 1997, 122-128.

<sup>5</sup> Tacitus *Ann.* 15.43; see further chapter 2.

<sup>6</sup> Jackson and Marra 2006.

## **Aims**

The tufo outcrops at Gabii are some of the best preserved of the Roman quarries, due to the contraction and abandonment of the ancient city in early imperial times and the apparent cessation of large-scale extraction. They provide a unique window onto the Roman tufo industry in the first century BCE, when the most intensive extraction took place. The central aim of this dissertation is to fully describe the production, transportation, and consumption of *lapis Gabinus*, and to situate the exploitation of this resource in the economy of urban construction at Rome. The principal evidence for this analysis consists of the remains of quarried stone faces at Gabii, associated archaeological features, and extant Roman structures in which blocks of *lapis Gabinus* can be found. Remains at Gabii were investigated in conjunction with the Gabii Project, an international research initiative charged with the excavation and study of the ancient city. As part of this project, the visible quarry faces were examined and documented. Quarry faces were also uncovered in the Project's excavations, along with associated features and artifacts, providing further data and, importantly, greater chronological control. This evidence provides a picture of the scale, organization, and techniques of *lapis Gabinus* production. Consumption, on the other hand, is approached with an analysis of the distribution of the stone as found in Roman construction, confirmed wherever possible with petrographic analysis. In addition, this dissertation explores methods of quantifying the cost of tufo quarrying, in terms of manpower, in order to assess the economic significance of the quarries more generally. Supplementary and comparative evidence is drawn from the ancient texts (which only rarely address ancient quarrying, or indeed the city of Gabii) as well as archaeological studies of other ancient quarries.



Broadly speaking, I use this evidence to reconstruct an understudied sector of the Roman economy and explore its significance. By examining the structures that include *lapis Gabinus*, the quarries at Gabii, and the potential transportation networks between the two, I hope to illuminate aspects of urban construction which are too often overlooked in studies which give priority to luxury stones extracted from imperial quarries. There are many such studies, which will certainly inform my analysis of the quarry economy and which have greatly increased our understanding of the trade in stone. For example, since the imperial government spent vast sums to move decorative stone great distances, the so-called “marble trade” can inform us of the demonstrably larger scale of industry possible under the Roman Empire as compared with previous periods, and can illustrate the potential for economic growth at this time. However, imperially owned quarries, which extracted most such luxury stone, made up only a small percentage of all stone quarries in the empire. If we wish to better understand the economy of urban construction, we cannot ignore the extraction of more ordinary types of building stone, sometimes termed dimension stone, more commonly quarried across the empire by non-imperial agents. Scholars of ancient stone have begun to recognize this, but surprisingly, the local tufo industry of Rome itself has been largely ignored.<sup>7</sup> My focus on one such tufo, *lapis Gabinus*, is intended to contribute to a more balanced view of stone in the building industry of Rome.

A second goal of this study is to use *lapis Gabinus* as a way to explore more broadly the changing relationship between the city of Rome and its immediate hinterland. Exploitation of this stone reached its height in the first century BCE, when Rome had already begun to draw resources from nearly the whole of the Mediterranean world. The city’s hinterland remained essential, though, especially for perishables and for goods too heavy for feasible long-distance transport. *Lapis Gabinus*, quarried 18 km away, fits the latter category, along with other building

---

<sup>7</sup> Russell (2009, 2013), especially, suggests a broader view of the stone trade.

materials, and analysis of the industry can provide insight into the social and economic relationships that characterized this territory and tied it to the capital. S. Graham, for instance, has shown how the local brick and tile industry documents such relationships in the Tiber valley during the first three centuries CE.<sup>8</sup> Already in the first century BCE, however, these economic and social ties were already changing dramatically, adjusting to the greater influx of long-distance goods to Rome and to the proximity of such a large, and still growing, metropolis.<sup>9</sup> The city of Gabii declined notably around this time, as did other nearby centers. They have long been considered casualties of these changes, but few studies have tackled the thorny issue of just how this occurred. The city of Gabii and the *lapis Gabinus* industry provide a point of entry to investigate these city-hinterland issues. What major economic changes took place? What role did transport networks play? To what extent did the presence of natural resources mitigate, or alternatively, exacerbate, these developments? How much were such resources depleted? From where was labor drawn, and how were settlement patterns affected? The quarries at Gabii allow for a detailed case-study investigating these questions.

In addition, the rise of more powerful (and ultimately imperial) families at this time would have had its own effects on social and economic relationships in the *suburbium*. The first century BCE was a period of vast political transformation, and *lapis Gabinus* is found in many monuments commissioned by the authors of this transformation, from Sulla to Augustus. The quarries, producing stone which was essential to the buildings on which the profits of empire were spent, must have attracted their interest. The *lapis Gabinus* industry can provide insight into the rise of these families, and, later, to the ability of the imperial family to command or otherwise

---

<sup>8</sup> Graham 2006.

<sup>9</sup> See Morley 1996.

acquire the use of resources in the city's hinterland. In this way, my thesis has relevance for Roman imperialism and the power of the state in the first century BCE more generally.

The study of *lapis Gabinus* and the quarries whence it came therefore has the potential to shed light on several historical issues currently of interest to scholars of ancient Rome. My main focus, however, remains economic. It has become clear that what we conveniently label “the Roman economy” belies a complexity which is difficult to describe, much less analyze. While the economy of the ancient world was very clearly agrarian at its core, increasingly scholars are recognizing that non-agricultural activity, including the extractive and construction industries, merits further attention.<sup>10</sup> But important questions remain. How significant could such industries be, in light of the centrality of food production? How might they have been structurally related to agriculture? What role can quantification play in our research, in light of the inherent uncertainties in extrapolation from archaeological data? In examining the economics of *lapis Gabinus*, I hope to address such questions, and in particular to show the advantages of using careful and considered quantification in answering questions about the ancient economy. On a higher level, we might ask how tufo quarrying and other non-agricultural production fits into larger markets, or whether a unifying concept of a singular “Roman” economy is even feasible. D. Mattingly has suggested thinking in terms of plural “economies” in order to model more accurately the structure and performance of inter-related local, regional, and empire-wide trade networks, which involve potentially very different economic mechanisms.<sup>11</sup> Such theories must be grounded in archaeological data, and the trade in building stone, which operated on similarly various levels, makes an ideal case study for testing these ideas.

---

<sup>10</sup> See, e.g., Mattingly and Salmon 2001 (for a summary of the non-agricultural economy), Delaine 2001 (for construction), Rihll 2001 (for coinage), Wilson 2001 (for textile production).

<sup>11</sup> Mattingly 2011, 138-145.

In sum, I hope to provide insight into one important yet largely hidden aspect of the Roman economy—or at least, one of Rome’s economies. The tufo industry has been an economic blind spot for too long, and by bringing it to the fore perhaps other industries, similarly hidden, will begin to receive the attention they merit.

## **Summary and Methods**

The overall aim of this dissertation is to illuminate aspects of the Roman economy. In practice, this involves addressing a number of much more specific questions about the city of Gabii, about the economics of the building industry, and about the extraction, transport, and use of *lapis Gabinus*.

Such a goal requires first an assessment of past research on Gabii and the *lapis Gabinus* quarries. In Chapter 2 I provide this background, briefly describing the history of Gabii as it is known from literary sources and from archaeological and epigraphic discoveries, and identifying problems and gaps within this scholarship. Economic considerations are more fully explored in Chapter 3, where I review past research on the economics of Roman quarrying in order to establish an analytical framework with which to assess the *lapis Gabinus* industry. I discuss the evidence for Roman quarrying and its organization, and consider how scholars have approached this material in the past. The chapter ends with an overview of the local *tufo* industry of Rome, which has not yet received a comprehensive scholarly treatment.

Chapters 4 and 5 form the core of the dissertation, in which I focus on the direct evidence for *lapis Gabinus* quarrying, transport, and construction. In Chapter 4, I introduce the geological background for the stone and present the new archaeological evidence for quarrying at Gabii itself. This data allows for an analysis of extraction techniques, quarry morphology and

organization, stone transportation, and chronology. Understanding these basic components of the industry is necessary before asking the broader questions posed in later chapters.

While Chapter 4 focuses on the production of the stone, Chapter 5 addresses its consumption, presenting a catalogue of buildings and monuments in which ashlar *lapis Gabinus* is to be found, confirmed wherever possible by trace element analysis. In analyzing this distribution I ask a number of questions: what is the scale of the *lapis Gabinus* industry? How, specifically, was the stone used in construction? What were the likely transport routes? Who had access to the stone? Is it limited to public or state construction? When and for how long was it in use? The answers to such questions have important ramifications for the economy of urban construction at Rome and for the organization of quarrying at Gabii itself.

In Chapter 6 I discuss the operation of the quarries in light of this new evidence, addressing the labor, capital, and infrastructure required at Gabii for the scale of production apparent from the list assembled in Chapter 5 and in view of the archaeological material from Gabii. For example, minimum quantities of stone extracted within a given period, as provided by the catalogue, are used to estimate the minimum number of active quarry workers. I also consider who exactly may have owned, operated, and otherwise worked in the operations. My aim is two-fold: (1) to situate quarrying at Gabii in a local production context and (2) to integrate an investigation of the technology and economy of extraction and transportation with consideration of the social conditions and relationships involved. Too often tufo extraction is viewed only from Rome, and from a technological perspective, ignoring the social context of production. Like all industrial processes, quarrying does not occur in a social vacuum, and quarry workers are not automata mindlessly extracting raw materials for economic consumption in Rome. Reconstructing the social organization of production from material remains is

challenging, but the evidence provided, as well as comparative material from the Graeco-Roman and early modern world, allows for provisional conclusions to be drawn.

In sum, I consider the place of *lapis Gabinus* in the larger Roman economy of urban construction, as well as the implications of this research for broader social-historical questions. By comparing the quarrying and distribution of the stone with that of other varieties of tufo prevalent in Roman buildings, I question long standing assumptions about availability and chronology. This entire industry should in fact be seen in the context of the complex social and economic relationships tying the city of Rome to its immediate hinterland. Finally, I suggest that *lapis Gabinus* and its quarries played a major role in the changing relationship between Rome and Gabii, in particular the perceived decline of Latin towns in the late Republic and early empire.

## **Terminology**

Before proceeding further, a few notes on terminology are needed. Broadly speaking, archaeologists often use the term “marble” to denote any kind of stone that can take a high polish, including granites, porphyries, and other non-metamorphic rocks that are not geological marbles. While this is a convenient shorthand, I have preferred to use either more scientifically accurate terms or, when referring to such types as a group, more inclusive terms such as “decorative stone” or “luxury stone”. In addition, the Italian “tufo” is generally used to refer to the general type of stone of interest here when it appears in the Roman world. In English, this kind of stone is known as a tuff, and I occasionally use these terms interchangeably as called for by the context. However, in English-language archaeological scholarship, especially older scholarship, “tufa” is sometimes used to describe this kind of stone. As several more recent

scholars have noted, however, geologically tufa refers to a completely different sedimentary rock, a kind of limestone that is not produced volcanically like tufo.<sup>12</sup> I echo these scholars in asking that the distinction be kept in mind and the term avoided.

The different varieties of tufo have naturally been given various Italian names, some of which can refer to multiple, geologically distinct rocks from different deposits. For instance, sperone can refer to stone from Gabii or from Tusculum to the south, and peperino has been used of *lapis Gabinus*, *lapis Albanus* from the Alban hills, and even cappellaccio from the center of Rome. Cappellaccio itself refers to at least two distinct types of tufo. I have avoided such terms wherever possible, preferring those names based either on quarry location (e.g., *lapis Albanus*) or on accepted geological nomenclature (e.g., tufo rosso a scorie nere, tufo lionato). Many of these terms and conventions are further discussed in chapter 3.

---

<sup>12</sup> Gazda 2001, 164 (n. 4); Lancaster 2005a, 12; Jackson and Marra 2006, 405.

## Chapter 2: History and Archaeology of Gabii

### Introduction

Quarry activity at Gabii was inextricably linked to circumstances at the adjacent settlement. Assessing the significance of the *lapis Gabinus* quarries therefore first requires a diachronic understanding of historical and social conditions at the city. Though the entire lifespan of the site is relevant, the peak extraction period—the first century BCE—is especially so.

In this chapter I address the history of Gabii as it can be reconstructed from textual, archaeological and epigraphic sources. While there are relatively few references to Gabii in the ancient sources, and systematic archaeological fieldwork at the site has been somewhat limited, scholars have nevertheless used such data to provide an historical narrative for the city. In this narrative, the city reached its height as an independent Latin center in the mid-first millennium BCE, after which it came into conflict with and was subsumed by an expanding Rome, declining to near-abandonment by the Imperial period. My main goal in reviewing this body of work is to identify problems and gaps within this narrative and to demonstrate how a study of the quarries at Gabii can help address them. In particular, the state of Gabii in the late Republican and early Imperial periods—precisely the period when the intensity of quarrying at the site is greatest—is imperfectly understood. I will show that *lapis Gabinus* played a more important role in this later history than is generally recognized.



With this goal in mind I present first the historical and literary sources which have traditionally formed the basis of the city's history. These texts are sometimes remarkably informative, but seem often to have been taken at face value, producing an oversimplified narrative that has diverted attention from potentially more meaningful analytical approaches. This is especially true for the era beginning in the late Republic, when the unqualified decline of the city presented in contemporary texts has been largely accepted as the defining characteristic of the period. Such a view seems to me to be grounded as much in elite Roman attitudes toward Gabii and toward the past more generally as in contemporary circumstances at the site. Analyzing these same sources from an economic perspective, on the other hand, provides for insight into the new role of Gabine territory as a source of resources, services, and elite residences for the ever-growing metropolis of the imperial capital. Hints as to exactly *how* this transformation occurred remain neglected by scholars.

In the second part of this chapter I provide a summary of previous archaeological research at Gabii. Until recently, however, archaeological research at the site had been limited, with only a few systematic surveys and excavations completed in the last half century. The quarries of *lapis Gabinus* themselves have been largely ignored. Plenty of work therefore remains to be done at Gabii, but the results of excavation, field survey, and geophysical investigation provide a perspective complementary to the narrow view provided by the texts, allowing for a better understanding of the social conditions under which quarrying at the site was undertaken.

## The View from Rome: Gabii in the Textual Sources

At first glance, Gabii seems to be well-represented in the ancient texts. Livy and Dionysius of Halicarnassus provide an historiographical perspective on early relations between Gabii and Rome, while Augustan poets like Horace and Propertius describe the decrepit state of the city in their own time. Additional sources, such as the speeches of Cicero or the biographies of Plutarch, provide the occasional anecdote. Such texts have been used in past attempts to distill a coherent historical narrative for Gabii, in particular concerning its relationship with Rome.<sup>13</sup>

These attempts are fraught with difficulty. For one thing, references to Gabii are typically brief, and were not necessarily intended as accurate, narrative depictions of an historic past. The narratives that we do have were written in the late first century BCE, describing events up to five hundred years earlier. Though they rely in part on lost works by earlier historians, there remain roughly three hundred intervening years of oral tradition, filled with some amount of “creative storytelling”.<sup>14</sup> While few of the specific details can be accepted unambiguously as historical fact, such stories may preserve more general memories of events, which can provide some idea of general historical circumstances.

In addition, the texts present a narrow, elite Roman perspective in which Gabii is frequently used for symbolic or rhetorical purposes. Gabii’s past seems to have become a powerful memory which could be evoked for dramatic effect in poems, speeches, and even on coinage. While these appropriations of the city’s history may occasionally lead us to suspect the historical accuracy of the texts, they also provide us with invaluable insight into how later Romans, in the first century BCE and first century CE, thought about Gabii. This coincides

---

<sup>13</sup> E.g., Bruun 1967, Palmer 1990.

<sup>14</sup> Wiseman 2008, 310. In general, I hold with Wiseman’s view of pre-literary Roman oral tradition, which does not “hand down the memory of events”; it elaborates, recycles, omits, invents, creates a succession of stories for a succession of audiences with ever-changing priorities (310)”.

almost exactly with the most intense period of stone quarrying at the site, and it is in this way that the texts purporting to describe earlier periods are relevant to this study. The most useful accounts even comment directly on the contemporary material and social conditions of the city in the first century BCE, allowing for some speculation concerning the local economy and the stone quarries themselves. As a whole, then, the textual sources possess an overlooked potential to shed light on this later period at the city.

### *Archaic and Early Republican Gabii: Legend and Myth*

Several traditions exist concerning the early history of Gabii. The Romans themselves traced the city's antiquity far into the past, and appear to have held the city in high regard. Solinus notes that the city was founded by the Sicels, though other sources maintain that it was a colony of Alba.<sup>15</sup> Plutarch and Dionysius indicate that it is to Gabii that Romulus and Remus were taken as children, there to be educated in the Greek traditions, including literature, music, and combat.<sup>16</sup> This story ascribes a certain prestige to Gabii and may preserve a vague memory of the city as a locus of international culture; its resident elites were perhaps taking part in the same cultural changes sweeping the Italian peninsula in the first millennium BCE. In any case, the tale reinforces a Roman's sense of Latin identity and connects this with a Greek heritage, while imbuing the city with a sense of authority and antiquity. Its survival suggests that Gabii was a convenient image with which to reify the relationship between the Latin and Greek past and the Roman present.

Interestingly, two early inscriptions found at Gabii also suggest the influence of Greek culture. One of the earliest Greek inscriptions known was discovered during excavations at the

---

<sup>15</sup> Solinus 2.10

<sup>16</sup> Plutarch *Life of Romulus* 6, *De Fortuna Romanorum* (*Moralia* IV 23); Dionysius 1.84. Also to be found in the late 4<sup>th</sup> century CE *Origo Gentis Romanae* 21.

Iron Age cemetery of Osteria dell'Osa at Gabii, on a local vessel included as a grave good in the tomb of a woman dating to ca. 770 BCE.<sup>17</sup> The inscription reads either *eulin* or *euoin* and probably relates to weaving.<sup>18</sup> A later vessel (mid-to-late seventh century), locally produced and imitating a Greek *dinos*, has a Latin inscription similar to symposiastic toasting expressions, perhaps suggesting the practice of certain Greek social customs.<sup>19</sup> At any rate, these artifacts clearly attest to some sort of contact with the Greek world, even if the exact circumstances remain murky.

Livy and Dionysius provide us with more detailed historical narratives. Both describe the confrontation between Rome and Gabii toward the end of the monarchy, at the conclusion of which Gabii appears to have come under Roman sovereignty.<sup>20</sup> These accounts document prolonged hostilities in which the people of Gabii were often rather successful; Dionysius claims they plundered up to the walls of Rome. Finally, Sextus Tarquinius is said to have infiltrated Gabii pretending opposition to his father, Tarquin the Proud. Sextus sends to his father for instructions, and Tarquin's only reply is to cut the heads off the tallest poppies in his garden. Sextus accordingly slaughters the most prominent men of Gabii, and the town is handed over "unresisting" to Tarquin, who appoints his son as king. Dionysius also includes the tale of Antistius Petro, the most distinguished statesman of Gabii, framed by Sextus and brutally stoned by his own people as a result. Livy claims that later, after Tarquin is expelled from Rome, Sextus attempted to return to Gabii but was assassinated upon arrival.<sup>21</sup> According to Dionysius,

---

<sup>17</sup> *Editio princeps* in Bietti Sestieri, De Santis, and La Regina 1990; see also Peruzzi 1992; Ridgeway 1994; Holloway 1994; Watkins 1995.

<sup>18</sup> It has also been suggested that the inscription is not in fact Greek, but rather a proper name in Etruscan or one of the other Italian dialects; see Holloway 1994, 112.

<sup>19</sup> Colonna 1980, Peruzzi 1992, 1995.

<sup>20</sup> Livy 1.53-54; Dio. 4.53-8; the story is also retold in verse by Ovid (2.689-710), who seems to have relied on the Livian narrative: see Murgatroyd 2005, 187-190, 229-233.

<sup>21</sup> 1.59

Tarquin also travels to Gabii at this time before moving on to Tarquinia, and Sextus later leads troops from Gabii against Rome in the service of King Porsenna.<sup>22</sup>

Some of these events essentially combine elements from Herodotean episodes—the pretense of Sextus’ defection recalls the fall of Babylon to Darius and the Persians, and Tarquin’s metaphorical advice mimics the advice of Thrasybulus, tyrant of Miletus, to Periander, tyrant of Corinth.<sup>23</sup> Again, most of the details are of little consequence as far as a factual history of Gabii is concerned, and some scholars have rejected all but the simple fact of Gabii’s fall.<sup>24</sup> However, we may be able to infer general historical conditions, admitting that the exercise is somewhat speculative. In this broad analysis, we see Gabii as an important player in the early territorial expansion of Rome, undoubtedly due to the proximity of the two centers, and eventually (in whatever way) coming more and more under Roman influence. Additionally, the story may reflect something of the social dynamics of the period, with elites like Sextus potentially maintaining their status as they move around regionally between settlements. The texts also document a certain respect for the residents of Gabii—as formidable enemies, but also, in Antistius, noble statesmen and sympathetic characters. Such a variable relationship perhaps characterizes the fluctuating interstate politics between two regional rivals who, we must imagine, were occasionally allies and occasionally adversaries. For Romans in the first century BCE, it seems, Gabii was thought to have been on more or less equal footing with Rome.

A similar conclusion can be drawn from the tradition concerning the peace treaty thought to have been made at some time after the above events. This is the *foedus Gabinum*, a treaty

---

<sup>22</sup> 5.3; 5.22

<sup>23</sup> Dionysius himself recognized the allusion to Thrasybulus, 1.56.3. See also Mastrocinque 1984; Wiseman 2008: 137-138; Ampolo 1990; Meulder 2005.

<sup>24</sup> E.g. Ogilvie 1965.

providing for peace on equal terms (*isopoliteia*).<sup>25</sup> Dionysius claims that Tarquin had the terms inscribed on an ox-hide shield subsequently placed in the temple of Semo Sancus/Dius Fidius in Rome, and implies that the shield still existed in his own day. The existence of this treaty, or at least the antiquity of the shield, has been doubted. The temple was built by the consul of 466, Sp. Postumius Albus Regillensis, and later Postumii held land and offices at Gabii (see further below), so the family may have had an interest in encouraging a positive attitude toward the city, as Palmer has argued.<sup>26</sup> Ogilvie suggests that the shield was actually a war trophy from the capture of Gabii during the Latin War, even though Gabii's participation in this war is itself uncertain.<sup>27</sup> Even if the treaty, or merely the shield, was indeed fabricated, or if a later artifact was assigned to a more ancient event, this represents an interesting re-interpretation of the past and demonstrates the symbolic value which could be attached to the memory of Gabii in later periods.

The same might be said for the numismatic evidence often cited in support of the treaty. At the end of the first century BCE, two men from the *gens Antistia* minted coins which commemorated the *foedus Gabinum* on the reverse and Augustus on the obverse (fig. 3).<sup>28</sup> As Gary Farney has shown, this is a clear attempt by these *triumviri monetales* to associate themselves with the legendary Antistius Petro, the sympathetic Sabine statesman, and thus with Gabii as their place of origin.<sup>29</sup> The Antistii thought it useful to advertise their supposed ancient Latin lineage at a time of expanding citizenship, and the idealized past of Gabii was a perfect symbol for this. At the same time, this example shows how the city's past was susceptible to subtle manipulation, for the coins advertise the treaty as a *foedus populi Romani*, not a *foedus*

---

<sup>25</sup> Dionysius 4.58; Horace *Epist.* 2.1; see Bruun 1967; Montero Herrero 1981.

<sup>26</sup> Palmer 1990.

<sup>27</sup> Ogilvie 1965: 209-10; Bruun 1967 argues for authenticity and a date of 468-460 BCE.

<sup>28</sup> C. Antistius Vetus, ca. 16 BCE, and C. Antistius Reginus, ca. 13 BCE.

<sup>29</sup> Farney 2007.

*regum* as the other sources would have it. The Antistii had been loyal supporters of Caesar and later saw great success under Augustus. They were admitted into the patriciate in 29 BCE, and one of these moneyers was later consul in 6 BCE.<sup>30</sup> Perhaps they thought it imprudent to reference kingship in Augustus's ostensibly Republican society.<sup>31</sup> At any rate, these coins tell us more about aristocratic propaganda in the age of Augustus than about any ancient *foedus*. By this time, the memory of Gabii had become a useful symbol of Latium Vetus for those with ties to the city and, perhaps, property within it (see further below).

Certain references to Gabii in ritual contexts are sometimes used to suggest that the city acquired favorable terms in this ancient treaty.<sup>32</sup> The *cinctus Gabinus* was a particular way of wearing the toga during several important ceremonies, including the foundation of a city, a *devotio* on the battlefield, the ritual *amburbia* purifying the city, or the opening of the Temple of Janus for the declaration of war.<sup>33</sup> In addition, according to Varro the *ager Gabinus* retained unique augural status whereby *auspicia* taken there were as valid as those taken in the *ager Romanus*.<sup>34</sup> The origins of these practices are lost, however, and they do not necessarily have anything to do with the *foedus Gabinus*. At best, we can say that they suggest a close relationship between Gabii and Rome from an early period, as well as similar religious customs at both cities.

All in all, then, the sources have rather little to say about Gabii in the archaic and early Republican periods. They do seem to suggest an important role for the city in the early territorial expansion of Rome, and may hint at some level of cultural significance or indebtedness, but they offer more insight into the late first century BCE, when these stories had been accepted into antiquarian traditions and become subject to appropriation in the context of elite self-

---

<sup>30</sup> For the later Antistii see Badian 1969; Minieri 1988.

<sup>31</sup> Cf. Bruun 1967, who uses the wording to date the treaty to after the expulsion of the kings.

<sup>32</sup> E.g., Ogilvie 1965: 209

<sup>33</sup> Dubourdieu 1986.

<sup>34</sup> Varro *Ling.* 5.33

representation. Though the sources are largely silent concerning the economy at Gabii, or the nearby tufo quarries, they reveal interesting elite attitudes toward the city in the Augustan age, when quarrying was at its height.

### *Mid-Republican Gabii*

Our sources are even less informative concerning the period from the mid-fifth century BCE to the late Republic. Livy tells us that Gabii was allied with Rome in a war against Praeneste in the early fourth century.<sup>35</sup> Later, however, the city may have opposed Rome as part of the Latin League (340-338 BCE), though this remains controversial.<sup>36</sup> R.E.A. Palmer has argued that Gabii was re-founded by the Postumii after the league's defeat, but this is far from certain.<sup>37</sup>

A fragment of Livy discovered in 1986 sheds some light on affairs at Gabii at the time of the Third Samnite War.<sup>38</sup> Bravo and Griffin, comparing the fragment to other textual sources, identified the author as Livy and the context as the Third Samnite War.<sup>39</sup> Together, these sources indicate that Lucius Postumius Megellus, consul in 291 BCE, assembled an army at Gabii and then travelled to his estate nearby. Megellus took 2000 of these soldiers with him to fell (probably sacred) trees and perform other tasks on his property. Many of these soldiers subsequently became ill and Megellus was eventually prosecuted for exploiting his soldiers in

---

<sup>35</sup> Livy 6.21-29

<sup>36</sup> Dion. Hal. 5.61.3

<sup>37</sup> Palmer 1990; the argument is based on a corrupt passage of Macrobius, the ownership of property near Gabii by the Postumii (see below), and the existence of men named Gabinius at Cales beginning in the third century BCE.

<sup>38</sup> Bravo and Griffin 1988; Palmer 1990; Vinchesi 1990; Gabrielli 2003; 2012. Translation, according to Bravo and Griffin 1988, 496: (Side A) "...[he owned - - -] not far from the town of Gabii. Since it was at Gabii that the new army had been ordered to assemble and since it was there that the soldiers had been organized in centuries, (the consul?) set out with two thousand foot soldiers for his own estate." (Side B) "... that he will be doing . . . as long as he remains in the *provincial* without his authorization; and that, if he continues to disobey, he will exercise his *imperium* against him, in person. Fabius when he received these orders . . ."

<sup>39</sup> Bravo and Griffin 1988. The other literature includes Dion. Hal. 17/18.4.-5; Dio, 8 fr. 36.32; Periocl. 11; Suidae Lexicon, 4.180, n. 2118 (ed. Adler, Leipzig, 1935).



this way. This fragment is more revealing than it appears. First, it suggests the continuing interest in Gabii of the Postumii family, as suggested above. More generally, we learn that a wealthy Roman aristocrat held a very large property within the city's territory at this time, that this property included forested land that needed to be cleared (whether for immediate financial gain, to restore a sacred area, or to make it suitable for agriculture), and that much of the area may have been marshy (leading to the illness of the soldiers).<sup>40</sup> While we should not extrapolate too much from a single source, it provides an interesting snapshot of land use and Roman intervention at Gabii in an otherwise silent period.

Livy only occasionally mentions later events at Gabii. Hannibal is said to have passed near the town during the Second Punic War, though the local effects of this are unknown.<sup>41</sup> A series of omens reported for the year 176 BCE also includes lightning striking a temple of Apollo and other private buildings at the town.<sup>42</sup>

These few references provide barely a hint of the political, social, and economic changes which must have been taking place at Gabii in this period. The re-founding of the town in 338, if confirmed, would obviously have had considerable consequences—for the fate of the local population, for land ownership and economic activity, and for the political status of the city. The fragment of Livy, on the other hand, provides us with a specific example, even if on a small scale, of how Rome had begun to transform its surrounding territory. This process would continue, at an accelerated pace, into imperial times.

---

<sup>40</sup> Gabrielli 2003; 2012.

<sup>41</sup> Livy 26.9

<sup>42</sup> Livy 41.16

### *Late Republican and Imperial Gabii*

The changes wrought by this transformation did not go unnoticed, and the ancient sources suggest that Gabii was far less prosperous by the mid-first century BCE than it once was. Indeed, the upheaval of the Social War and the civil wars of the 80's may have exacerbated these changes. The *Liber Colontiarum* documents a Sullan intervention which has sometimes been taken as evidence that the dictator reorganized the town as a colony and redistributed the land to his veterans.<sup>43</sup> If this is the case, it may suggest either that the area was already relatively depopulated, or that land was taken from residents as a punitive measure for opposing the dictator. The text, however, says only that Sulla fortified the town. In any case, the *Liber Colontiarum* was assembled in the fourth century CE based on Augustan and imperial documents, and its contents are not entirely reliable.<sup>44</sup> Regardless, the nearby town of Praeneste was certainly a Sullan colony, and Tusculum probably was as well; even if Gabii was not handed over to army veterans, the surrounding region must have seen significant turmoil. Of course, a fortification of the town would also have had implications for the *lapis Gabinus* quarries—it is worth noting that large-scale construction in Rome with lapis Gabinus begins at about this time.

Other sources are much more explicit in detailing the unfortunate results of demographic change. Cicero includes Gabii in a list of municipal towns in which citizens celebrating the Latin Festival are difficult to find.<sup>45</sup> More interesting is a digression by Dionysius introducing the Sextus episode, worth quoting in full:

There was a city of the Latins . . . distant one hundred stades from Rome and standing upon the road that leads to Praeneste. The name of this city was Gabii. Today not all parts of it are still inhabited, but only those that lie next to the highway and are given up to inns; but at that time it was as large and populous as

---

<sup>43</sup> Mommsen, T., *Die Libri Colontiarum* (Berlin 1852) p. 143. "Gabis oppidum lege Sullana munitum, ager eius militi ex occupatione censitus est iter populo non debetur."

<sup>44</sup> See Roselaar 2009, 198-200, for a recent assessment of the authenticity and accuracy of the text.

<sup>45</sup> Cic. *Pro Plancio* 9.23.

any city. One may judge both of its extent and importance by observing the ruins of the buildings in many places and the circuit of the wall, most parts of which are still standing.<sup>46</sup>

Augustan and later poets were quick to seize on the image of Gabii as a symbol of desolation, a ruined city fallen from its golden age. Virgil's Anchises, for instance, lists the walls of Gabii as one of the glories to come for the descendants of Aeneas, while Propertius, reflecting on the origins of Rome, observes that "Gabii, now nothing, was a multitude".<sup>47</sup> Horace cites Gabii, along with nearby Fidenae, as paradigms of deserted towns.<sup>48</sup> A similar picture of the city appears in Lucan's *Pharsalia*, in which the author emphasizes that only "dust-covered ruins" remain, somehow a result of the terrible depopulation caused by the battle of Pharsalus.<sup>49</sup>

These accounts have sometimes been taken at face value, as evidence of Gabii's unqualified disintegration and depopulation.<sup>50</sup> Certainly, as we shall see, the population must have decreased over this period, with pockets of the city remaining inhabited while others fell into ruin. But this wholesale adoption of the Roman attitude toward Gabii has impeded more profitable examination of these texts, which can provide an interesting picture of economic changes since the *floruit* of the city. These authors use Gabii for specific rhetorical or symbolic purposes, which may or may not reflect, exaggerate, or ignore genuine circumstances. Cicero, for instance, is concerned to show that his friend's accuser had little support from his own region—Tusculum and its surrounding towns, including Gabii—in contrast to the defendant.<sup>51</sup> However, the famous orator himself owned a villa in Tusculum, and we know that the entire region was

---

<sup>46</sup> Dion. Hal. 4.53.

<sup>47</sup> *Aeneid* 6.774; Propertius 4.1.34

<sup>48</sup> *Epist.* 1.11

<sup>49</sup> 7.392

<sup>50</sup> E.g., Ashby 1902, 189, who calls any evidence of prosperity at Gabii "fictitious"; Ogilvie 1965, 206.

<sup>51</sup> Friendship and *gratia* were central in the defense, see Craig 1990.

filled with elite country residences.<sup>52</sup> While Gabii as a civic center with a population of respected Latin citizens may have declined, villa agriculture and other economic activity in the area clearly continued.

As for the poets, bemoaning the sorry state of the once-great Latin cities is an established literary motif by the Augustan age. In these excerpts, this is clearest in the way that Gabii is lumped together with various other Latin cities. In the same breath as Gabii, Virgil names Nomentum, Fidenae, Collatia, Pometii, Inus, Bola, and Cora; Propertius mentions Bovillae, Alba, and Fidenae; Horace also includes Fidenae; and Lucan uses the very same clause to describe Gabii, Veii, and Cora. These references are meant to evoke a lost Latin age, and not to accurately reflect the current state of these sites.

In fact, elsewhere in the poets Gabii is not presented in quite such a negative light. A letter of Horace notes that a local slave might be born there, and in another he suggests the existence of rejuvenating baths, confirmed later by Juvenal.<sup>53</sup> Indeed, by Juvenal's time Gabii seems to have recovered its reputation somewhat; the poet characterizes it as a quaint, modest alternative to the crowds, greed, and immorality of Rome, a place where buildings are small but solidly constructed and where the duties (and temptations) of a magistrate are blessedly few.<sup>54</sup> Interestingly, according to Juvenal those duties included overseeing weights and measures, suggesting some amount of commerce at the site. Of course, Juvenal is subject to the same scrutiny as the other poets, and we should be wary of extrapolating to actual conditions at Gabii—in fact, Juvenal pairs the city with Fidenae just as the other poets do. But the ancient

---

<sup>52</sup> Cicero is thought to have written the *Tusculanae Disputationes* at his villa in Tusculum. For villa locations in central Italy see catalogue and discussion in Marzano 2007.

<sup>53</sup> *Epist.* 2.2.3; *Epist.* 15.9; Juvenal *Sat.* 7.4

<sup>54</sup> 3.190; 6.56; 10.100

sources are not quite as one-dimensional as they at first appear, and they show that Gabii had not been wholly abandoned, a sense sometimes given in modern scholarship.

Dionysius' description of contemporary Gabii cited above, with rather specific details about the remains of the city, is more interesting. One cannot ignore the historian's seemingly straightforward remarks on the current ruinous state of the city's walls and buildings. Clearly the inhabited area had contracted, but the author also notes that it is now concentrated around the road, which must be the *via Praenestina*. What is more, he characterizes some economic activity at the site, noting the presence of inns catering to travelers. In fact, Gabii was ideally positioned for this business, sitting twelve miles from Rome – perhaps a full day's travel on foot – and halfway to Praeneste, where the ancient sanctuary of Fortuna Primigenia had been heavily redeveloped in the late second or early first centuries BCE. Cicero suggests that by his time the associated oracle had become disreputable among the well-born, but that it was still revered by the common people, and we can presume some amount of traffic through Gabii as a result.<sup>55</sup> In fact, inscriptions from Praeneste attest even to senatorial patronage, including from a Lucius Antistius Vetus, probably a grandson of the Antistius who commemorated the *foedus Gabinus* on coins in 16 BCE; the language used suggests that Lucius himself participated in oracular consultation.<sup>56</sup> The aforementioned elite villas in the area would also have provided some travelers. It was perhaps the city's fortuitous location and its participation in this transportation economy which led it to be included on itineraries such as the Peutinger Table.

It is also in this period that our sources comment directly on the stone quarries at Gabii. Strabo notes the position of the city close to Rome on the *via Praenestina*, and describes the

---

<sup>55</sup> *De Div.* 2.41.

<sup>56</sup> CIL 14.2849; Várhelyi 2010, 118.

quarries as “more serviceable to Rome than any other”.<sup>57</sup> He elaborates further when discussing the course of the Aniene River:

Thence the river flows out through a very fruitful plain past the quarries of the Tiburtine stone, and of the stone of Gabii, and of what is called "red stone"; so that the delivery from the quarries and the transportation by water are perfectly easy — most of the buildings at Rome being constructed of stone brought thence.<sup>58</sup>

Later, Tacitus records the existence of a regulation stipulating the use of either *lapis Gabinus* or *lapis Albanus* in reconstruction following the fire of 64 CE, as both were thought (more or less correctly) to be fire-resistant (*ignibus impervius*).<sup>59</sup>

These references are brief but informative. They suggest that *lapis Gabinus* was a well-known building stone, with certain properties appreciated by architects. Strabo’s comments are more elaborate, and bring up two important points in relation to the stone: transportation and ubiquity. First, he details the probable transportation route of *lapis Gabinus* and two other types of stone along the Aniene River. The “Tibertine stone” refers to travertine, the quarries of which are still worked today near Tivoli, and the “red stone” is tufo lionato quarried from deposits along the Aniene from Tor Cervara to Lunghezza (see map, figure 1).<sup>60</sup> Both of these stones could be moved easily to the river and floated down to the Tiber and thence to Rome. The quarries at Gabii, on the other hand, sit on the opposite side of the river and some six kilometers

---

<sup>57</sup> 5.3.10: ἐν ἀριστερᾷ δὲ τῆς Λατίνης αἱ μεταξύ αὐτῆς καὶ τῆς Ὀυαλερίας, Γάβιοι μὲν ἐν τῇ Πραϊνεστίνῃ ὁ δῶ κειμένη, λατόμιον ἔχουσα ὑπουργὸν τῇ Ῥώμῃ μάλιστα τῶν ἄλλων, διέχουσα τὸ ἴσον τῆς Ῥώμης τε καὶ Πραϊνεστοῦ, περὶ ἑκατὸν σταδίου.

<sup>58</sup> 5.3.11: ἐντεῦθεν δὲ διέξεισι πεδίων εὐκαρπύτατον παρὰ τὰ μέταλλα τοῦ λίθου τοῦ Τιβουρτίνου καὶ τοῦ ἐν Γαβίοις τοῦ καὶ ἐρυθροῦ λεγομένου, ὥστε τὴν ἐκ τῶν μετάλλων ἐξαγωγὴν καὶ τὴν πορθμείαν εὐμαρῆ τελέως εἶναι, τῶν πλείστων ἔργων τῆς Ῥώμης ἐντεῦθεν κατασκευαζομένων. Translation here is from Jackson and Marra 2006, excepting the last phrase from the Loeb Classical Library translation by H.L. Jones, 1917-1932.

<sup>59</sup> *Ann.* 15.43

<sup>60</sup> For more on these stones see chapter three.

from its course as it flows today. Blocks of *lapis Gabinus* would thus have required at least some transport by land and, possibly, additional loading facilities on the southern bank of the Aniene. In this context, it is interesting to note that when Strabo first praises the convenient location of the quarries it is in the context of the *via Praenestina*, an alternative route to the city. I will discuss issues of stone transportation in greater detail in Chapter 6.

In addition, Strabo suggests that most major construction projects in his time were utilizing blocks from these particular quarries. The obvious examples are the Forum of Caesar and the Forum of Augustus, both of which were built in the author's lifetime and use some combination of these three stones for the bulk of the ashlar masonry. On the other hand, tufo lionato and travertine appear to have been used in construction far more frequently than *lapis Gabinus*, and Strabo may have had primarily these in mind in making such a claim. But we can certainly accept this as evidence that the quarries at Gabii were active in the late first century BCE.

Tacitus' remark suggests that the stone was used even beyond this, into the mid-first century CE, though no major monuments with *lapis Gabinus* have survived from this period. It is possible that the stone was used in private construction, or in public monuments no longer extant. Such a regulation would have been difficult to enforce, however, and anyway could be met with *lapis Albanus*, which seems to have been used more widely into (and beyond) the first century CE. In any case, Tacitus proves here that Roman builders and policy makers were aware of the fire-resistant properties of the two stones, which have been confirmed in recent research by M. Jackson and colleagues.<sup>61</sup>

These off-hand remarks are exceptional in the ancient sources, and *lapis Gabinus* is not mentioned where we might also expect, in Pliny's *Naturalis Historia* or Vitruvius' *De*

---

<sup>61</sup> Jackson et al. 2006, 12; and Jackson et al. 2005: 506-507.

*Architectura*.<sup>62</sup> While Pliny mentions few non-luxury stones, Vitruvius is another matter; the architect describes several varieties of tufo coming from the neighborhood of Rome, and that from Gabii is a notable omission.<sup>63</sup> Regardless, the evidence of Strabo and Tacitus suggests that the quarries were fairly active by the late first century BCE and into the early Imperial period. Unfortunately, they say nothing concerning the actual operation of the quarries. It is tempting to speculate on a connection between the *gens Antistia*, with their Gabine origin and first-century-BCE political advancement, and the supplying of *lapis Gabinus* for the monuments of Caesar and Augustus. However, there is little concrete evidence to support this.

All in all, the literary and historical sources for this period do suggest a certain amount of decline for Gabii as an independent civic center during the late Republic. However, the situation is more complicated, and more interesting, than is generally recognized. This analysis of the texts suggests a landscape characterized by elite villas and associated agriculture, participation in the transportation economy of the Roman hinterland, the existence of baths catering to wealthy Romans, and the extraction of natural resources for the growing capital. In other words, in the late first century BCE and first century CE Gabii was a typical suburban site, undergoing vast social and economic changes driven by the proximity of Rome. From this perspective, the city is exceptional only in its former status as a Latin center, the symbolic value attached to this status, and, significantly, in the presence of an important stone resource. It therefore presents an ideal site with which to examine these long recognized but little understood suburban changes. The

---

<sup>62</sup> Pliny's only reference to Gabii strangely notes that the land there shakes whenever horsemen pass over it: *Nat. Hist.* 2.94.

<sup>63</sup> 2.7; Jackson et al 2006, 9-11 identify several kinds of tufo in this passage, including *tufo rosso a scorie nere* from near Fidenae, *lapis Albanus* from the Alban hills, *tufo lionato* from the banks of the Aniene River, and *tufo giallo della Via Tiberina* quarried near Grotta Oscura. These stones, and the passage of Vitruvius, will be discussed further in chapter three.



textual sources for late Republican Gabii, when considered from this point of view, provide new insight into the changing economy of the Roman hinterland.

### *Imperial Inscriptions*

A series of inscriptions from Gabii adds considerably to our knowledge of the town in the imperial period and suggests a moderate amount of prosperity at the site. All have been known for some time, but the affluence they suggest has largely been overshadowed by the negative impression suggested by the literary and secondary sources:

This prosperity, however, was probably to some extent fictitious. The impression given by the inscriptions is about as far removed from the truth on the one side, as the language of the poets is on the other....Like Fidenae, to which Horace most aptly compares it, it became a small roadside village, and it was to its position that it owed, if not its existence, at any rate the greater part of such prosperity as it continued to enjoy.<sup>64</sup>

While Ashby recognized, to some extent, the hyperbole of the poets, one cannot uncover the dynamics of change at Gabii simply by averaging out the impressions given by the two types of evidence. At any rate, I do not intend to argue that Gabii was something *more* than a “small roadside village,” mainly important due to its position, but it is exactly this process—how formerly populous, independent centers became new kinds of suburban settlements—that needs further clarification. In light of this goal and my re-examination of the textual sources, the inscriptions from the area deserve a second look.

Many of these suggest ties to the imperial family. Significantly, several inscriptions document the construction or restoration of various monuments under the emperor Hadrian. One mentions a *curia Aelia Augusta*, for instance, while another documents work on an aqueduct,

---

<sup>64</sup> Ashby 1902, 189.

possibly to repair one which had fallen into disrepair.<sup>65</sup> An inscription from the monumental temple of Juno records reconstruction of an unspecified sort, necessitated by the vicissitudes of old age (*[r]uinis vetu[st]ate prostratum restituit*).<sup>66</sup> Others are simple dedications honoring the emperor: a notable example honors both Hadrian and his wife Sabina as benefactors of the city (*locupletatoribus municipii*).<sup>67</sup> Hadrian's activities are the most visible, but other imperial personalities were also honored. One fragmentary inscription, dating to between 51 and 54 CE, mentions a gold shield portrait along with the names of Drusus the Elder, Germanicus, Drusus Caesar (son of Tiberius), Agrippina the Elder, and Antonia (daughter of Claudius).<sup>68</sup> Another inscription, also fragmentary, is dedicated to Septimius Severus in the late second century CE.<sup>69</sup>

One of the more interesting inscriptions from Gabii commemorates the donation of a temple dedicated to the memory of Domitia Longina, wife of Domitian, by her freedman Gn. Domitius Polycarpus and his wife (and her freedwoman) Domitia Europa.<sup>70</sup> In 140 CE the two built a shrine on land donated by the city council, decorated it with statues, and provided money for the annual public celebration of Domitia's birthday. The shrine seems to have been turned into a temple of the imperial cult, as numerous high quality sculptures of the imperial family were found in the area (see further below).<sup>71</sup>

As Ashby noted, such evidence does not prove that Gabii was a flourishing center at this time. However, it does raise a number of questions worth considering further. In particular, the matter of construction under Hadrian (and later) is especially relevant to this study, since any building activity may have had implications for the *lapis Gabinus* quarries, which were easily the

---

<sup>65</sup> CIL 14.2795; 14.2797: for a reconstruction indicating repair see Alföldy 1998.

<sup>66</sup> AE 1982.14.

<sup>67</sup> CIL 14.2799; also 14.2796 and 14.2798.

<sup>68</sup> CIL 14.2794; see also Flower 2006, 141.

<sup>69</sup> CIL 14.2800.

<sup>70</sup> CIL 14.2795.

<sup>71</sup> See Varner 1995.

most accessible source of tufo for dimension stone and concrete facing or aggregate. The shrine to Domitia, at least, must have represented new construction, requiring substantial building material. Other projects, including work on the aqueduct and the Temple of Juno, appear to be related to repair or maintenance, and it is difficult to say much about the scale of the work (though see below for more on the temple). While tufo may have been available from nearby abandoned buildings, the use of new material was generally preferred over such *spolia*, perhaps especially so for advertised imperial work.<sup>72</sup> It seems likely that any additional tufo required would have been acquired as locally as possible, and the *lapis Gabinus* quarries were just beyond the city limits.

The fact that some buildings at Gabii had fallen into disrepair, as the textual sources also suggest, merits further comment in its own right. Certainly, the language of the building inscriptions (e.g., *ruinis vetustate prostratum*) would seem to corroborate the interpretation that in this period the town had fallen on hard times. On the other hand, in an exhaustive study by Thomas and Witschel, in which building inscriptions like these were compared with available archaeological data, the authors demonstrated that such inscriptions do not necessarily reflect the real state of Roman buildings, which may have been exaggerated in order to advertise the builder's concern with their symbolic value.<sup>73</sup> What is more, they found that such inscriptions may have also served to recognize more the antiquity of a town than its actual architectural circumstances. We have already seen that Gabii served as an important symbol of an ancient Latin identity, so it would have been a prime candidate for such commemoration. We should therefore be cautious of using these as evidence of the town's physical (and often by implication, social and economic) disintegration. At any rate, the Temple of Juno repaired by Hadrian had

---

<sup>72</sup> Thomas and Witschel 1992: 149ff. But cf. Pliny *Epistles* 46, who suggests that blocks from an unfinished aqueduct be re-used in the arches of a replacement.

<sup>73</sup> Thomas and Witschel 1992

last been repaired in the time of Augustus a century earlier. The fact that Roman construction required occasional maintenance is unsurprising, and alone does not constitute evidence of civic deterioration.

On the other hand, the inscriptions also cannot be taken as any sort of exceptional attention to Gabii on the part of the imperial family. Hadrian's involvement in building programs across the empire, and more specifically in many Italian towns, is well established and was in all likelihood initiated by local residents.<sup>74</sup> However, the inscriptions do document an active community at Gabii, one which was interested in architectural maintenance and construction, and one which, significantly, was thought to be an appropriate place for elite and imperial commemorative practices. The mere presence of such inscriptions suggests the existence of a suitable audience for inscribed self-representation. I have already discussed the various reasons travelers may have passed through Gabii, but it is difficult to imagine that only passers-by were intended to observe these dedications, and we must consider the possibility of a moderately prosperous local population. There are more concrete hints of this in the inscriptions themselves. One from the mid-first century refers to *ludos scaenicos*, though the exact context is lost.<sup>75</sup> More interesting is the dedication to Domitia, in which the freedmen provide funds to celebrate the empress's birthday at Gabii in a public ceremony (*praesentibus decurionibus et sevir discumbentibus in public aequos portonibus fieret division*); research has emphasized the importance of the public nature and theatricality of such events to those who sponsored them.<sup>76</sup> It is reasonable to suppose that some number of moderately wealthy residents persisted at the town in this period, even if many of them were freedmen.

---

<sup>74</sup> For Italy: Boatwright 1989, 235-71; for the empire more generally, and the importance of local initiative: Boatwright 2000.

<sup>75</sup> CIL 14.2794, as credibly reconstructed.

<sup>76</sup> Slater 2000.

In fact, many of the same themes elucidated above are visible in dedications at Gabii by and for such local notables. A good example is the dedication made by the decuriones in 140 CE, honoring Agusia Priscilla for her position as a priestess and for her benefactions to the town.<sup>77</sup> Agusia supported the presentation of *ludos spectaculos*, again suggesting an active local community, as well as the reconstruction of a porticus nominally in need of repair (*vetustate vexatum*). The inscription, on a marble base, also refers to an associated statue, underlining the communicative power of dedications placed at Gabii. Numerous similar but less informative dedications from the town also attest to this.

Another striking text, inscribed on a marble altar, commemorates the donation of a temple to Venus in 168 CE by A. Plutius Epaphroditus, *accensus velatus* and *negotiator sericarius*.<sup>78</sup> In addition to financing the temple and its decoration, this man—a freedman, as indicated by his Greek cognomen—also distributed *sportulae* to the decuriones, Augustales, and *tabernarii*, and provided an endowment of 10,000 HS for the annual celebration of his daughter's birthday in a public feast. In another inscription, also found at Gabii, Plutius himself is honored by two of his own freedmen.<sup>79</sup> Plutius seems to have been a moderately wealthy resident of Gabii, albeit a freedman, who was involved in the silk trade (*negotiator sericarius*) and held a minor administrative post (*accensus velatus*), and who was eager to donate on a local level and to advertise his benefactions publically in the town.

A number of interesting issues emerge in these two inscriptions concerning Plutius. First, they document the residence at or near Gabii of a wealthy man, who was connected to large scale commercial activity. Plutius' activities as a silk merchant would have connected him with broad trade networks beyond the local Gabine market, and his commemorations at Gabii suggest that

---

<sup>77</sup> CIL 14.2804; see also Forbis 1990.

<sup>78</sup> CIL 14.2793.

<sup>79</sup> CIL 14.2812.

local residents could still be closely tied to the larger economy of urban Rome.<sup>80</sup> In addition, with the presence of a wealthy freedman in the area, we might speculate that his former master was active near Gabii as well. Moreover, this may not be an isolated case, as other inscriptions from the city document the activities of different, and presumably wealthy, freedmen.

Second, these inscriptions further substantiate the presence of a dynamic community at Gabii. Bessir Amiri has suggested that Plutius' donations were meant to facilitate social promotion for a man in an otherwise potentially marginal occupation, with a correspondingly low legal status.<sup>81</sup> The public nature of the texts and their ability to effectively communicate with the donor's potential peers were therefore of central importance, and Plutius, at least, must have supposed Gabii to have an appropriate number of relatively noteworthy residents. Other details of the inscription also support this. It is stipulated, for instance, that the feast in honor of Plutius' daughter take place openly in public (*publice in triclinis suis epulentur*). Moreover, *sportulae* like those supplied by Plutius to local priests, officials, and businessmen, often took place visibly, in order to advertise the donor's generosity to the community.<sup>82</sup> Such measures would be entirely ineffective if Gabii consisted only of roadside inns in this period, and we can assume that Plutius would have been shrewd enough to recognize this.

Finally, the *sportulae* themselves might provide some insight into the local economy. The inscription records that the *tabernarii* each received eleven sesterces, compared to thirteen for the Augustales and fifteen for the decuriones, and it has been suggested that this relatively generous amount reflects greater respect for these men, and thus perhaps greater economic or

---

<sup>80</sup> Several other *sericarii* are documented in inscriptions from Rome and Latium: CIL 14.3712 = ILS 7599 (Tibur); CIL 6.9678, 9890, 9891, 9892 = ILS 7600, 9893 (all from Rome).

<sup>81</sup> Amiri 2012.

<sup>82</sup> Slater 2000, who mentions both CIL 6.2793 and 2795 in this context.

social status on the local level, than is usually seen.<sup>83</sup> Gabii had long since given up its position as an important independent center in its own right, and these *sportulae* perhaps recognized the increasing significance of small scale commercial activity in a small town located on an well-traveled road in the capital's hinterland. This accords well with Dionysius' description noting the prevalence of inns catering to travelers. At the same time, the restriction of these *sportulae* to those shopkeepers *intra murum negotiantibus* might imply that it was felt necessary to encourage development and commerce within the town. In this case, perhaps greater cash payouts to *tabernarii* instead reflect hard times for local shopkeepers, or a tendency to set up new shops outside the city walls. It is also worth noting that this inscription, like that honoring Domitia, contained a clause transferring the donated funds to nearby Tusculum if the annual birthday celebrations were neglected. Small-scale commercial activity at Gabii may not have helped it remain a strong civic center in its own right.

In another inscription, the decuriones honor Lucius Antistius Vetus, son of the C. Antistius Vetus who was consul in 6 BCE and who minted coins with a legend commemorating the *foedus Gabinus*, as described above.<sup>84</sup> The Antistii Veteres had great political success from the mid-first century BCE to the mid-first century CE, with many reaching the office of consul.<sup>85</sup> An Antistius Vetus (probably the great-grandfather of the Lucius honored at Gabii) served as propraetor in Spain in 69-68 BCE when Caesar was quaestor, and a Gaius Antistius Vetus (probably his grandfather) served extensively under Caesar before reaching the consulship in 30

---

<sup>83</sup> Ashby 1902, 188-89.

<sup>84</sup> CIL 14.2802.

<sup>85</sup> The prosopography of the Antistii Veteres is somewhat complicated, not least due to the prevalence of Lucius and Gaius as male praenomina, and many of the familial relationships discussed here are not as secure as one would hope. Notably, in addition to the men here, Caesar's physician was named Antistius: Suet. *Caesar* 4.82. See also Badian 1969; Minieri 1988; Camodeca 2002.

BCE.<sup>86</sup> Lucius's father Gaius is praised in glowing terms by Velleius Paterculus, and Lucius himself was consul in 28 CE, in addition to the offices noted on the Gabii inscription (pontifex, praetor, decemvir and quaestor).<sup>87</sup> His brother Gaius had been consul only a few years before him, in 23 CE. This brother's sons, also named Gaius and Lucius, reached the consulship in 46 and 55 CE, respectively, though Lucius was obliged to commit suicide in 65 in anticipation of condemnation under Nero.<sup>88</sup> Finally, a Lucius Antistius Vetus of the next generation was consul in 96 CE.

Between the coins commemorating the *foedus Gabinus*, the tale of Antistius Petro in Dionysius, and this inscription honoring Lucius Antistius, it is clear that the family maintained a close relationship with the city of Gabii throughout this period. In this context one might also point to the previously mentioned dedication made at nearby Praeneste by a Lucius Antistius, probably to be identified with the consul of 55. It seems likely that the family owned property in the area, and it is tempting to speculate about a connection between the political advancement of this family under Caesar and Augustus on the one hand and the supplying of *lapis Gabinus* for imperial monuments on the other. Indeed, the family fortunes seem to have coincided with the period of intensive stone extraction in the first centuries BCE and CE. In addition, G. Antistius (the consul of 23 CE) held the post of *curator riparum et alvei Tiberis* under Tiberius, in which he was responsible for protection from floods, the navigability of the river, as well as supervision of the building and maintaining of quays where cargo was unloaded.<sup>89</sup> *Lapis Gabinus* was most likely transported to Rome by river (as we shall see), and in this post Antistius would have been

---

<sup>86</sup> Antistius Vetus in Spain: Velleius 2.43; Suet. Caesar 7.

<sup>87</sup> Vell. Pat. 2.43

<sup>88</sup> Tac. Ann. 16.10-11.

<sup>89</sup> CIL 14.4704; for the post of *curator riparum et alvei Tiberis*, see Aldrete 2006, 198-202; Robinson 1992, 73-77.



in a position to facilitate such business. There is, however, only this circumstantial evidence linking the family to quarrying operations.

The epigraphic evidence from Gabii ultimately has little to say about stone quarrying. Although the building inscriptions do suggest a local need for construction materials, there is no way to know how much, if any, *lapis Gabinus* would have been used; for private work, spoliated material would likely have been preferred. The value of these texts lies instead in the picture they can provide of social and economic activity in the imperial period. They suggest a dynamic local community, moderate prosperity, and an appropriate setting for commemorative practices. While Gabii was no longer the thriving city it may have been in the Archaic Period, there is little reason, in my view, to dismiss such moderate prosperity as fictitious. It should be noted, however, that the majority of these inscriptions date to the second century CE, and the town may have been less prosperous prior to this.

### *Post-Classical Gabii*

Our knowledge of Gabii in the medieval and Renaissance periods is limited, but some amount of activity seems to have continued at the site. A diocese of Gabii existed from at least the fifth to the ninth centuries CE, and a monastery and church dedicated to San Primitivo were dedicated in the eleventh century; the ruins of the latter still stand today.<sup>90</sup> A fortified village known as the “Castrum Castillionis” or “Castrum Sanctae Praxedis” was constructed along the east side of the crater at some point in the twelfth or thirteenth century but largely demolished in the early fifteenth at the order of Pope Bonifacio IX. The tower, known as the Torre di

---

<sup>90</sup> Carboni 1997; Guaitoli 1981

Castigilione, survived, and a rural farmstead was built atop the site sometime in the late fifteenth or early sixteenth centuries.<sup>91</sup>

More recently, pictures from the first years of the twentieth century record the existence of a small village of huts near this farmstead, replaced in the 1920's by more permanent farm buildings as the region's land use was reorganized.<sup>92</sup> Finally, in 1987 the majority of the former urban area (including most of the stone quarries) became an archaeological park under the Soprintendenza Archeologica di Roma, with offices in the buildings of the former farmstead.<sup>93</sup> The southern reaches of the city, on the opposite side of the modern via Prenestina which bisects the urban space, lie underneath a small private airstrip.

For much of this time, the area was subject to agriculture of one kind or another, as plow marks in recently excavated areas attest. On the other hand, it is more difficult to determine whether and to what extent the stone quarries may have been worked. Some faces have remained visible, certainly, and may have been exploited for construction of the medieval *castrum* or the later farmstead, as Cappanesi and colleagues have suggested.<sup>94</sup> However, the amount of stone needed would have been relatively small, and it seems likely that required building materials could be more easily found and spoliated from the nearby city ruins. Regardless, it remains possible that post-Classical extraction occurred on a small scale from quarry faces near the medieval and early modern buildings.

---

<sup>91</sup> Cappanesi et al. 1991

<sup>92</sup> Ashby 1902; Almagia 1929, figs. 11 and 13.

<sup>93</sup> The area south of the modern via Prenestina, however, is under the jurisdiction of the Soprintendenza per i Beni Archeologici del Lazio, while west of the park several private properties sit within the ancient city walls.

<sup>94</sup> Cappanesi et al. 1991.

## Archaeological Research at Gabii

Roman authors presented Gabii in ways which suited their worldview, emphasizing themes such as the Latin golden age and the decline of the Roman countryside. The result is a simplification, highlighting only ideas relevant to their specific purposes. Ultimately, these views have made it easy for historians to immediately discount Gabii as more or less irrelevant in the late Republic and later periods. Archaeological evidence provides an alternative perspective which must be considered in its own right.

Unfortunately, the city of Gabii has seen little in the way of systematic archaeological fieldwork. Previous work has tended to focus on the large religious structures or the early cemetery at nearby Osteria dell'Osa, which have proven crucial to our understanding of late Republican sanctuaries and early Iron Age society, respectively. The excavations of the Gabii Project, still in their early stages, have a similar potential to illustrate processes of urban development and decay over the course of the last millennium BCE. More significantly for my purposes, the archaeological evidence provides further data on the Gabine economy and its changes over time, evidence which can help us to understand the transformation of the site in the late Republic, just as the extraction of *lapis Gabinus* became crucial to the economy of urban construction at Rome.

### *Hamilton's Forum and Imperial Sculpture*

The first excavations at Gabii took place in the 1790s, when the Scottish antiquarian Gavin Hamilton uncovered what he identified as the forum of the city. The excavations were not well-documented, but a plan shows a large open square fronting on a road (presumed to be the *via Praenestina*) with porticos on three sides parts of a few adjacent buildings (fig.4); the

location of this complex has since been lost, and whether it actually represents the forum remains debatable.<sup>95</sup> Hamilton recovered over 200 statue fragments and several inscriptions, including some of the inscriptions discussed in the previous section. Several of the statues—including busts of Agrippa, Germanicus, Tiberius, Corbulo, Geta, and Septimius Severus, a statue of Claudius, a head of Hadrian, and portraits of Nero and Marcus Aurelius—are now in the Louvre. These were recovered from the shrine to Domitia Longina Augusta (wife of Domitian and daughter of Gn. Domitius Corbulo) which was later dedicated to the imperial cult, as I have noted above.<sup>96</sup>

### *Temple of Juno Gabina*

Large-scale systematic fieldwork began in the 1950's with the excavation of the sanctuary thought to be dedicated to Juno Gabina.<sup>97</sup> The Spanish team revealed a monumental temple-theater complex of the mid-second century BCE, similar to that dedicated to Hercules at Tibur, with some additions and repairs in the first and second centuries CE (fig. 5). The complex consists of a temple *peripteros sine postico* resting on a large podium, preceded by a short staircase and a large altar and surrounded on three sides by a Doric portico with *tabernae*. A large *cavea*, no longer visible, was built into the hillside to the south, in front of the temple. Some of the area in front of the temple was paved, as was a walkway leading to it from the southeast, but elsewhere cavities carved into the bedrock may have once held trees, suggesting the presence of a sacred grove (*lucus*). A fragment of a Doric frieze associated with the altar preserves the inscription CETHEGUS, probably referring to P. Cornelius Cethegus, consul in

---

<sup>95</sup> Visconti 1797; Canina 1856; Cozza and Pasqui 1885; Lanciani 1901; Smith 1901; Ashby 1902; Pinza 1903. See also Becker et al. 2009, 632.

<sup>96</sup> Varner 1995.

<sup>97</sup> Almagro-Gorbea 1982 for full bibliography.

160 BCE, who may have been responsible for the monumentalization of the sanctuary.<sup>98</sup> Most of the stone elements of the sanctuary, including this inscription, were composed of *lapis Gabinus*, an important point which will be further considered in chapter five.

This complex was preceded by an earlier shrine dedicated to Fortuna, as attested by several late fourth to early third century BCE inscriptions. Beneath these layers the excavations brought to light votive deposits of the fifth and sixth centuries BCE and hut remains going back to the eighth century BCE, documenting continuous occupation and religious activity in the area over a long period.<sup>99</sup>

### *Santuario Orientale*

Another sanctuary has been discovered just beyond the city walls to the east, and is therefore known as the Santuario Orientale (fig. 6). Excavations first took place in 1976-77, with additional work in 1999 and 2007, revealing a cult location with activity between the seventh and second centuries BCE.<sup>100</sup> A votive deposit dating to the late seventh to early sixth centuries BCE was discovered underneath the walls of the later complex, which included a great number of bronze figurines and miniaturized ceramic vessels, as well as a significant amount of *aes rude*. In the sixth century a rectangular structure in ashlar masonry was built, oriented east-west and opening to the west. Also associated with this phase is a well surrounded by large pavers, found to the north of the structure. In the fourth century BCE the area was reorganized, with the construction of another ashlar wall at the rear of the complex as well as several altars. By the early second century BCE the cult building was abandoned, and a large portico with *opus*

---

<sup>98</sup> Coarelli 1982

<sup>99</sup> Le Glay 1985

<sup>100</sup> Mancini and Pilo 2006; Majarini and Musco 2001; Guaitoli 1981a; Fabbri et al. 2012; Zuchtriegal 2012a; 2012b. This and other attested cults at Gabii are discussed in Granino Cecere 1986.

*incertum* walls was built to the east. Imperial period tombs suggest that by this time the area was outside the zone of occupation.

### *Field Survey*

Also beginning in the 1970's, a series of extensive field surveys documented habitation areas within the city.<sup>101</sup> A Middle and Late Bronze age scatter indicates settlement along the eastern rim of the crater, while several concentrations of Early Iron Age material suggest separate occupation areas within the area of the later city. This pattern is quite similar to that found in nearby Etruscan settlements like Tarquinia, Caere, and Veii, as well as at Rome, and seems to attest to scattered occupation over a large area which only became a unified urban settlement in the eighth or seventh centuries BCE. In addition, while the entire area within the city walls shows signs of occupation from the Archaic to the Middle Republican period, in the Late Republic this had shrunk to a small area centered on the *via Praenestina* and the Temple of Juno, with only limited evidence for occupation in Imperial or Medieval times. This process of contraction and abandonment obviously has implications for the quarrying activity of the Late Republic, which sometimes took place in formerly occupied areas, but it is difficult to say more from the survey evidence.

### *The Cemetery of Osteria dell'Osa*

Between 1971 and 1986, the excavation of a cemetery at Osteria dell'Osa, just west of the urban area of Gabii, provided a rare glimpse of Latium in the early Iron Age. The cemetery contained some six-hundred tombs, both inhumations and cremations, dating between the Latial

---

<sup>101</sup> Guaitoli 1981b.

IIA to Latial IV periods (early ninth to early sixth centuries BCE).<sup>102</sup> A smaller cemetery dating to the ninth century BCE was also excavated on the eastern rim of the crater near the medieval tower, where it had disturbed an early Bronze Age settlement. Together these burials constitute our best evidence for early Iron Age funerary patterns in the region.

Those at Osteria dell'Osa are particularly interesting. They are organized into fourteen distinct clusters, some of which are distinguished chronologically while others are of similar date but have discrete assemblages and features. For example, two adjacent clusters in the northwestern area of the cemetery date to the ninth century BCE. They are similar in some respects, as each is organized around a central area of cremated burials with miniaturized grave goods (including weapons, and therefore presumably indicating male burials), surrounded by inhumation burials of adult women, children, and occasionally men, with young women buried on the fringes. However, burials in the northern group are characterized by the frequent inclusion of travertine slabs covering *dolia*, portions of meat, and the exclusion of hut urns, while those to the south include white pebbles, little meat, and many hut urns. Other differences are apparent in the type of fibulae and the quality of the pottery present in the burials of each group. These contemporary clusters clearly indicate group affiliations, which some have argued may represent the early formation of the distinct kin group known from later textual sources as the *gens*.<sup>103</sup> Alternatively, they may simply reflect the discrete residential groups suggested by the field survey evidence, though these two interpretations are by no means mutually exclusive.

In the eighth century inhumation was the norm, and the organization of the preceding period seems to have been lost, with graves massed together and intruding on one another. Of possible significance to this study is the fact that some bodies were covered with very large tufo

---

<sup>102</sup> Bietti Sestieri 1992a; 1992b; see also Holloway 1996, 103-113.

<sup>103</sup> Bietti Sestieri 1992a; 1992b. Cf. Smith 2006.

slabs, suggesting some early expertise in stone working. Tombs of the seventh century were typically large *fossa* with a hollow on one side for placement of the grave goods, while those of the early sixth century were chamber tombs cut into the bedrock. The cemetery is also notable for producing the eighth century Greek inscription already discussed, in the section on the history of Archaic and Early Republican Gabii.

### *Other Excavation within the City*

The sporadic excavations of the Soprintendenza Archeologica di Roma within the walls have not yet been thoroughly published, but have revealed a small portion of the ancient city centered on the *via Praenestina*.<sup>104</sup> They exposed the paved roadway as well as private buildings and a structure fronted by pillars, which has tentatively been identified as the so-called forum excavated by Hamilton. More recently, excavations have uncovered a bath complex of the imperial period also along the road.

Recent excavations in the highest part of the city have also revealed an important tripartite structure of the archaic period, which seems to have been ritually obliterated and covered with a *tumulus* consisting of large irregular stones. This impressive structure has yet to be fully published, but the excavators suggest that it may be the *Regia* of Gabii and thus possibly related to the events at the end of the regal period described in our literary sources.<sup>105</sup> Linking the archaeology to specific historical events may be premature, but the building clearly fulfilled an important public or semi-public function in a period for which little architecture is otherwise known, and publication of the excavations is eagerly awaited.

---

<sup>104</sup> Majarini and Musco 2001.

<sup>105</sup> Summaries of these excavations for a general audience can be found in Fabbri et al. 2010 as well as online at <http://www2.unibas.it/ssa/index.php/en/gabii>.



### *The Gabii Project 2007-2013*

Work conducted since 2007 by the Gabii Project has substantially increased our understanding of the organization and development of the city.<sup>106</sup> Work began with coring samples and a magnetometry survey in 2007-2008 before open-area excavations began in 2009. For convenience, the excavation has been divided into six distinct areas, labelled A-F, to which I will refer in the following paragraphs (fig. 7). Excavations are ongoing and many conclusions remain tentative, but the tombs, houses, and other structures revealed thus far allow us to speak more confidently about what exactly was going on at Gabii between the eighth century BCE and the second century CE.

Our early work shed light on the overall organization of the city. The core samples provide a site profile demonstrating that the city must have consisted of terraces levelling large areas along the hillside, while the results of geophysical survey indicate a unique orthogonal road plan, with a curving central trunk road paralleling the crater itself and side roads radiating outward (fig. 8). As a result, city blocks become progressively wider further down the slope. Subsequent excavation of several of the secondary roads suggests that the roads were probably first laid out sometime in the fifth century BCE, attesting to a substantial reorganization of the urban area at this time.

The earliest phases within the excavation area are represented by two elite infant inhumation burials in area A.<sup>107</sup> The earlier dates to between the second half of the eighth and the beginning of the seventh centuries BCE and contained an assortment of grave goods, including a finely made impasto drinking set and eight pieces of bronze ornamentation. The other, dating to

---

<sup>106</sup> The results of the magnetometry survey and core sampling are presented in Becker et al. 2009, Terrenato et al. 2010, and Kay 2013, while a preliminary excavation report on the 2009-2011 seasons can be found in Mogetta and Becker 2014. Other publications include: Gallone and Mogetta 2011, 2013, and Mogetta 2013. Seasonal summaries can be found on the FASTI online website.

<sup>107</sup> Becker and Knowlin 2011.

the mid-seventh to early-sixth centuries, included seven high-quality ceramic vessels. These tombs attest to increasing social stratification at Gabii and signify the importance of material wealth associated with funerary rituals. Associated residential structures remain elusive, but they are likely to have been located in the immediate area and destroyed by later construction.

An elite complex in area D represents the earliest domestic evidence yet discovered. A retaining wall encloses two rectangular rooms, as well as an associated hearth, a well, and a semi-circular construction of indeterminate function, all datable to the second half of the sixth century BCE. There are traces of an earlier phase in the late seventh or early sixth centuries, including burnt surfaces beneath the later floors (suggesting destruction of an earlier structure by fire) and the original construction of two walls in one of the rooms. The area was abandoned by the early fifth century and used for three rock-cut tombs, each consisting of deep shafts with side niches for one or more inhumations. The relative importance of the deceased is clear both from the labor intensive tomb construction and from the location of the burials within the city, as the fortification wall must have been in place by this time. Another important find for this early period is a fragmentary public inscription; while too little remains for the content to be reliably reconstructed, Fortson and Potter have been able to date the inscription to the fifth century based on the paleography.<sup>108</sup>

Many of the architectural remains uncovered in the excavations date to mid- or late Republican times. At the end of the third century BCE two courtyard houses were constructed in areas B and C, aligned with the orthogonal street plan. This grid was renewed around the same time, as the roadway was raised and side walls were constructed to contain this fill. The house in area C consists of numerous rooms surrounding a central court, with similarities to the classic *atrium* plan, including a possible *hortus* to the north which contained a well feature with large

---

<sup>108</sup> Fortson and Potter 2011.

tufo slabs paving the surrounding area. The house in area B also features a courtyard surrounded by rooms, though only on the eastern and northern sides. An entryway on the southern side of the this courtyard provided access from a narrow basalt paved road which continued south beyond the excavation area, presumably joining up with the main trunk road further to the south. The house also contained a well in the courtyard, surrounded by pavers. Both houses seem to have been occupied in the late third and second centuries BCE.

More monumental Republican remains are to be found in area F, at the southwestern limit of the excavations. This area has not yet been published and excavation is ongoing, but the preliminary results are promising. A unified complex rises on three separate terraces beginning from the central trunk road to the south. A paved ramp leaves the road here, with rooms on either side, all supported on large ashlar foundations. The exact form and function of this lower terrace is difficult to ascertain, as the area was repurposed in imperial times, when the rooms take on the appearance of *tabernae* fronting the road. The second level contains several large, well-preserved rooms with finely made floors arranged around a courtyard paved with large tufo slabs. At the rear of this sits an impressive retaining wall, with a stone staircase preserved along the western side providing access to the upper terrace. Substantial robbing of structures on this highest level seems to have occurred, as no architectural remains are preserved. Excavations thus far do not permit great chronological precision, and the complex could date anywhere from the early-third to the late second century BCE. It is similarly difficult to determine the function of the complex. The organization of the rooms is similar to domestic architecture, but the sheer scale of construction suggests a public or semi-public purpose, and it is possible that we are dealing with some sort of *domus publica*; however, a number of other interpretations remain possible.

The late Republic witnessed a transformation in this part of the city. In the late second century BCE the house in area C was abandoned and the structures partially reused in an industrial complex which may have been a *fullonica*. Two wells are surrounded by a large area paved with basalt, with several adjacent rooms to the south. Along the street to the west, an *in situ* dolium base was found, possibly for the collection of urine. A similar industrial complex, less well-preserved, may also be situated further south in area E.

The Gabii Project has uncovered a wealth of data on quarrying in these later phases of activity at the site. These results are more thoroughly presented in chapter four, but they deserve some mention here, as they have proven crucial to our understanding of the waning of the city. In brief, the excavations uncovered a buried quarry face, a debris field, an assay pit, and the road seemingly associated with the quarry face. Quarry activity very clearly encroached upon what was formerly the occupied urban area. The main point to be made here is that this area of the city was evidently abandoned and repurposed at some point in the late Republican or early Imperial periods.

This process can also be seen in area B, where burials begin to appear in the area formerly occupied by domestic space. Two phases can be distinguished amongst twenty-seven graves, the earlier from the first and second centuries CE, the latter from the third to fifth centuries, though the dates are not certain. Many of the graves were very simply prepared, with the body resting in a shallow cut without funerary goods and covered by peaked tiles in typical *a cappuccina* fashion. Others were more complex and included lead sheeting covering parts of the body; the most impressive of these (Tomb 8) contained an adult male within a roughly shaped sarcophagus made from reused lead sheeting.<sup>109</sup> The cemetery includes men, women, and a few children, the latter buried in ceramic vessels of one sort or another. Like the quarrying activities,

---

<sup>109</sup> Gallone 2012.

this redevelopment of formerly urban space attests to the dynamic transformations occurring in this period at Gabii.

Recent study of the previously excavated area at the southern end of the area F complex (sometimes referred to as the “area urbana”) has shed light on the reuse of this area in imperial times. The rooms alongside the ramp to the higher terrace were reconfigured as some kind of *tabernae*, with large doorways opening on to the street. These rooms were previously excavated and little stratigraphy remains with which to date this activity, but limited excavations suggest that the latest phase was in the second or third centuries CE. The location—along the *via Praenestina* just at the point where it turns to the south to continue on to Praeneste—was ideal for catering to travelers, and one is reminded of Dionysius’s description of inns along the road. Further study should help clarify our understanding of these late structures.

## **Conclusions: Stone Extraction and the History of Gabii**

The research summarized here provides only a very general outline of Gabii’s history, though the current excavations of the Gabii Project have begun to fill in the gaps. It seems worthwhile here to reiterate several points which have emerged concerning the transformation of the city in the late Republic and early Empire and, more specifically, the role of stone extraction in this process and in the history of the site.

Both the ancient sources and previous archaeological research suggest substantial changes at Gabii in the late Republic. While the texts are most frequently taken to demonstrate abandonment, they also document important suburban features such as baths and villas, as well as new (or increasingly significant) commercial activities such as innkeeping and stone extraction. The material remains also indicate abandonment in some parts of the city, with

contraction of the occupied area and the appearance of tombs well within the walls. Just as significantly, though, we see the re-use of many structures for industrial or commercial purposes and the development of extensive quarries for building stone needed in Rome. These and similar processes occurred throughout the capital's hinterland in this period, and further examination is needed to understand overall economic trends and settlement patterns.

The modern tendency to follow the Roman perception of decline at Gabii must be tempered with more rigorous analyses. It has recently been argued that the “decline” of Italian cities in the early Empire belies more complex changes in the economy, in land use, and in broad settlement patterns.<sup>110</sup> I contend that similar transformative processes occurred even earlier in cities and towns closer to Rome, as people and resources were increasingly drawn toward the capital. While few would dispute this contention, I would further emphasize that understanding these processes—abandonment, redevelopment, and/or resource extraction—is crucial for our interpretation of the changing economy of the Roman *suburbium*. But few studies have considered them in any detail.

The rest of this dissertation takes understanding these phenomena as its goal, by focusing on Gabii and on only one of these transformative developments—stone extraction. The ancient sources and the archaeological data suggest that quarrying at Gabii became significant both for urban construction at Rome and for local activity on site, but a number of questions remain. How was extraction organized? How was *lapis Gabinus* used at Gabii, and not just at Rome? In addition, the chronology of the quarries has not been fixed, and we know little about early extraction or about why the stone was abandoned in the early Empire. It is my hope that a history of the extraction and use of *lapis Gabinus* addressing these issues will elucidate broader patterns

---

<sup>110</sup> Patterson 2006.

in the economy of Rome and its immediate hinterland. First, however, we need to consider how quarries more generally have been related to the broader economy of ancient Rome.

## Chapter 3: Quarries and the Roman Economy

### Introduction

In this chapter I provide an overview of past research addressing how quarries functioned within the economy of ancient Rome, including current theories and models, with the intention of establishing an analytical framework with which to assess the *lapis Gabinus* industry. I discuss our evidence – both textual and archaeological - for Roman quarrying and its organization, and consider how scholars have approached this material in the past. Previous studies have tended to privilege quarries associated with marble or other decorative stone, especially in cases of imperial involvement or where stone can be shown at least to have travelled long distances. This approach has substantial merit and has resulted in appealing models of the imperial stone trade, but it is limited in scope and chronology and largely ignores the dimension stone used regularly in urban construction, as well as quarries with merely local or regional distributions. Other scholars have focused on the construction industry more generally, bringing attention to more mundane but economically significant building materials like tufo, and emphasizing the value of informed quantitative analysis. The investigation of “local” quarries (those with more local or regional distributions) across the empire has also received recent attention, highlighting their significance in shaping the overall trade in stone. All of these approaches have developed alongside the increasing importance and capabilities of petrographic and geochemical analysis, which permit the specific geological provenance of stone artifacts to be accurately determined.



In particular, my goal is to determine the most valid and effective approaches for the study of ancient stone quarries, and for those at Gabii in particular. Important questions concern just how analogous extraction at Gabii might have been to that at marble quarries, which have seen more scholarly attention, as well as how tufo might fit in to broader economic models. By contrast with marble, the local tufo industry of Rome has not often been considered in the larger economic debates surrounding the Roman stone trade or construction industry. In the final part of this chapter I assess our knowledge of this more local quarry industry, and attempt to frame the overall construction economy of Rome such that tufo—and not merely luxury stone—has a place within it.

## **Methodological Approaches to the Quarry Economy**

### *Modeling the “Marble” Trade*

Early research into Roman quarries was sparked by the discovery in 1868 of several hundred inscribed blocks at the Roman marble yards near the Tiber, studied by L. Bruzza.<sup>111</sup> These inscriptions have since been supplemented with hundreds of others, from Rome as well as from quarries around the Mediterranean, and constitute one of the most important sources on the organization of the Imperial decorative stone industry.<sup>112</sup> The texts vary, but for the most part list similar items and may include: the consular date, the procurator in charge of the quarry, the contractors involved, the specific work team, and both the quarry branch and the precise location of the quarried block.

---

<sup>111</sup> Bruzza 1870.

<sup>112</sup> For the most recent summaries see Hirt 2010; Russell 2009; 2012. Perhaps the best introduction is provided by Fant 1989, which supplies many of the inscriptions related to the marble quarries in Phrygia.

Based largely (though by no means exclusively) on such inscriptions, scholars identified a vast imperial system, run by the state, organizing the production and transportation of fine decorative stone. Subsequently, the majority of quarry and stone research has focused on the organization and administration of imperially owned quarries and the distribution of their products. The study of this imperial system, moreover, became significant in larger debates over the Roman economy, as it appeared to introduce a certain amount of economic rationalization, standardization, prefabrication, and possibly even marketing—in other words, certain elements of a modern market economy, which could be described with modern economic terms.

John Ward-Perkins is widely recognized as the founder of this field of research. In 1951, while working on the sites of Sabratha and Lepcis Magna, he published an article discussing a number of inscriptions from the two sites which he recognized as documenting the supply and trade of marble from the mid-first century CE to the end of the second century.<sup>113</sup> He concluded that the introduction and widespread use of these quarry marks, in Tripolitania as well as elsewhere, represented an elaborate accounting system and indicated a vast increase in the production of the quarries, now imperially owned and organized. These ideas were further developed in a series of papers over the next three decades, in which Ward-Perkins took into account newly available evidence and fully outlined the system as he understood it.<sup>114</sup> It can be summarized, in its most complete and complex form, as including:

1. Imperial control of the major sources of supply.
2. Rationalization of quarrying methods in order to increase quantity and efficiency of production.

---

<sup>113</sup> Ward-Perkins 1951.

<sup>114</sup> In addition to the above, see especially Ward-Perkins 1980, which most completely elaborates the system presented here. These and other of Ward-Perkins' works are conveniently collected in Ward-Perkins 1992.

3. Bulk-production at quarries and stockpiling both at quarries and at importing cities, allowing for almost all demand to be met from normal production and stocks held locally.
4. Standardization and prefabrication of architectural elements and sarcophagi, and even specialization of designs for particular markets.
5. Specialized workmen available as labor to customers at quarries or agencies serving the quarries.
6. Establishment of agencies overseas to facilitate ordering and distribution, ultimately shaping the pattern of that distribution.

Ward-Perkins believed that the development of such a system relied first and foremost on the *pax romana*, which cleared the way for economic development and long-distance trade. The Augustan building program and the annexation of Egypt then prompted imperial officials to recognize the benefits of imperial control, and in 17 CE Tiberius confiscated many of the most important sources of supply.<sup>115</sup> The new system developed largely in the next few decades but reached its perfected form in the middle of the second century.

Ward-Perkins was ahead of his time in the holistic way he combined epigraphic, textual, and archaeological data and in the economic questions he considered. He presented a model of the imperial quarry system which was essentially modernist—driven by supply and demand, carried out by economically rational actors, and able to be described with modern economic terms. This became the dominant model, one which is in some ways still relevant today. Just as importantly, however, his work fostered a new scholarly interest in the subject of stone in the Roman world, leading to the founding in 1965 of the “Committee for the Study of Marble and Similar Stones in Antiquity.” This was superseded in 1988 by the “Association for the Study of

---

<sup>115</sup> As documented in Suetonius, *Tib.* 49.2, on which see further below.

Marble and Other Stones in Antiquity” (ASMOSIA), which holds regular conferences and publishes their proceedings.<sup>116</sup> This interdisciplinary association is remarkable in its integration of archaeometry and scientific techniques with more traditional art historical, historical and archaeological approaches.

The heightened scholarly interest led to a great amount of research in the decades following Ward-Perkins’ seminal article, and a wealth of new data documenting quarries and trade continues to emerge. Much of this data has failed to support, or has even contradicted, the Ward-Perkins model, leading to a number of refinements and critiques. Large stockpiles have been called into question, as even the thousands of blocks and columns found at the imperial marble yards in Rome would have constituted merely a fraction of annual imports, and anyway appear to be rejects of rather poor quality.<sup>117</sup> Blocks for veneer and sarcophagi certainly had standardized dimensions, but columns exhibit much greater variability. The evidence for overseas agencies was always circumstantial. Overall, the model seems to work better for some regions and markets (such as sarcophagi from the Proconnesian workshops and quarries) than others.

On the other hand, the vast scale of the imperial organization, sometimes called the “marble bureau” or *ratio marmorum*, has been largely confirmed. Epigraphic evidence names many different officials and attests to imperial involvement with at least sixteen distinct stones and their quarries; textual sources, as well as other suggestive but inconclusive evidence, implicate possibly nine more.<sup>118</sup> These include many of the quarries supplying the most famous of Roman decorative stones – white marble from Carrara, Paros, and Proconnesus, and colored

---

<sup>116</sup> Most recently: Garcia-Moreno et al. 2012.

<sup>117</sup> Fant 2001.

<sup>118</sup> Fant 1993. The secure cases of imperial ownership are: *m. Carystium*, *m. Chium*, *m. Lacedaemonium*, *m. Luculleum*, *m. Numidicum*, *m. Synnadicum* or *Phrygium*, *m. Troadense*, *lapis alabastrites*, *basanites*, and *porphyrites* from Egypt, *m. Claudianus*, *m. Lunense*, *m. Parium*, and *m. Proconnesium*.

varieties such as *africano* from Teos, *giallo antico* from Numidia, and the porphyries and granodiorites of Egypt, among others.

J. Clayton Fant attempted to reconcile this apparent paradox by proposing an alternative model for the distribution of imperial stone, one which questions two general assumptions of the Ward-Perkins model on which it builds: (1) that a market economy existed for decorative stone from the beginning and changed little over time, and (2) that supply and demand were therefore the original motivation and controlling force of the imperial confiscation and organization.<sup>119</sup> Noting that marble had become symbolically and ideologically charged over the course of the late Republic, and that in the Augustan period almost all imperial stone was restricted to imperial buildings, Fant argues that a desire for imperial prestige, and not economic demand, motivated the creation and maintenance of the imperial system. The emperor needed reliable access to marble in order to be able to build and repair imperial edifices and to maintain Rome as a worthy imperial capital, but once this was satisfied secondary distribution from Rome became possible, and marble spread throughout Italy and, to a lesser extent, the provinces. Much of this redistribution was no doubt commercial in nature and driven by market forces, but Fant also understands the use of some marble in large scale public buildings in terms of a gift economy, in which the emperor provided benefactions of columns and other supplies.<sup>120</sup> Market-oriented trade increased dramatically only in the second century CE, commensurate with the popularity of stone sarcophagi, when the emperors "had to decide to loosen their hold on supplies, and had to change operating instructions to encourage procurators to look to the market."<sup>121</sup>

---

<sup>119</sup> Fant 1993.

<sup>120</sup> *Ibid.* 155. Epigraphic and literary sources provide evidence of such imperial benefactions at Smyrna (IGR IV 1431 = I. Smyrna no. 697) and Athens (Paus. 1.18.8-9).

<sup>121</sup> Fant 1988, 151.

Fant supports this model with the geographical and chronological distribution patterns of the imperial stones. In Italy marble spread only very slowly beyond Rome, and as it did it was used earlier in public and imperial buildings than in private. Only in the early second century CE does marble become more widespread among the public buildings and private villas of Italy, and Fant reasons that the slowness of this diffusion reflects a lack of response to demand. In the provinces marble is far rarer, but appears to follow similar patterns. At Carthage and Utica, for instance, Numidian marble does not appear in private contexts as it does in Italy. A redistributive model accounts for this, as only imperial projects or socially connected institutions or individuals would have access to marble from Rome.

This model takes into account more evidence than Ward-Perkins was able to and adds chronological depth, in addition to recognizing the clearly non-economic elements of the imperial system and their relation to the economic elements. On the other hand, Fant himself offers several caveats. Most of his observations are qualitative rather than quantitative, owing to the dearth of detailed distribution studies. What is more, he noted that different types of imperial stones had varying individual characters and histories, despite imperial ownership. Thus, the wide provincial distribution of Carystian marble may suggest that commercial intentions underlay its exploitation from the beginning of imperial ownership.<sup>122</sup> Not *every* imperial stone necessarily travelled to Rome for imperial use or redistribution, nor did every block produced from a given imperial quarry. In fact, a distinction is drawn between inscribed stones destined for the Rome and stones with "internal" inscriptions or no inscriptions, which may have entered regional markets.<sup>123</sup>

---

<sup>122</sup> Fant 1993. 162-3.

<sup>123</sup> Fant 1993, 157-162.

New studies have borne out Fant's reservations. Paton and Schneider's study of imported marbles on Roman Crete, for example, shows that stones appear in larger quantities in the second century than Fant's model would perhaps suppose, and are distributed throughout the island rather than limited to important centers like Gortyn, the probable residence of the provincial governor.<sup>124</sup> None of the pieces bear inscriptions, and the large amount of some types, such as *marmor Claudianum*, is difficult to fit into a redistributive or gift economy. What is more, at Knossos, Kissamos, and Makryialos marble often shows up at domestic sites, which the model predicts should have the least access to such stones. It is significant that this private use entails not only veneer and paneling but also monolithic columns of Chian marble, at Knossos and possibly Kissamos. The authors of the study conclude that imperial marble, even large amounts or large individual pieces, was relatively easy to acquire for those who could afford it, possibly due to the position of Crete on sea-trade routes between the quarries and Rome. We might compare other provinces off of such routes, such as Roman Palestine, where the more limited distribution is more accurately portrayed by Fant's model.<sup>125</sup>

However, Fant's work hinted that no single system governed the entire trade in stone, or even that in imperial marble, a point that newer research has emphasized. In a broad study of epigraphic material concerning imperial mines and quarries, for instance, A. Hirt argues that the Roman state preferred to interfere as little as possible with stone extraction and transportation while maintaining overall control of the system.<sup>126</sup> Hirt shows that only in limited cases did imperial officials play a primary role in provisioning and operating stone quarries—for instance, in Egypt, where the remote location must have dissuaded independent contractors. Quarry marks on other stones, such as white marble from Docimium in Asia Minor and Luna in Italy, instead

---

<sup>124</sup> Paton and Schneider 1999.

<sup>125</sup> Fischer 1998.

<sup>126</sup> Hirt 2010

suggest the importance of private contractors partnering with the imperial authorities. The system in general was flexible and decentralized, with the local administration making the important day-to-day decisions and top-down imperial intervention occurring only on an ad-hoc basis.

Other work has drawn attention to non-imperial factors. B. Russell, examining the trade in sculpted stone (sarcophagi, statuary, and architectural elements) across the empire, emphasizes the importance of private consumption and of individual consumer choice in dictating the shape of this trade.<sup>127</sup> Most recently, L. Long's dissertation considers similar issues on a regional scale within Asia Minor, tracing the paths of non-imperial marble and the sculptors who carved it in order to expose the dynamics of a sizable local market for decorative stone.<sup>128</sup> The new consensus seems to be that the importance of the imperial marble bureau has been exaggerated; that is, that while the organization may have constituted a substantial output on the part of the state, and did lead to some notable changes in economic modes of production, it can nevertheless represent only a fraction of the total trade in stone within the Roman empire, and anyway was governed by a unique set of rules. Even with this recognition, however, these recent studies continue to focus almost exclusively on marble and other fine decorative stones, noting but largely passing over coarser building stones such as tufo which constituted a significant portion of most urban construction.

### *The Nature of the Evidence*

The "Imperial Marble Trade" and the use of decorative stone in the empire has come to dominate the discussion of Roman quarrying due in large part to the nature of our available

---

<sup>127</sup> Russell 2009; 2013.

<sup>128</sup> Long 2012.



evidence and to the primacy attributed in the past to textual approaches. In particular, the reliance on epigraphic evidence has skewed research toward the complex, large-scale, state-sponsored trade in luxury stone. While such sources can provide important data on the organization of this trade, the broader organization of Roman stone extraction can also be approached from other angles. In light of the need to synthesize this disparate evidence, the following pages briefly review the nature of the data and how it can contribute to an economic study of Roman quarries. I hope to illustrate both how we came to our current understanding of the trade in stone as well as how limiting this understanding is.

Literary and historical texts provide a wealth of information on quarries, but it is often anecdotal, decontextualized, and difficult to integrate into a larger view of the stone industry. The agronomists, for instance, offer a very different picture of Roman stone quarrying than that supplied by inscriptions on imperial marble—that of small-scale extraction by individuals on private property. Varro notes that it is perfectly acceptable to quarry stone on any suitable land one might own, even if this does not strictly constitute agriculture.<sup>129</sup> Columella, in describing the ideal country estate, includes the presence of hills which can furnish stone for any necessary construction.<sup>130</sup> These sources may reflect more the ideal image of a self-sufficient estate than actual practice, but they suggest at the very least the possibility of quarrying by landowners for their own private use, a possibility ignored by focusing exclusively on decorative or imperial stone. In fact, the bulk of private construction may have drawn on such small, privately held quarries.

It is perhaps this type of quarrying which can also be seen in legal sources. Both Ulpian and Paulus discuss the extraction of stone on land given to a husband as part of a dowry, in

---

<sup>129</sup> Varro *de re rustica* 1.2.23

<sup>130</sup> Columella *de re rustica* 1.2.4

which case any profit derived from the stone rightfully belonged to the husband following divorce.<sup>131</sup> Similarly, entries on usufruct indicate that the usufructuary was permitted to open and work stone quarries, as long as the land was not required for normal agricultural cultivation.<sup>132</sup> In fact, if doing so provided more income than vineyards or orchards, these could be cut down to improve the property. Such laws seem at first to encourage the development of stone extraction, particularly for quarries of profitable luxury stone—Ulpian, in fact, specifies that it is marble and not a more mundane building stone which is under discussion here. However, Roman law was often inconsistent regarding economic development, and quarries are no exception. The discussion of dowries also notes that stone was not considered part of the “yield of the land” as was gold, silver, chalk, or sand, so any expenses incurred in its removal were left to the husband following divorce. Quarries on land under usufruct were even more limited; operations could not pollute the air or require a large number of workers, and only buildings needed for harvesting crops could be constructed. This would in all likelihood limit the scale of potential stone extraction, which requires substantial labor and facilities for, at the very least, blacksmithing and shelter. Thus, while the *Digest* demonstrates the existence of private quarries, it also shows how Roman law could act as a brake on their development.

State-owned quarries, on the other hand, would not have been subject to these limits. Such quarries have seen greater scholarly attention, in part because ancient authors themselves found them worthy of comment. Suetonius relates what is typically seen as the seminal event in the imperial marble system—the appropriation by Tiberius of mines and quarries from many cities and individuals who previously held the *ius metallorum ac vectigalium*.<sup>133</sup> A more specific case is mentioned by Tacitus, who describes the same emperor’s seizure in 33 CE of Spanish

---

<sup>131</sup> *Dig.* 23.5.18; 24.3.7.

<sup>132</sup> *Dig.* 7.1.13.

<sup>133</sup> Suetonius, *Tib.* 49.2: *plurimis civitatibus et privatis veteres immunitates et ius metallorum ac vectigalium*.

gold and copper mines belonging to Sextus Marius.<sup>134</sup> Suetonius, as a biographer of emperors, and Tacitus, as an historian of imperial Rome, naturally privilege the actions of the emperor, especially when such actions could be portrayed negatively, but we need not follow their example. Hirt, in fact, argues that Suetonius is exaggerating, since it is clear from the epigraphic record that many cities maintained their right of *vectigalia* through at least the end of the first century CE.<sup>135</sup> At any rate, while these or similar events may have allowed the state to acquire some mines and quarries, the vast majority must have remained under private or municipal ownership and operation; only for the most important quarries, extracting decorative stone for imperial projects which was otherwise difficult to acquire or which the emperor wished to monopolize, could the empire afford the cost and inconvenience of organizing extraction.

It is this kind of luxury stone which Roman authors were mainly interested in. In book thirty-six of the *Natural History*, Pliny presents a history of stone use and construction which covers many of the significant marble quarries of the ancient world. He particularly focuses on early marble use at Rome, discussing, for instance: the early importation of Hymettian marble columns by L. Crassus; the use of three-hundred and sixty such columns in the theatre of M. Scourus; the Numidian marble threshold to the house of M. Lepidus; and the Carystian or Luna marble walls in the house of Mamurra, Caesar's *praefectus fabrum*.<sup>136</sup> Such anecdotes can be useful in charting the use of marble in Rome, but also articulate the attitude of later writers toward such actions. Pliny's discussion is overtly moralizing, censuring these men for such private displays of wealth, in keeping with his overall theme condemning *luxuria*.<sup>137</sup> Decorative stone was a potent symbol of wealth and power, and it is for this reason that later emperors

---

<sup>134</sup> Tacitus

<sup>135</sup> Hirt 2010, 85.

<sup>136</sup> *Nat. Hist.* 36.

<sup>137</sup> For more, see Isager 1991.

would seek access to it and some sort of control over its extraction. This is also what led authors like Pliny to discuss it, and building stones like tufo are rarely found in our sources—the notable exceptions are a few important passages in Strabo and Vitruvius, and these will be discussed later in this chapter. In general, however, the modern preoccupation with “marbles” directly follows that of the ancients.

The interest of the state in the symbolic power of decorative stone is tangibly displayed in the rare documentary texts detailing the organization of imperial extraction. I have already mentioned the quarry-block inscriptions which constitute the best evidence for the imperial management of certain stone quarries. Such inscriptions have been found throughout the Roman world, from the quarries in the eastern Mediterranean and Africa to the marble yards of Rome, and often they include very specific information such as the consular date, the contractors involved, and the precise location of the quarried block. Several studies have illustrated the insights provided by such texts, including Hirt’s examination of imperial mines and quarries already described. Even earlier, Fant published an exhaustive survey of epigraphic material relating to a single group of quarries, those producing *pavonazzetto* marble at Docimium, Turkey.<sup>138</sup> He was able not only to elucidate the complex mechanisms of control in place at the quarries, but also to show how changes in extraction related to broader, empire-wide trends in stone use and demand.

In addition, there are a number of recently published *ostraka* from Egypt which shed light on stone extraction in the Eastern desert. The quarries at Mons Claudianus supplied grano-diorite for numerous imperial projects, including the monolithic columns on the porch of the Pantheon, and excavations at the site have unearthed hundreds of texts bearing on the supply and

---

<sup>138</sup> Fant 1989a.

organization of these quarries.<sup>139</sup> These include lists of workers and their deployment, and of tools for quarrying and metal-working, accounts of finished work, of water distribution, and of stone sources, as well as correspondence between supervisors and their superiors. One can even determine the wages of particular workers, which were on par with mining wages in Dacia.<sup>140</sup> These texts provide amazing insight into the logistics of imperial extraction, documenting the great cost and effort necessary to supply such an endeavor in the remote desert. Indeed, the geographical constraints made this an extraordinary undertaking, possible only with the resources and command of the imperial government. Consequently, this presents a very lopsided view of the stone trade, biased toward luxury stone and imperial enterprise.

This bias has carried over into archaeological work at quarry remains. The small, private quarries of the ancient world are nearly impossible to locate today, while imperial quarries were worked on such a scale that many have been located and investigated archaeologically. The most fully explored and published examples are Mons Claudianus and Mons Porphyrites in the eastern desert of Egypt, where the dry climate, isolated location, and hardness of the stone quarried have all contributed to the remarkable preservation of both the quarry faces and associated archaeological material.<sup>141</sup> Survey of the surviving faces allows for the study of extraction techniques and quarry development, while excavations at the related fort and habitation structures document life and work at imperial installations in the eastern desert. At Mons Claudianus in particular, the combination of quarry survey, excavation, and some 9,000 documentary ostraka provides an astonishingly full picture of the imperial extractive organization. The fact remains, however, that this picture is limited to the extraordinary rather

---

<sup>139</sup> Bülow-Jacobsen, 2009.

<sup>140</sup> Cuvigny 1996.

<sup>141</sup> Maxfield and Peacock 1997; 2001.

than the ordinary. Smaller, non-imperial quarries are far less understood, mainly due to a lack of preservation.

In locating and exploring these outcrops, archaeologists have been able to acquire samples of most of the widely used luxury stones of the Roman world. While stone sampling for comparative purposes has always been an important element in the study of ancient stone, the increasing accuracy and viability of petrologic laboratory analyses has significantly increased the value of such sampling, permitting the secure sourcing of stone taken from ancient remains. This has been especially helpful for types of stone which are macroscopically (or even microscopically) very similar, such as white marbles, but even colored luxury stones can appear similar while originating from different source quarries. Depending on the type of stone, many types of analysis may be available, varying in cost and efficacy, and studies now typically use some combination of various techniques. The microscopic examination of thin-sections allows identification of individual mineral fragments and structure, while isotopic and trace-element analysis permit even more detailed geochemical characterizations, which can be compared with samples taken from specific quarries or deposits.<sup>142</sup> These analyses allow for the mapping of the more accurate distributions necessary in order to understand the economy of the trade in stone.

This review of our material on quarries, necessarily selective, nonetheless brings several important issues to light, many of which are all too often glossed over in discussions of quarries and their role in the economy. For one thing, our initial reliance on epigraphic and textual evidence has biased research toward imperial stone quarries. Inscriptions and ostraka provide a unique window onto the operation of such ventures, demonstrating the massive resources dedicated by the state to the extraction and transportation of luxury stone, as well as the elaborate

---

<sup>142</sup> Such studies are too numerous to list here. They are published regularly in the journals *Archaeometry* and *ArchéoSciences*, as well as in the proceedings of ASMOISA conferences. For a recent collection, see the articles in Garcia-M. et al 2012, sections 2 and 3.

administration it created to facilitate these actions. These activities were only possible with the involvement of the Roman state, which did not function as a rational economic actor concerned with costs and profits. Many scholars have noted that while the extractive industries produced on a demonstrably larger scale in the Roman period, there is stronger evidence for non-economic involvement than in other industries; according to this view, the imperial quarries in Egypt represent economic "distortions" driven by the state.<sup>143</sup> For instance, imperial quarries were funded by the state, and often shipped stone to individual construction projects also funded by the state, reducing the scope of commercial transactions.<sup>144</sup> While they serve as examples of the scale of activity possible in the Roman world, they cannot provide a complete picture of the economy of Roman stone extraction. It is difficult to assess how comparable the practices, labor, and institutions involved with imperial extraction might have been to those involved with other kinds of stone quarries serving local or regional needs.

In addition, the epigraphic and textual evidence for Roman quarrying can also encourage the conflation of two very different extractive activities: mining and quarrying. Both can be referred to with the Latin *metallum*, and both were subject to similar administrative systems for state enterprises, as the title of Hirt's *Imperial Mines and Quarries in the Roman World* suggests.<sup>145</sup> In addition, criminals (and later, Christians) could be sentenced to either from at least the end of the first century CE.<sup>146</sup> However, mines and quarries, while perhaps similar in concept (involving frequently difficult labor removing material from the earth), were quite dissimilar in practice, requiring different resources, expertise, and infrastructure. More

---

<sup>143</sup> Mattingly and Salmon 2001: 6-7.

<sup>144</sup> Lo Cascio 2007: 646. Importantly, however, others have emphasized the roles of private contractors working in conjunction with imperial agents.

<sup>145</sup> Though it is important to note that Hirt's work is conceived as more a study of imperial administration than of the economy of metal and stone.

<sup>146</sup> Millar 1984; Davies 1958. It remains debated as to whether convicts were sent exclusively to mines and quarries administered by the state. The economic implications of convict labor are discussed further in chapter six.

significantly, they created products with qualitatively different economic roles. Metals like gold, silver, copper, tin, lead, and iron were needed for coinage, jewelry, and innumerable tools and weapons used in a variety of industries and in everyday life, while stone quarrying was tied to construction and sculptural decoration.<sup>147</sup> Metal and stone artifacts thus show different patterns of use and distribution, as they participated in different sorts of commercial systems.

Even within the study of ancient stone quarrying, however, the prominence of imperial quarries has skewed research toward luxury stones rather than more ordinary building stone, with a correspondingly limited understanding of the economy of stone more broadly. Marble was needed by the emperor and by elites for the production of symbolic capital—that is, to acquire prestige. It was a true luxury good, worth little to the vast majority of the populace, and therefore subject to different economic processes. Ordinary dimension stone, on the other hand, was so central to Roman urban life that it might be considered a staple, necessary for the more or less constant (though cyclical) construction of all kinds of structures, from the grandest marble-covered temple to the humblest apartment building or private home. Yet the extraction and transportation of this kind of stone is too often taken for granted, or given only brief lip-service, in architectural and economic studies.

Despite these issues, a more positive feature in the study of stone quarrying is also clear: the availability of a wide range of evidence of various kinds, and the need to integrate such evidence to develop an understanding of the industry. The durability of stone allows for excellent survival in the archaeological record, even if the extractive sites themselves occasionally fare rather less well. Combined with the insights garnered from textual sources and from petrographic analyses, there remains great potential in the study of ancient stone.

---

<sup>147</sup> While much sculpted stone was architectural in nature, one might debate the extent to which artifacts such as statuary or sarcophagi can be considered elements of the construction industry. Russell's (2008, 2013) excellent research focuses on such artifacts and their economic import.



*An Alternative View: Quantification and the Economy of Construction*

Several of the issues described above can be overcome with an alternative approach to stone quarrying, one which focuses on the economics of construction in the ancient world. In recent scholarship, traditional architectural approaches to Roman construction, emphasizing the often technical aspects of the complex engineering involved in monumental building, have increasingly drawn attention to the organization and economic impact of the building process. This approach has the virtue of considering all kinds of building materials, including both decorative marble and more functional types of building stone, as well as a range of building activities both monumental and mundane. The construction industry of Rome as a whole was undeniably important in the economic life of the city; Delaine estimates that in the Severan period it may have directly employed 4-6% of the population, or 15-24% of total adult males, while Kolb suggests that it sustained (both directly and indirectly) up to 150,000 urban inhabitants.<sup>148</sup> While the extraction and transportation of stone was only one element in the construction process, it was a crucial one requiring a large amount of labor, and would have constituted a significant portion of the overall cost of building. Delaine estimates, for instance, that the production and transportation of building materials for the Baths of Caracalla ultimately accounted for nearly half of the total cost of construction.<sup>149</sup>

A thorough understanding of the organization of the building industry has proven elusive, not least because it was characterized by some amount of variation (for example, between public and private construction) and by change over time. Holistic attempts also require the integration of many types of evidence, most of which provide only a brief snapshot of a single stage in the

---

<sup>148</sup> Delaine 1997, 200-1; Kolb 1995, 483-5.

<sup>149</sup> Delaine 1997(219-20, fig. 88), who admits the hypothetical nature of the land transportation figures utilized in the calculation.

building process.<sup>150</sup> Literary and legal documents, for instance, establish the importance of contracts and occasionally illustrate interactions between builders and patrons; a few representative examples will suffice here.<sup>151</sup> A letter of Cicero, for instance, explains that the senator was unhappy with several elements in the construction of a new villa and ordered the builder to alter them.<sup>152</sup> A notable inscription from Puteoli records an incredibly detailed building contract for the construction of a wall in 105 BCE, including exact dimensions and the specific building material required, as well as the cost and sureties involved.<sup>153</sup> Only rarely, however, do such sources illuminate the role of quarries in the building process. For private construction, Cato suggests that landowners supply the stone and other building material for any construction on their property even when hiring an outside contractor.<sup>154</sup> Dio Chrysostom implies that he himself inspected the quarries supplying stone for municipal projects in Prusa.<sup>155</sup> These sources suggest that those financing construction, both public and private, took an active interest in the supply of construction materials.

Visual evidence for the building industry can be found in paintings and sculptural relief, which sometimes include images of construction activities, such as the well-known crane on the late first century CE Tomb of the Haterii.<sup>156</sup> A painting at the Villa of San Marco at Stabia shows workmen finishing ashlar blocks and erecting columns, while a relief found at Terracina includes the shaping of blocks and construction of a wall, with two men looking on who appear to be

---

<sup>150</sup> The most comprehensive studies include: Adam 1994; Blake 1947; 1959; Blake and Bishop 1973; and Lugli 1957. See also Ling 1985. Both Delaine 1993 and Taylor 2003 examine the step-by-step construction process of individual buildings.

<sup>151</sup> Valuable sources in addition to those discussed here are Vitruvius' *de architectura* and the *Digest*.

<sup>152</sup> *Ad Quintum fratrem* 3.1.1-2.

<sup>153</sup> *CIL* I<sup>2</sup> 698.

<sup>154</sup> *De re rustica* 14.

<sup>155</sup> 40.7

<sup>156</sup> For which see Coarelli, 2009. A comprehensive collection of such images and reconstructions (including the Haterii relief) can be found in Adam 1994.

supervising.<sup>157</sup> But the symbolic nature of such displays means that it is difficult to move from these representations to the actual organization of construction. In fact, the most direct evidence of the building process is fossilized in the physical remains of the structures themselves, which furthermore constitute an ever-increasing data set. Ancient buildings preserve numerous indications of construction techniques and activities, from Lewis holes in individual blocks to large areas which can be identified as construction yards.<sup>158</sup> Even at the most basic level, however, we can determine the building materials needed for construction and, increasingly, their original source.

As far as the economy of construction is concerned, this is important because it allows for the quantification of material and labor necessary for various construction projects. It must be admitted that such quantification can be dangerous, as it almost always requires the estimation of unknown variables, and thus may give a false impression of precision. Biases in archaeological preservation and in excavation priorities further complicate the picture.<sup>159</sup> Some of the difficulties of quantification are apparent in Thornton and Thornton's attempt to compare the relative manpower costs for the construction of all public building programs in and around the city of Rome between 27 BCE and 68 CE.<sup>160</sup> They relied heavily on the area of a given building as a determinant of the cost of construction, an inexact and potentially misleading metric which can conceal differences in the cost of materials acquisition and decoration, among other factors. In addition, the use of arbitrary units and multipliers (e.g., the Maison Carrée at Nimes as the

---

<sup>157</sup> Adam 1994, 44-45.

<sup>158</sup> See, e.g., Lancaster 1999 for identification of construction yards and a reconstruction of building machines for the Column of Trajan.

<sup>159</sup> See Wilson and Fulford 2009 for discussion of these problems.

<sup>160</sup> Thornton and Thornton 1989.

baseline 60 “work units”, or a multiplier of 0.4 for construction deemed a “restoration” rather than new construction) leaves the results with dubious comparative value.<sup>161</sup>

Nevertheless, more recent research has shown that careful quantification has the potential to reach new and insightful conclusions in a variety of economic issues, provided it has a more circumscribed focus and greater attention to detail.<sup>162</sup> It is often essential to concentrate on *minimum* estimates, or on ranges indicating both minimums and maximums, and to carefully explicate any and all assumptions made in the calculations. The end result can provide only a rough guide to the reality, sometimes only in terms of orders of magnitude, but even with these limitations, quantification has allowed for more detailed description of economic trends and is a central contribution which archaeology can make to the study of the ancient economy more broadly. At the very least, such exercises can lead to hypotheses which can be tested in other contexts.

J. Delaine has deftly applied this kind of thinking to the construction of the monumental Baths of Caracalla.<sup>163</sup> After a detailed study of the material remains in which she estimated the amount of building materials, she uses nineteenth-century construction manuals (supplemented in places with figures from the ancient texts as well as data from experimental archaeology) to assign work values to various construction activities, ultimately allowing her to evaluate the man-power requirements for every stage and technique of the building process. For instance, the initial terracing of the construction area required the removal of 370,000 m<sup>3</sup> of clay, which needed to be excavated, loaded into baskets, and transported to carts for removal offsite. Using labor constants gleaned from the construction manuals for each of these activities, Delaine

---

<sup>161</sup> As discussed in chapter two, epigraphic descriptions of building activity do not necessarily reflect the type and scale of actual construction: see Thomas and Witschel 1992.

<sup>162</sup> Wilson and Fulford 2009 illustrate the vast potential of quantification studies concerning a variety of archaeological material related to the economy.

<sup>163</sup> Delaine 1997

calculates that this process required 174,000 man-days of unskilled labor and 17,400 man-days of skilled labor.<sup>164</sup> Ultimately, she is able to calculate the work force required for the project as a whole and the time likely spent on the various stages and construction, and to consider the social and economic implications of this for the building industry of Rome.

Importantly for my study, Delaine also applies this methodology to the production and transportation of construction materials, including tufo.<sup>165</sup> The builders of the Baths of Caracalla employed tufo only as aggregate and facing for concrete, and not for ashlar masonry, which is the focus here, so quarrying methods and the transportation of stone to the construction site would have looked quite different. In fact, outcrops of relatively poor quality tufo just a few kilometers away seem to have been used, rather than any of the well-known varieties further afield. Nevertheless, Delaine's work serves as an example of how one can investigate tufo extraction sites based on the *in situ* archaeological material of built environments. She estimates that the foundations and central block of the baths (that is, those portions thought to have been completed by 216 CE under Caracalla) required nearly 190,000 m<sup>3</sup> of tufo, quarried from deposits between 600 meters and 3 kilometers from the construction site. Again using manpower figures from the nineteenth century handbooks, she estimates that this would require 297,000 man-days to produce at the quarries, and a further 347,000 ox-cart days to transport to the baths.

We can take these calculations further in looking more specifically at the implications for these activities at the quarries themselves. We know that construction of these parts of the baths commenced in 211 CE and was completed in 216, so even if we make the (impossible) assumption that work took place every day of the year, over two-hundred men would need to be active at the quarries, with nearly forty ox-carts running six round trips per day between the

---

<sup>164</sup> Delaine 1997, 174 and Appendix 5, 268.

<sup>165</sup> Delaine 1997, 122-130.

quarries and the worksite. It is important to remember that the calculations here (both Delaine's and my own, based on her figures) tend to minimize man-power results, and the true figures could be much higher; as such, they make clear the scale of activity needed at stone quarries for large state projects. For quarries further out in the hinterland of the city, such activity would have great effects on local settlement patterns and economy.

Similar research attempting to determine the cost of construction has been conducted by other scholars at different sites both in Rome and beyond, though few have been as quantitative and as rigorous as Delaine.<sup>166</sup> However, such studies tend to focus on the act of construction as a whole rather than its effects on the area of the quarries.<sup>167</sup> This is certainly a valid approach, but the implications of construction for these distant source zones—essential areas of the construction process, I would argue—are not fully appreciated.

### *Local Quarries and Regional Economies*

Another recent trend in the archaeology of Roman quarries has centered on “local” quarries, those with limited distributions, and their importance to regional economies. Due to the limited distribution of *lapis Gabinus*, the quarries at Gabii can be considered one such “local” phenomenon, albeit one which is perhaps more notable for supplying the imperial capital. The methodologies utilized in previous studies of this sort must therefore inform my analysis of the *lapis Gabinus* quarries. Though it is impossible to provide a summary of such studies, I examine briefly here the state of local quarry research in Iberia and Britain, in order to illustrate the important contributions of this approach to the understanding of the Roman economy of stone,

---

<sup>166</sup> E.g., Kendal 1996; Prisset 2008; Dumasy 2008; Camporeale et al. 2008; Pensabene et al. 2012.

<sup>167</sup> An important exception is the work of G. Cifani (2008; 2010), who considers the tufo quarries used in and around Rome in the Archaic period.

and to even larger issues in the study of the Roman world such as “Romanization” and economic growth.<sup>168</sup>

In the Iberian peninsula, cities saw vast growth in the Roman period, though much of the eastern littoral had already participated in the emergence of Mediterranean urbanism under Punic and Greek influences.<sup>169</sup> This growth demanded large quantities of both decorative and bulk-building stone, and this demand could be only very partially satisfied by imports of imperial stone.<sup>170</sup> As a result, provincial residents turned to local quarries, a huge number of which appear to have been first exploited following Roman occupation. Total figures are difficult to estimate; a study by M. Cisneros identified nineteen stones from different quarries within Baetica alone.<sup>171</sup> For the most part, individual quarries are difficult if not impossible to locate, though there are exceptions, such as the recently discovered and well-preserved limestone quarry at Colaride in Lusitania.<sup>172</sup> Recent studies have compensated for this difficulty by examining and provenancing the stone within different buildings and settlement sites and comparing the local and regional geologies, made possible by the advances in petrography discussed above.<sup>173</sup>

Site-based approaches are useful in that they allow a comparison of the relative use of local and imported stones, and just such an approach has been used to examine the stone from

---

<sup>168</sup> I use the term Romanization broadly here, to describe the complex and varied processes by which individuals beyond Rome came to participate in the broadly similar material culture which permeated the Mediterranean in the Roman period.

<sup>169</sup> For early Roman-period town development in Tarraconensis, see contributions in Abad Casal et al. 2006; for Baetica, Keay 1998.

<sup>170</sup> There are no proven cases of imperial quarries *within* the Iberian provinces themselves. However, an inscription hints at one somewhere west of Cordoba, and the quarries of white marble at St. Beats in the Pyrenees are another (though doubtful) candidate for imperial ownership: Fant 1993, 166-7. State ownership has also been suggested for the quarries at Almadén de la Plata (see discussion below): Mayer and Rodà 1998.

<sup>171</sup> Mayer and Rodà 1998, citing Cisneros 1988.

<sup>172</sup> Coelho 2008.

<sup>173</sup> See especially contributions in Nogales and Beltrán 2008.

the well-preserved structures of Augusta Emerita, the provincial capital of Lusitania.<sup>174</sup> The most common building stone is a granite, and petrographic analyses have located the quarries about five kilometers from the modern town of Merida. These stones constitute the bulk of most of the public monuments of the city, such as temples, theaters, aqueducts, and bridges. Decorative stone, on the other hand, came from a variety of more distant locations. The majority came from the quarries of Estremoz within Lusitania itself, and much of the rest was also extracted within the province, such as breccias from the city's own territory. There is also a smattering of imperial marbles, including *giallo antico*, *africano*, and *cipollino*. However, Estremoz marble dominates, and in fact this source provided all the marble for the provincial temple of the imperial cult, a building we might naturally expect to utilize imperial stones. This stone has also been found at Conimbriga, much farther from the quarries, raising the possibility of a distribution beyond the local level.<sup>175</sup> It is the primacy of the locally-sourced granite, however, which is most striking, and which would have most affected local economies.

As a complement to site-based studies we might consider a single type of “local” stone, its quarries, and distribution. This presents a more comprehensive view of the stone, allowing one to assess each stage of the economic process—production, trade or transport, and consumption. A type of limestone known as Santa Tecla stone, for example, was used extensively in northeastern Spain. The quarries are just north of Tarraco itself and were worked beginning in the reign of Augustus; they provided stone for the architectural elements, funerary stelae, pedestals, altars, and *opus sectile* pavements within the city.<sup>176</sup> But the stone is found at several villas in the hinterland of the city, further inland at Ilerda and Iesso, to the north in

---

<sup>174</sup> Nogales et al. 1995. This study is helpful, but the presentation of more quantitative data would facilitate comparisons.

<sup>175</sup> Alarcão and Tavares 1988.

<sup>176</sup> Álvarez et al. 2009.



Barcino, and even as far south as Saguntum. A similar pattern is apparent with marble from the Almadén de la Plata quarries northwest of Italica. This stone appears in great amounts at Italica and nearby sites like Munigua, but also in smaller amounts throughout Baetica.<sup>177</sup> At Italica it was used beside numerous imperial stones in monuments like the Traianeum and theater, suggesting that access to imported stones did not displace the use of "local" marble, even in important public buildings. It has been suggested that the Almadén de la Plata quarries were under imperial ownership, with a *statio marmorum* located at Italica;<sup>178</sup> this might help explain its use in these monuments, but would complicate the mono-directional model sometimes suggested for imperial stones, in which most imperial quarries sent stone to Rome for use or secondary redistribution.

Overall, the evidence points to an increase in the number of active quarries in Iberia in the Roman period, even if this cannot yet be quantified with any accuracy. Indeed, this would be the next step in assessing the economic growth of the industry in these provinces - calculating how many quarries opened and how much labor they required for extraction and transportation of the stone. For now, though, we can highlight several significant points: regional distributions of non-imperial stones, the use of locally quarried material alongside imports in the same municipal monuments, and the possibility of imperial quarries operating on a different economic model than the better-known quarries. More research is needed to fully understand these issues; in particular, more quantitative studies of stone distributions will allow finer-grained analysis of how various stones are utilized. The economic importance of "local" quarries is clear, however.

Britain presents another interesting case: a province especially distant from the majority of imperial quarries in the eastern Mediterranean, and one which in large part had no previous

---

<sup>177</sup> Mayer and Rodà 1998.

<sup>178</sup> *Ibid*, 228.

tradition of large scale stone construction.<sup>179</sup> Here, a substantial number of quarries began to be worked in the Roman period. Inscriptions attest to seven such quarries, mainly near Hadrian's Wall and associated with the military and the construction of fortifications.<sup>180</sup> Another at Chester appears to date to ca. 100 CE.<sup>181</sup> For the most part, however, quarries can be located only very generally, based on regional geology, and for more information we are reliant on the appearance of many types of stone in construction projects at towns and forts. Recent geological studies of the provenance of architectural stones allow us to appreciate the great number of types which were exploited.<sup>182</sup> Almost all such stone was locally quarried, rarely travelling more than a few kilometers. A good example is the use of Sudbrook Sandstone from a small outcrop in South Wales.<sup>183</sup> The stone was first used in the 70s CE at the legionary fortress of Caerleon fifteen kilometers from the outcrop, suggesting that the military may have been involved in the prospecting and initial quarrying efforts. At the fort it was used whenever large or carved blocks were needed, and therefore makes up only a small percentage of the fort's building stone. It appears in more substantial amounts at the town of Caerwent (*Venta Silurum*), much closer to the outcrops, in the second and third centuries CE. Here it was found in the form of column bases, steps, paving, drains, door jambs and other elements, in public buildings such as the forum-basilica and temples but also in private housing.

Locally quarried stones like Sudbrook Sandstone clearly make up the majority of building stone in the Roman period. Even so, public and domestic construction on the Roman model demanded a supply of finer decorative stone for veneer, paving, columns, and other

---

<sup>179</sup> Blagg 1990, 33; Pearson 2006: 15-16, who at the same time notes that some upland areas did have a tradition of stone construction to some degree. It is notable that the volume containing Blagg 1990, which considers quarrying in Britain down to the 16th century, explicitly begins in AD 43.

<sup>180</sup> Pearson 2006: 46.

<sup>181</sup> Ibid: 51.

<sup>182</sup> E.g., Hayward 2009.

<sup>183</sup> Pearson 2006, 116-120, citing Allen 2005.

elements. Yet imports of imperial stones remained scarce in Britain throughout the Roman occupation; the first-century monumental arch at Richborough, for example, is often cited as the only building in Britain externally covered in imported marble veneer (from the quarries at Carrara). At London imported stone makes up only about half of all the Roman "ornamental marble" surveyed in 1986.<sup>184</sup> The difference is largely made up by a British substitute, the so-called Purbeck marble (actually a bluish-grey limestone which takes a high polish) from the Isle of Purbeck, Dorset.<sup>185</sup> This stone made its first appearance in the Roman period, though it continued to be quarried until the nineteenth century. Though the exact location of the Roman quarries is unknown, excavations at Norden near the outcrop produced waste material indicating the working of the stone from the second to the late third or fourth centuries.<sup>186</sup> In other contexts the stone appears as early as the mid-first century CE. It was used mainly for veneer, paving, *opus sectile* flooring, decorative architectural elements, and tablets for inscriptions, and differs from other British stones in its much larger regional distribution across all of southern Britain. It is to be found in public buildings like the temple of Claudius at Colchester, temples at Silchester and Verulamium, and the forum of Silchester, and in domestic settings like the palace at Fishbourne. Purbeck marble also dominates the colored stone assemblages from London and Canterbury, and isolated finds occur at Gloucester, Exeter, and as far north as Lincoln.<sup>187</sup>

These examples from Britain, like those from Iberia, reveal the complexity of provincial stone supply and production in the Roman period. Across the provinces new quarries emerged to satisfy the increased demand for building stone, often driven early-on by military needs. The exploitation of Sudbrook Sandstone illustrates how an initially military-related demand might

---

<sup>184</sup> Peacock and Williams 1995.

<sup>185</sup> Williams and Peacock 2000.

<sup>186</sup> Blagg 1990: 45-46.

<sup>187</sup> Williams and Peacock 2000 contains the best overview of this distribution.

lead to the discovery and quarrying of a new stone later to be utilized in private or municipal settings. At the same time we must note the relatively small-scale of the military use at Caerleon when compared with that at Caerwent; even a relatively modest Roman town required large amounts of locally quarried building stone. Purbeck marble, on the other hand, presents a regional distribution resulting from the scarcity of imported imperial decorative stones. A re-distributional model for imperial stone accounts for this scarcity, but naturally cannot consider the economic importance of Purbeck marble. In fact, it has even been suggested that the quarrying and trade of this stone *was* controlled by the state, as represented by the army.<sup>188</sup> If this is the case, then the stone clearly does not follow the redistributive pattern established for some other imperial stones, but may illustrate yet another means by which the Roman state allowed for and stimulated economic growth through stone extraction.

This is perhaps the most interesting issue to emerge from these provincial case studies - stones from provincial quarries like Purbeck, Estremoz and Almadén de la Plata, which have regional distributions and hints of imperial involvement. These might constitute a new category of quarries, challenging the local/imperial dichotomy assumed in much of the scholarship. It is possible that they operate almost as a microcosm of the empire-wide re-distributional model, centered on provincial centers like Augusta Emerita instead of Rome. After demand at the center was satisfied, the stone could have been made more widely available in the hinterland and beyond. This is largely conjecture, but more focused, quantitative research on such stones is needed to assess their overall economic importance. At any rate, these examples demonstrate the variety of organizational systems possible in the realm of stone extraction, and draw attention to

---

<sup>188</sup> Pearson 2006, 115-116. The argument is based on: the location of a military base in an excellent position to distribute the stone; the presence of Purbeck marble at another nearby military site, at the Claudian base of Richborough, and in prestige buildings in Colchester; military inscriptions on the stone; and the lack of wealth invested near the quarries themselves in the form of villas owned by those exploiting the stone. The author admits that the evidence is inconclusive.

the significance of the local and regional trade in stone, a significance which quarry scholarship is only just beginning to appreciate.

## **The Roman Tufo Industry**

In spite of recent attention to regional trade in non-imperial stone, and to the economics of the building industry, few studies have rigorously examined the production of local tufo for urban construction in Rome. This is all the more surprising because identifying and distinguishing the various types of tufo found in Roman architecture has a long history, and is often considered an essential skill for contemporary excavators. However, a full understanding of this important building material has been hindered by several factors, above all by the difficulty of accurately recognizing different tufo varieties macroscopically and by a limited knowledge of production centers—that is, the quarries themselves. The relatively recent application of petrographic and chemical analysis has partly alleviated the former issue, while this dissertation, in part, is intended to shed light on the latter. The industry has rarely been considered in full, but past work has laid the foundation for just such an endeavor. In this section, I review these past approaches to Roman tufo quarrying and present a summary of our current understanding of the industry.

### *Tufo and Chronology*

The first major synthesis of the evidence for tufo production and distribution was Tenney Frank's *Roman Buildings of the Republic: An Attempt to Date them from their Materials*.<sup>189</sup> Frank saw the presence of different types of tufo as a way to provide a relative chronology for

---

<sup>189</sup> Frank 1924; see also Frank 1918. An earlier, though less comprehensive and less accurate assessment can be found in Porter 1907.

undated Roman monuments. Relying on tufo found in well-dated buildings, as well as presumed dates for the operations of some quarries, Frank developed a chronology of stone use which has been only slightly refined in the years since (see fig. 9).<sup>190</sup> In this scheme, before the beginning of the fourth century BCE cut-stone ashlar construction at Rome was limited to the use of cappellaccio, a relatively friable tufo found in the immediate area, under the Palatine and Capitoline. The conquest of Fidenae (426 BCE) and Veii (396 BCE) allowed access to quarries of higher-quality stone, known as Fidenae tufo and Grotta Oscura, respectively. The use of these tapered off from the late third century on, as *lapis Albanus* (sometimes known as peperino) from the Alban hills became the favored stone for building as well as inscriptions. *Lapis Albanus* itself was displaced by a number of stones in the late Republic: *lapis Gabinus* (between 144-20 BCE) from Gabii, Anio tufo (from 140 BCE) from quarries along the Aniene River, and Monte Verde (ca. 179-50 BCE, with later use at Ostia) from near the Tiber just south of the city. However, *lapis Albanus* became popular once again following the fire of 64 CE and into the mid-second century.

Frank's approach was handicapped by several limitations. For one thing, as figure 9 clearly demonstrates, nearly all the varieties of tufo seem to have been in use toward the end of the second and into the first centuries BCE, even cappellaccio, presumably resulting from the excavations into this deposit for the foundation of the Tabularium. Re-use of spoliated material from earlier monuments becomes a further obstacle, and examples are often written off as anomalies. In addition, while Frank noted that tufo varieties had been misidentified in the past (especially *lapis Albanus* and *lapis Gabinus*), he was nonetheless limited to macroscopic identification techniques himself, which recent studies have often proven ineffective.<sup>191</sup> Most

---

<sup>190</sup> Frank 1924, 17-32; the refinements are discussed at length below, but above all see Jackson and Marra 2006.

<sup>191</sup> Jackson and Marra 2006, See further below

significantly, though, this method cannot provide an undisputed date for a given monument, because there is no way to prove that certain stones were not used before the earliest or after the latest well-dated example.<sup>192</sup> There is therefore a very real danger of circular reasoning. Frank himself recognized some of these limitations, however, and overall the work was an excellent contribution to the study of Roman tufo, providing some new dates as well as reasonably accurate accounts of construction materials for many buildings. An illustrative example is his discussion of the Carcer Tullianum, where he noted that the presence of *lapis Albanus*, rarely seen before the mid-third century BCE, suggests a date later than the regal period maintained at the time by other authors.<sup>193</sup> A relatively recent  $^{40}\text{Ar}/^{39}\text{Ar}$  analysis (dating the formation of the volcanic stone) confirms the presence of this stone, though the authors are more conservative in their dating, suggesting a date sometime from the fourth century on.<sup>194</sup> As Frank wished, his work “eliminates some serious errors, establishes some new facts, and invites the excavators to give fuller and more accurate notes on the materials they find.”<sup>195</sup> For future work on tufo, in fact, the last of these was perhaps the most significant.

Frank’s study made contributions to the chronology of Republican monuments and encouraged the cataloguing of building materials; it is not, however, an economic analysis. The focus is on the presence or absence of certain kinds of tufo in monuments, and not on the extraction and transportation of blocks—that is, limited to the consumption of this commodity rather than its production. Frank did attempt to locate the quarries for many these stones, and he provides useful information concerning those visible in the early twentieth century, some of which are no longer extant. But the organization of these quarries, the methods of stone

---

<sup>192</sup> Possible exceptions are *termini post quem* for Fidenae tufo and Grotta Oscura, since these were very likely only available after the conquest of Fidenae and Veii.

<sup>193</sup> Frank 1924, 36.

<sup>194</sup> Karner et al. 2001a.

<sup>195</sup> Frank 1924, 8.

extraction, and possible transport routes, are discussed only in passing. The quarries of *lapis Gabinus*, in fact, are mentioned only once, and the only location provided is three miles from the Aniene River; Frank assumes that the reader knows where the town of Gabii is situated, and transportation of the stone by cart to the river, and by barge to Rome, is presumably thought to be unproblematic.<sup>196</sup> There is no consideration of the effect of these quarries on the countryside around Rome. In addition, discussion of perhaps the most promising evidence for the organization of extraction, the quarry marks found on blocks of (usually) Grotta Oscura tufo, focuses mainly on which alphabet is used and the ethnic identity of the quarry workers.

Much of the subsequent work of the last century largely followed this example, cataloguing the presence of the various types of tufo as chronological markers, with little attention paid to extractive and transportation processes. In Marion Blake's comprehensive *Ancient Roman Construction in Italy* (based to a large extent on the notes of E.B. Van Deman), for instance, the entry for each variety of tufo is followed by essentially a list of monuments and dates.<sup>197</sup> The same can be said for Giuseppe Lugli's magisterial *La Tecnica Edilizia Romana*.<sup>198</sup> Archaeological excavations today continue to rely on this relative and rather general dating technique, while the chronology itself is treated rather un-problematically. Newer publications have fleshed out our picture of the geological and mechanical properties of various tufos (see the following section), but the full implications of tufo use, in economic terms, have not always been considered. In order to fully appreciate these implications, we need to take a step back and assess what exactly we know about Rome's tufo quarries.

---

<sup>196</sup> Frank 1924, 24-5.

<sup>197</sup> Blake 1947, 23-39.

<sup>198</sup> Lugli 1957.



## *Geological Background*

Tufo, or tuff, is a pyroclastic stone produced as a result of volcanic explosions, and can be found throughout much of Italy. Pyroclastic flows of gas, magma, ash, and other materials run down from volcanoes, settle, and eventually consolidate, forming mineral cements which harden the components into what is frequently a suitable building material. Tufo is therefore a composite rock made up of these various materials—ash, crystal, lava, mineral cements, and pieces of other types of rock. The resulting speckled appearance no doubt led to the Italian appellation “peperino” for many of these stones, referring to the small, dark, pepper-like inclusions found throughout the stone. The color of the surrounding matrix can vary from yellow, to red, to various shades of gray. Importantly, however, even a single deposit can feature significant variation in color, composition, and size of inclusions.<sup>199</sup> This fact, combined with the sometimes similar appearance of tufos as found in archaeological remains, has made macroscopic identification difficult.

In fact, the processes involved in the formation of tufo—both volcanic and diagenetic—allow for a great deal of variation in appearance, composition, texture, cementation, and importantly, in the mechanical characteristics of the resulting stone. Tufo from deposits within the city of Rome, for instance, are typically weakly consolidated and contain an abundance of glass fragments rather than rock fragments, making them likely to crumble when exposed to water; alternatively, coarse-grained varieties which are predominantly rock, such as *lapis Gabinus* and Tufo di Tuscolo, have greater compressive strength more suited to load-bearing construction.<sup>200</sup> In addition, some kinds of tufo are able to handle thermal expansion better than

---

<sup>199</sup> Jackson et al. 2005, De Casa et al. 1999.

<sup>200</sup> See Jackson et al. 2005; Jackson and Marra 2006.

other nearby stones such as travertine or Carrara marble.<sup>201</sup> These properties have implications for the selection of tufo for use in construction.

The geology of tufo makes it moderately durable yet relatively easy to cut compared to other dimension stones, especially when recently exposed. As such it has been used as a building material in many parts of the world and in various periods. In Roman times, quarries were also exploited in the Eifel region of Germany, where the stone supplied centers along the Rhine River.<sup>202</sup> The hill-towns of Etruria sit on tufo plateaus, and Etruscan builders quarried the stone for construction while also carving elaborate tombs into it.<sup>203</sup> In later periods, tufo from the Eifel region is also found in medieval churches in Belgium, Denmark, Germany, and the Netherlands, as well as in reconstruction efforts and some new construction of the late-nineteenth and early-twentieth century.<sup>204</sup> In Cappadocia, the famous rock-cut Byzantine churches are carved from tufo, which also, more recently, has been proposed as a cost-efficient, energy-saving facing for new construction in the area.<sup>205</sup> Further afield, most of the iconic *moai* statues on Easter Island were carved from tufo from the Rano Raraku volcanic crater.<sup>206</sup> In the U.S., tufo quarries in Arizona, Nevada, Utah, and Oregon supplied building material in the 19<sup>th</sup> and 20<sup>th</sup> centuries, and some see small-scale extraction today.<sup>207</sup> A study of tufo extraction therefore has far-reaching implications, and there is potential for interesting comparative studies. But it is in and around

---

<sup>201</sup> Jackson et al. 2005, 12; Jackson et al 2006, 506-7.

<sup>202</sup> Schaaff 2000. Note that this and the following can represent only a partial list of world-wide tufo exploitation, which has also taken place in Latin America, Japan, Romania, and elsewhere; a good summary can be found in Funciello et al. 2006.

<sup>203</sup> E.g., Cicciolelli et al 2010.

<sup>204</sup> Nijland et al 2003. Notably, tufo appears in Berlin's Charlottenburg Gate, constructed in 1907.

<sup>205</sup> Ozkahraman and Bolatturk 2006.

<sup>206</sup> For more, and full bibliography, see Richards et al. 2011; and Hamilton et al. 2011.

<sup>207</sup> For historical use in the United States, see entries (by state) in Smith 1914. Extraction of tufo continues today at Ideal Quarry in Baker City, Oregon, a quarry which supplied much of the stone for construction in Baker; see Lawrie 1914, 37-40, and figs. XX-XXI.

ancient Rome that it was most intensively exploited, as the primary building stone for the urban development of the capital over some six centuries.

In the area of Rome, the volcanic eruptions which ultimately formed tufo occurred sporadically beginning about 600,000 years ago, resulting from the Monti Sabatini and Alban Hills volcanic districts (to the northwest and southeast of the city, respectively, see fig. 1).<sup>208</sup> The main eruptive periods for the Monti Sabatini district occurred between 560,000 and 280,000 years ago, and for the Alban hills district, between 560,000 and 350,000, with further activity around 260,000 and 36,000 years ago.<sup>209</sup> The various tufo deposits thus created interfingered with each other and with sedimentary deposits created by the Tiber; the action of this river and, more recently, human activity, further modified the complex geology of the area. Both volcanic districts produced tufos frequently identified in Roman construction: from Monti Sabatini, varieties known as Fidenae, Grotto Oscura, and cappellaccio; and from the Alban hills, *lapis Albanus*, *lapis Gabinus*, Anio, Monteverde, and (yet again) cappellaccio.

However, as Jackson and Marra have noted (and as the repetition of cappellaccio in this list makes clear), these and other terms as often used in the archaeological literature are imprecise or ambiguous, and lead to some confusion.<sup>210</sup> For instance, “sperone” can refer to tufo from Gabii or from Tusculum to the south, and “peperino” has been used of *lapis Gabinus*, *lapis Albanus*, and even cappellaccio from the center of Rome. Specific names, including *lapis Gabinus*, have been used erroneously in the past to refer to stone from other volcanic units. This vague or inaccurate terminology has appeared in spite of geological work conducted in the last

---

<sup>208</sup> Standard works on the wider geological setting of Rome (and the place of tufo within it) include Ventriglia 1971, Funicello 1995, and Funicello et al. 2008.

<sup>209</sup> For the most complete chronology of these volcanic districts see Karner et al. 2001b; also Karner and Renne 1998.

<sup>210</sup> Jackson and Marra 2006. Other scholars had previously recognized some of these difficulties (see Blake 1947; Van Deman 1934), without addressing them systematically.

half of the twentieth century that has greatly increased our understanding of the geographic distribution, age, and mineralogical composition of the volcanic products of central Italy. Early work included that by W. Alvarez, which provided the basis for a greater understanding of tufo rosso a scorie nere and other volcanic deposits in the region north of Rome.<sup>211</sup> The products of the Colli Albani volcano (which produced *lapis Gabinus*) also saw the attention of a number of scholars, including M. Fornaseri, D. De Rita, and Funicello.<sup>212</sup> These studies were a part of the explosion of geological research resulting from the progressive development of more advanced analytical techniques over the last fifty years.

Work of this sort led to collaborative research between geologists and archaeologists that made significant contributions to the study of Roman construction. Albert Ammerman, for instance, has shown how local geological constraints affected the development of the Roman forum.<sup>213</sup> Alvarez and colleagues similarly demonstrated that the complex tufo stratigraphy of the Capitoline hill influenced the development of the urban architecture above it.<sup>214</sup> In addition, the sourcing of volcanic materials allowed archaeologists to begin thinking about the economics of supplying Roman construction and its effects on the selection of building material. Several scholars, for instance, have focused on identifying materials within Roman concrete.<sup>215</sup> E. Gazda convincingly argues that the builders of the concrete harbor installations at Cosa reserved imported tufo (as opposed to local materials, as determined by petrographic analysis) for structures which required greater strength.<sup>216</sup> In several recent studies, L. Lancaster examines the provenance of lightweight volcanic products found in concrete structures from around the

---

<sup>211</sup> See Alvarez 1972; 1973; 1975; Alvarez et al. 1975; Alvarez et al. 1976.

<sup>212</sup> See, e.g., Fornaseri 1963; De Rita et al. 1988; 1993; 1995; and recently, Funicello and Giordano 2010. See also Locardi et al. 1977

<sup>213</sup> Ammerman 1990; 1996.

<sup>214</sup> Alvarez et al. 1996.

<sup>215</sup> See Gazda 2001, 152-155, for a fuller discussion of this historiography (up to 2001).

<sup>216</sup> Gazda 2008, 279.

Roman world, providing a better understanding of the long-distance trade that was sometimes necessary to supply construction.<sup>217</sup> Scientific identification techniques are now widely used and allow archaeologists to be more certain than ever before of the sources and transportation routes of volcanic building materials.

In recent decades this trend in interdisciplinary stone research has also influenced the identification of ashlar Roman tufo in surviving monuments. Macroscopic observation of monuments and outcrops has been supplanted by microscopic examination of thin sections allowing more accurate and more complete lists of mineralogical components.<sup>218</sup> In addition, we now have a more or less complete understanding of the complex geochronology of the area, thanks largely to the application of argon dating techniques to the volcanic material.<sup>219</sup> It is possible to use this same radio-isotopic method to date tufo from Roman monuments, thus determining the eruptive unit to which it belongs and the provenance of the stone, as Karner and colleagues have done for the *lapis Albanus* of the Tullianum, the oldest portion of the Mamertine prison on the slopes of the Capitoline.<sup>220</sup> Most recently, X-ray and spectrometry techniques allow a more complete geochemical characterization of tufo samples.<sup>221</sup> These methods can detect the presence of several trace elements, the ratios between which comprise unique geochemical signatures which can distinguish between the volcanic products of the area.

Other recent work has been spurred on by conservation and restoration issues. While tufo can be an effective load-bearing dimension stone, it is susceptible to weathering and erosion when exposed to air and water. A study published in 1994 assessed the mechanical and chemical

---

<sup>217</sup> Lancaster et al. 2010; Lancaster et al. 2011. See also Lancaster 2005, 12-17 and 51-67.

<sup>218</sup> Jackson et al. 2005; Jackson and Marra 2006, 406 provide an informative table correlating the archaeological terms with known geological units.

<sup>219</sup> Karner and Renne 1998; Karner et al. 2001b; Marra et al. 2003; Freda et al. 2006; Giaccio et al. 2009; Sottili et al 2010.

<sup>220</sup> Karner et al. 2001b

<sup>221</sup> Marra et al. 2011 with bibliography.

alteration of tufo blocks from over forty monuments in the Forum and on the Palatine, finding significant evidence of scaling, fissuring, and loss of cohesion.<sup>222</sup> Much of this damage was related to the humidity of the environment; repeated soaking and drying of the stone caused enormous damage, but if it was left in a humid environment (that is, buried or submerged in water) or otherwise covered or protected it fared better. Roman builders seem to have been at least somewhat aware of these properties. At the Roman port of Cosa, for instance, as E. Gazda points out, tufo seems to have been preferred in concrete port structures which saw sustained water pressure.<sup>223</sup> Other studies have noted that the surface of *lapis Gabinus* in the Tabularium was highly degraded, though internally the stone remained robust and maintained its original mechanical properties.<sup>224</sup> In fact, it was for this reason that Roman builders preferred to use tufo in areas which would not be exposed to such weathering or to changes in temperature and humidity, such as foundations, or to cover tufo construction with plaster or a façade of travertine or marble. The degradation of tufo and potential treatments have also been investigated for Etruscan tombs, for the rock-cut churches of Cappadocia, and for tufo architecture from other parts of the world.<sup>225</sup> Recent publications continue to emphasize that the Roman tufo exposed by modern excavations should be covered or protected in some way.

This research has contributed to a good understanding of the geological age, mineral and chemical composition, and potential quarry locations of the Roman tufos. The geological, archaeological, and collaborative studies on Roman tufo have reached a critical mass, and have laid the foundation for my interdisciplinary examination of the economy of the tufo industry.

---

<sup>222</sup> Bianchetti et al 1994.

<sup>223</sup> Gazda 2008. See further below.

<sup>224</sup> De Casa et al. 1994; Sappa et al. 1995.

<sup>225</sup> Ciccioli et al. 2010; Turkmenoglu et al. 1991; a summary of similar research from around the globe can be found in Grissom, C.A., 1994, in a volume which also contains several case studies. For the area of Rome, see also Bianchetti et al. 1982.

### *Roman Knowledge of tufo*

The works of Vitruvius provide some idea of Roman knowledge concerning the quarry locations, material characteristics, and architectural applications of tufo by the late first-century BCE. He describes a number of building stones from the region:

Now order demands that I explain about quarries, from which both squared blocks and the supplies of rough, unhewn stone for building are obtained and readied. These, in turn, will be found to have unequal and dissimilar qualities. Some are soft and yielding around the city itself, in the manners of the *Rubrae* stones, the *Pallenses* stones, the *Fidenates* stones, and the *Albanae* stones. Some are of moderate strength, like the *Tibur* stones, the *Amiternae* stones, and the *Soracte* stones, and others of this type. Some are hard, like lavas.<sup>226</sup>

This passage has been analyzed by Jackson and Marra (whose translation I use above and whose conclusions I generally follow here). First, it is significant that Vitruvius recognized the varying quality of the different stones, with varieties of tufo described as “soft and yielding” (*molles*), travertine and limestone as having “moderate strength” (*temperatae*), and lavas (*siliceae*) as “hard” (*durae*). In addition, he distinguishes between four types of tufo which can be correlated with modern archaeological and geological names and quarry locations. The *Rubrae* stones refer to tufo lionato quarried along the Aniene River (“tufo d’Aniene”); the *Pallenses* stones, to tufo giallo della via Tiberina (“Grotta Oscura”); the *Fidenates* stones to tufo rosso a scorie nere quarried at Fidenae; and the *Albanae* stones to *lapis Albanus* from quarries near Marino in the Alban Hills.

It is also interesting, and worth emphasizing, that Vitruvius is aware of varieties of tufo which are traditionally not thought to have been used extensively during his lifetime (the mid- to

---

<sup>226</sup> Vitruvius *De arch.* 2.7.1; translation from Jackson and Marra 2006. Vitruvius goes on (2.7.3-4) to discuss tufo from the “Anician quarries” in the territory of Tarquinia, which, though durable and fire-resistant, was not employed at the capital; see also Pliny *Nat. Hist.* 36.168-169, McCallum 2010; Jackson et al. 2006, 12-13.

late-first century BCE), such as that from Fidenae and Grotta Oscura.<sup>227</sup> This highlights the choice available to Roman builders at the time, who would have selected appropriate stones based on availability, cost (for extraction and transportation), and physical properties. The above quotation illustrates an awareness of the qualities of *tufu* in relation to other kinds of stone, and Vitruvius goes on to discuss this further:

All these soft kinds have the advantage that they can be easily worked as soon as they have been taken from the quarries. Under cover they play their part well; but in open and exposed situations the frost and rime make them crumble, and they go to pieces. On the seacoast, too, salt eats away and dissolves them, nor can they stand great heat (*aestus*) either.<sup>228</sup>

The ease with which the stone could be worked no doubt played an essential role in its selection for construction. However, the architect also reveals an understanding of the problems which weathering and erosion could cause, as corroborated by the geological studies described above. Roman builders compensated for this by covering exposed tufu with plaster or a veneer of marble or travertine, or by using the stone in naturally hidden positions under roofs or in foundations.<sup>229</sup> The remark concerning heat resistance, however, does not seem to match Roman practice, in light of the regulation which required fire-resistant (*ignibus impervius*) *lapis Gabinus* or *lapis Albanus* in construction after the fire of 64 CE, as discussed in chapter two. Research on the heat-resistance properties of various stones, in fact, suggests that tufu handled high temperatures better than marble or travertine, and that lithic-crystal tufos like those from Gabii and the Alban Hills did so better than other varieties.<sup>230</sup> These facts, and the maritime context of the previous clause, are what must have led Jackson and colleagues to translate *aestus* not as

---

<sup>227</sup> Cf. Frank 1924 discussed above.

<sup>228</sup> *De arch.* 2.7.2 Jackson et al. 2005 inexplicably leave out the first sentence, and their insistence that the covering of the stone (*in locis tectis*) refer to plaster is appealing but not strictly necessary.

<sup>229</sup> This can be seen throughout Roman construction; for examples with *lapis Gabinus* see chapter five. Vitruvius himself describes the process of applying plaster, 7.8.5-9.

<sup>230</sup> Jackson et al. 2005.



“heat” but as “sea tides and spray” (an accepted alternative translation) which is likely correct. Alternatively, though, one might note that the only other instance of this word in Vitruvius (2.1.3) clearly refers to heat, and he may have the same meaning in mind here, as the repeated heating and cooling of tufo *can* weaken the stone.<sup>231</sup> It is possible that the fire-resistant properties of stone from Gabii and the Alban Hills were not recognized until later, perhaps only after the fire of 64 CE.

Interestingly, Vitruvius also describes in detail the methods which builders should use when selecting particular blocks of tufo for construction.<sup>232</sup> In order to avoid defects, he advises that both blocks and rubble for *caementa* be quarried in summer and left exposed for two years. Any stone which has been damaged by the weather after this period can be used in foundations below ground, while the rest is suitable for construction above ground. Jackson et al. interpret this in terms of the mechanical integrity of the stone: the quarrying of water-saturated blocks from below the water table (as is done in modern quarries) required a long period of drying out in order to regain compressive strength.<sup>233</sup> However, Roman quarrymen did not always work beneath the water table in this way, particularly when suitable stone existed above it and could be extracted more easily. In addition, the stipulation that the stone be left in the open would expose it to further rainfall. It seems possible that Vitruvius means this as a true test of actual weathering. Regardless, the significant implications which this procedure would have for the organization of extraction and construction have not been fully explored. Where would such stone sit for two years—at the quarry, the building site, or some other holding-yard?

Furthermore, it seems unlikely that builders and/or investors would be willing to wait two years

---

<sup>231</sup> *De arch.* 2.1.3. Freezing temperatures, obviously, could have the greatest effect, but less extreme shifts in temperature could encourage water adsorption which can dissolve cements and cause cracks to form; see Jackson and Marra 2006, 125-26.

<sup>232</sup> *De arch.* 2.7.5

<sup>233</sup> Jackson et al. 2006.

after commissioning a monument or requesting a certain amount of stone, particularly for structural elements needed early in the construction process such as tufo foundations. This would therefore require a standing supply of extracted stone, which might suggest the possibility of a market-oriented system rather than one based only on command. However, all this rests on how descriptive, rather than proscriptive, the comments of Vitruvius are; it remains possible that he is not accurately describing construction practice.

The only other Roman author who sheds any light on the tufo industry is Strabo, and I have already discussed his important passage on the travertine, tufo lionato, and *lapis Gabinus* quarries in chapter two. For other information on the quarries themselves we are left with the geological and archaeological evidence.

#### *Varieties of Tufo, their Uses, and Quarry Locations*

Roman builders utilized tufo from at least seven different pyroclastic deposits. For convenience, and because they are still widely used today, the following discussion is organized according to the archaeological terms used to describe different types of tufo. As I have noted, this does not always match up with a single, defined litho-stratigraphic unit. However, this organization is in keeping with current archaeological practice, and I will differentiate between the geological facies whenever possible. In addition, I have adopted a more-or-less chronological approach similar to Frank's, with the *caveat* that this is not intended to serve as a secure relative dating method. In fact, as I will show, at any given time Roman builders seem to have been aware of and had access to various kinds of stone. I am more concerned with the organizational implications and economic choices associated with the use or abandonment of particular types of

tufo. For each type, I describe the macroscopic appearance, mineral composition, use within Roman construction, and location of deposit and any known ancient quarries.<sup>234</sup>

Cappellaccio is frequently used by archaeologists to refer to a gray, friable, granular tufo made up mainly of ash, with distinct lapilli and few large inclusions. This stone is poorly lithified and readily degrades on exposure to weathering. Nevertheless, blocks appear throughout Roman architecture, notably in early monuments of the sixth and fifth centuries BCE, no doubt due to the accessibility of the deposits, which are available in the hills within the city itself.

In reality, cappellaccio refers to at least two different pyroclastic deposits.<sup>235</sup> The Grottarossa Pyroclastic Sequence resulted from activity in the Monti Sabatini district about 514,000-518,000 years ago and can be found at or near the surface at the summit of the Palatine Hill. This tufo appears in the walls of the archaic cisterns on the same hill.<sup>236</sup> Another deposit, Tufo del Palatino from the Alban Hills district, formed about 528,000 years ago and is accessible at the base of the Palatine and Capitoline. It is more durable and saw correspondingly more widespread use in Roman architecture, where it has been identified in the Regia, the Temple of Jupiter Capitolinus, and the older sections of the Servian Wall.<sup>237</sup>

Quarries for cappellaccio were located within and near the historic center of Rome itself, and thus have been modified by centuries of later activity. Stone for the construction of early monuments on the Palatine and Capitoline was undoubtedly quarried on the spot, in the course of digging foundations and leveling the area, or from as near as possible. The example frequently given is the area known in antiquity by the toponym *Lautumiae*, on the northeast slope of the

---

<sup>234</sup> Jackson and Marra 2006 provide the most comprehensive collection of this data, and I use their geological nomenclature whenever possible.

<sup>235</sup> Marra and Rosa 1995.

<sup>236</sup> *LTUR* 4:17-22.

<sup>237</sup> Carnabuci 2013; Bernard 2012.

Capitoline.<sup>238</sup> This served as a prison in later times, but scholars generally assume that it was originally an area of stone extraction, as its appellation (Greek λατομία) implies.<sup>239</sup> However, Varro notes that the Greek name is derived from the famous quarries of Sicily where Athenians were imprisoned in the late fifth century BCE, and thus it may relate more to its function as a prison than as an area of stone extraction. The etymological argument is suggestive but certainly not convincing, as others have also noted.<sup>240</sup>

Many possible extraction sites within the ancient city display signs of medieval and/or modern quarry activity, though ancient extraction must certainly have taken place. Only a few areas of ancient cappellaccio extraction have been identified, mainly to the northeast of the city center near the route of the Servian Wall. The best-known are perhaps those discovered in 1947 during construction of the Roma Termini rail station, documented by G. De Angelis D'Ossat.<sup>241</sup> A series of subterranean galleries up to 2.5 meters in height were cut into a deposit of “tufo granulare grigio” (granular gray tufo, often used to describe cappellaccio). The full extent of the galleries is unknown, and no datable archaeological material was recovered within, but based on the presence of this stone in early monuments scholars have hypothesized that extraction dates to the archaic period. The proximity of the Servian Wall, the oldest sections of which are of cappellaccio, is also suggestive, and these galleries may have been opened to supply its construction. Subterranean extraction of granular tufo also took place eleven meters beneath the nearby church of Santa Bibiani, as reported by R. Lanciani.<sup>242</sup>

Modern development is also responsible for revealing other cappellaccio extraction sites, such as the quarries at Villa Patrizi, between the via Nomentana and the viale di Policlinico.

---

<sup>238</sup> Frank 1918: 184-5.

<sup>239</sup> Frank 1924: 17; Lanciani 1897, 32.

<sup>240</sup> Cifani 2008, 233.

<sup>241</sup> De Angelis D'Ossat 1948.

<sup>242</sup> Lanciani 1880.

These were discovered in the early nineteenth century and described by Lanciani.<sup>243</sup> The extensive complex of subterranean galleries extends for over a hectare, exploiting a deposit of granular gray tufo twenty meters below the ground. The orthogonal galleries, up to three meters tall and four meters wide, also contain an elaborate drainage system. Other quarries have been found in the Vigna Querini beyond the Porta San Lorenzo, at an outcrop of granular tufo which allowed surface quarrying rather than underground galleries.<sup>244</sup> Five trenches were discovered in 1872, about 4.5 meters wide and 2.5 meters deep, containing several detached and squared blocks measuring 80 x 50 x 28 centimeters. Borsari noted that some blocks were only partially detached, with lines partially chiseled on two or three sides, interpreting this as the process of block removal. There was no material with which to date the quarry, and it has generally been assumed that, as with the previous quarries discussed, it dates to the archaic period.

As Frank noted, the territorial expansion of Rome in the archaic and Republican periods gradually made higher quality tufo available, first to the north of the city in the territories of Veii and Fidenae. The tufo called “Fidenae” stone by most archaeologists begins to appear in fourth century buildings. Geologically this stone is known as tufo rosso a scorie nere (red tufo with black scoria), a Monti Sabatini tufo deposited 449,000 years ago. It is typically reddish-brown in color, with numerous large inclusions of dark scoria and lava which give the stone its name. This tufo has been identified in the podium of the Temple of Juno Moneta on the Capitoline (fourth century BCE), the cella walls of Temple A in the Largo Argentina (third century BCE), and the internal walls of the Tabularium (78 BCE), among other places.<sup>245</sup> The stone was known by Vitruvius as *Fidenates*, clearly indicating its origin near Fidenae, but no ancient quarries are

---

<sup>243</sup> Lanciani 1918; Lugli 1957, 247; Cifani 2008.

<sup>244</sup> Lanciani and Visconti 1872; Borsari 1888; Lanciani 1897, 33; Cifani 2008, 229.

<sup>245</sup> For the Temple of Juno Moneta: Tucci 2005.

preserved.<sup>246</sup> In fact, Frank suggested that blocks may have been taken from the very walls of the city as punishment following its subjugation.<sup>247</sup> Regardless, the proximity of the deposit to the Tiber would have facilitated the transportation of blocks downstream to the capital.

Further to the north one can still find the quarries for what archaeologists call Grotta Oscura tufo, a yellowish stone with large inclusions of gray or yellow pumice. These quarries must have become available after the defeat of Veii in 396 BCE, and the stone indeed begins to appear in fourth century buildings like the Republican fortifications on the Aventine. However, it saw use throughout the Republican and Imperial periods, and can be found in numerous monuments, such as Temple C in the Largo Argentina and the Republican period temples at Sant'Omobono. In later periods it was frequently used as coarse aggregate within concrete walls, as in the Colosseum.<sup>248</sup> The pyroclastic flow deposit from which these blocks were quarried is known as tufo giallo della via Tiberina, and it crops out extensively to the north of the city in the Tiber valley, where the deposit can reach a thickness of up to 70 meters.<sup>249</sup> Existing quarries can be seen both at Grotta Oscura and especially between the thirteenth and fifteenth kilometers of the via Tiberina, where blocks were extracted from large rooms and tunnels cut into the hills in addition to surface excavations.<sup>250</sup> Again, the proximity to the Tiber, and the presence of a small stream flowing past the quarries, would have allowed easy transport by water. However, the quarries have not seen a dedicated study. In addition, Grotta Oscura tufo is particularly interesting as the only type of Roman tuff on which quarry marks occasionally appear. These marks were first collected by Säflund, and others have since been found at S. Omobono and

---

<sup>246</sup> Vitruvius 2.7.1.

<sup>247</sup> Frank 1918: 181.

<sup>248</sup> Lancaster 2005b, 77.

<sup>249</sup> Lombardi and Meucci 2006. Sappa et al. 1995: 737.

<sup>250</sup> Frank 1924; Lombardi and Meucci 2006; Jackson and Marra 2006 fig.7a pg. 419.

examined by Sommella, but as yet there is no consensus as to how they relate to the organization of extraction.<sup>251</sup>

The stone known as tufo lionato saw perhaps the most widespread use in Roman cut-stone masonry. It begins to appear in the sixth century, and by the late Republic had become perhaps the most common building stone in the city. Outcrops of this tufo can be found over a huge area, and in antiquity it was quarried from the Capitoline, the Monteverde area on the opposite side of the Tiber, along the Aniene River to the east, and on the Piccolo Aventino near San Saba to the south. The stone is typically a very identifiable reddish-brown color with an abundance of glass fragments. However, within this tufo there is also a good deal of variability in appearance and composition, and this (along with the large area of the deposit) has led to a number of different terms within the archaeological literature. The so-called “Monteverde” tufo is a light brown tufo lionato with inclusions of various colors, which has been identified in a number of second and first century BCE monuments such as pavements at Sant’Ombono and the podium of the Temple of Concord. These blocks were extracted in the Monteverde area on the left bank of the Tiber, at the base of the Janiculum and in the modern Magliana neighborhood. The stone was also widely used in Ostia into the first century CE, probably because it could be more easily transported downriver.<sup>252</sup> Frank notes that the deposit was still worked “vigorously” in the early twentieth century, and continuing quarrying and development has essentially destroyed the ancient quarries. Tufo lionato similar in appearance and composition is also found at the base of the Capitoline.<sup>253</sup> The outcrop near San Saba to the south, on the other hand, seems to have supplied the tufo *caementa* for the Baths of Caracalla in 216 CE.<sup>254</sup>

---

<sup>251</sup> Säflund 1932; Sommella 1968. See also Frank 1924.

<sup>252</sup> Frank 1924: 29-32, who also notes quarries of the same stone further down the river.

<sup>253</sup> Jackson and Marra 2006: 420.

<sup>254</sup> Delaine 1995:87, confirmed petrographically by Jackson et al. 2005.

The most extensive tufo lionato quarries, however, are still visible along the Aniene River to the east of the city; those furthest to the east can even be seen from the A24 freeway. Intensive extraction continued into later periods, and Frank reported that builders continued to pick through the blocks in the early twentieth century.<sup>255</sup> Today, many of the quarries are flooded with water. Blocks from these quarries have a distinctive red color, and are usually identified in archaeological remains as Anio tufo or tufo dell'Aniene. The stone saw extensive use between the second century BCE and the third century CE, both in block-work and as concrete facing and *caementa*. It has been identified in a long list of structures, from Temple B in the Largo Argentina to the fora of Caesar and Augustus.<sup>256</sup> It is clearly these quarries to which Strabo refers when describing the “red stone” (τοῦ καὶ ἐρυθροῦ λεγομένου) near the Aniene.<sup>257</sup>

L. Quilici provides excellent descriptions of these quarries in a volume of the *Forma Italiae*, based on survey carried out between 1969 and 1974 as well as earlier photographs and documentation.<sup>258</sup> As a result of this work, these are the most completely documented of Rome's tufo quarries. The existing remains can be found in three groups on the Aniene River between Tor Cervara and Salone, and constitute our most extensive preserved Roman tufo quarries, despite some subsequent extraction and re-use of the area and, more recently, destruction for modern development.<sup>259</sup> At each group of quarries, extraction seems to have begun in surface quarries on the hillsides facing the river, continuing in subterranean galleries preserving the surface of the hills. These galleries were vast underground spaces, in some cases up to twenty meters tall, their roofs supported by colossal piers of unexcavated tufo. Those at Salone cover an

---

<sup>255</sup> Frank 1918: 187

<sup>256</sup> Temple B: BLANK; imperial fora: BLANK. Attestations are far too numerous to list in their entirety.

<sup>257</sup> 5.3.11; see chapter two.

<sup>258</sup> Quilici 1974, 62-78 (no. 4), 105-118 (no. 32), 143-169 (no. 55).

<sup>259</sup> The A24 highway to Aquila, for instance, runs directly through the quarries at Salone, and those on via Mirtillo are wedged between the intersection of this highway and the Grande Raccordo Anulare.



area over 500 meters long and up to 330 meters wide. Much of the open area between the existing faces and galleries was clearly quarried superficially. The faces throughout preserve horizontal extraction marks suggesting the height of the individual blocks, which varied from 45 to 80 centimeters. Quilici also discovered numerous separated blocks and column drums throughout the quarries. Particularly interesting are areas with partially extracted stone, demonstrating both the measurements of the blocks as well as the method of extraction. Quarrymen removed blocks from top to bottom on a given face, first digging trenches 10-12 cm wide on the back and sides, and then separating the block on the bottom from the underlying stone. In some places, extraction was abandoned in the midst of this process, leaving a series of step-like, partially removed blocks. Stone debris from the extraction process was thrown into quarry areas already abandoned, forming large mounds which once covered much of the area but have now been mostly removed.

As with other kinds of tufo, dating these quarries has traditionally relied upon the presence of the stone in ancient monuments, found from the second century BCE into the first century CE. However, in these quarries extraction seems to have been responsible for partially destroying at least two late-Republican villas, providing independent confirmation of activity from the mid-first century BCE. It is impossible to date the abandonment of the quarries. Some faces were clearly re-used by the late second or early third century CE for the construction of a Mithraeum, but activity may have continued in other zones. Even as brick and concrete became the most common building materials, the light-weight tufo lionato proved essential for aggregate and facing, and the quarries may have been exploited well into the imperial period and beyond.

The clear advantage of these quarries was their proximity to the Aniene River, as noted in ancient times by Strabo.<sup>260</sup> In some places, areas of extraction are just a few meters from the riverbank, meaning that land transportation before unloading rafts or boats at Rome cost almost nothing. In fact, similar tufo lionato quarries, though far smaller in scale, have been documented elsewhere along the river, and these must have also profited from their prime location.<sup>261</sup> The Aniene was an important shipment route for all kinds of goods, especially building stone, which due to its weight and bulk was difficult to transport by land. Just a few kilometers up the river from the tufo lionato quarries, in fact, were those for travertine—a hard, durable limestone exploited by Roman builders beginning in the late Republic. Intensive extraction continued through the Imperial period, but Renaissance and modern activity has destroyed nearly all traces of the ancient quarries. While not a volcanic tufo, travertine is often found in conjunction with it in Roman architecture, and constitutes the only local material besides tufo suitable for ashlar masonry. The stone appears in Temple B of the Largo Argentina, the Temple of Portunus, the theater of Marcellus, and most notably the Colosseum, among many other monuments.<sup>262</sup> It clearly also benefited from the presence of the Aniene and the ease of transport to the city. In fact, the role of this river in shaping the dynamics of the trade in tufo lionato, travertine, and, as we shall see, *lapis Gabinus*, has not been fully appreciated.

By the late Republic, Roman builders had begun to exploit several hard, well-lithified tufos from well east and southeast of the city. Foremost among these was *lapis Albanus*, a hard, rocky, olive-gray tufo quarried near Marino in the Alban Hills, where a volcanic-debris flow filled the valley 36,000 years ago. This stone is typically called peperino by archaeologists, though the other gray lithoid tufos (*lapis Gabinus* and Tufo di Tuscolo) are also known by this

---

<sup>260</sup> 5.3.11

<sup>261</sup> Quilici 1974, nos. 89, 90, 72, 82, 84.

<sup>262</sup> Other sources provide more comprehensive lists. See Blake 1947; Lugli 1957.

name. *Lapis Albanus* appears in monuments beginning in the third century BCE, and can be found as late as the Temple of Antoninus and Faustina in 146 CE. It appears to have been the tufo of choice for load-bearing block-work throughout much of this period. This is somewhat surprising, considering the location of the quarries twenty kilometers to the southeast, near the via Appia but with no possibility of transportation by water. Unfortunately, *lapis Albanus* has been quarried nearly continuously since Roman times, and is still worked on a small scale today, so there is little evidence of ancient extraction. The deposit is between 25 and 30 meters thick near Marino.<sup>263</sup>

Tufo di Tuscolo comes from the northern side of the Alban Hills volcanic crater, near the ancient town of Tusculum, where it was deposited some 355,000 years ago as a pyroclastic surge.<sup>264</sup> Like *lapis Albanus*, it is a well-consolidated, rocky gray tufo which is also occasionally called peperino, as well as sperone. In Roman architecture it has been identified in the Tabularium, the Theater of Marcellus, the Colosseum, and the mithraeum and horrea of San Clemente; however, recent research suggests that tufo lionato has been misidentified as Tufo di Tuscolo at the Theater of Marcellus, and that the main use of the latter was limited to the period of construction of the Colosseum circa 70-90 CE.<sup>265</sup> Little is known about the quarries, but outcrops of the stone have been documented from Tusculum east along the crater for at least five kilometers.<sup>266</sup>

Finally, we come to the subject of this dissertation, *lapis Gabinus*. Since I will discuss this stone and its quarries more comprehensively in the following chapter, a few words will suffice here. *Lapis Gabinus* was quarried from near the rim of the Castiglione volcanic crater 18

---

<sup>263</sup> Sappa et al. 1995.

<sup>264</sup> Jackson and Marra 2006.

<sup>265</sup> Jackson and Marra 2006; Jackson et al. 2011 correct an earlier misidentification of Tufo di Tuscolo in the Theater of Marcellus and suggest the more limited use.

<sup>266</sup> Quilici-Quilici Gigli 1991, 44-45; Fornaseri 1963, 136-8.

kilometers from Rome, near the town of Gabii, where it resulted from a pyroclastic surge about 285,000 years ago. It is a gray, coarse-grained, rocky tufo with frequent inclusions of various sizes (some quite large), often characterized by visible layering of lighter and darker strata. In the past, it has been identified in a number of important monuments, and seems to have been used extensively in first century BCE construction, most notably the Tabularium, Forum of Caesar, and Forum of Augustus.<sup>267</sup> The small area of the deposit limited extraction to outcrops near the rim of the Castiglione crater, and quarries remain visible along its southern and eastern edges. Blocks could have been transported to Rome on the via Praenestina by ox-cart, or taken north to the Aniene River and floated down to the city, as Strabo implies.

In general, then, little is known concerning the various tufo quarries of ancient Rome, since later quarrying and modern development have destroyed most indications of Roman activity. While some quarries, such as those for tufo lionato along the Aniene, have been relatively well described, none have seen dedicated scholarly attention. Recent work documenting the presence of various tufos in Roman monuments, however, makes this an opportune moment to undertake just such a study.

## **Conclusions: The Economy of Tufo**

The construction industry of Rome relied heavily upon tufo as a building material, one which was suitable for a number of purposes and could be acquired locally. Archaeological research has only recently begun to appreciate the economic importance of this volcanic stone, and to explore the particulars of its use. An important point to emerge from this review is that the evolution of this tufo industry is more complicated than the chronological model described by

---

<sup>267</sup> The complete list can be found in Table 1, and all attestations are further discussed in chapter five.

Frank and accepted, implicitly, by scholars today. Quarrymen did not simply move from one tufo to the next as higher quality stone became available. From at least the fourth century and possibly even earlier, Roman builders had some degree of choice in terms of the type of tufo used in each particular part of a monument.

This seems especially to be the case in the first century BCE and first century CE, exactly the period in which *lapis Gabinus* saw the most use. Several studies, for instance, have argued that the careful use of *lapis Gabinus*, tufo lionato, and travertine in the Forum of Caesar reflects the sophisticated knowledge which Roman builders could bring to bear.<sup>268</sup> In the Forum of Caesar, the upper façade of the *tabernae* consist of light-weight tufo lionato, which minimizes the load on the strong *lapis Gabinus* pillars and flat arches. These arches are themselves reinforced with travertine at the keystones and above the pillars, which has the greatest compressive strength and to which the arches direct the greatest load. Elsewhere, the concrete barrel vaults utilize the lightest of the tufos, tufo giallo della via Tiberina, as coarse aggregate. We might also consider the Tabularium, in which one can find *lapis Gabinus* in the second story façade and foundations, tufo lionato and tufo rosso di scorie nere in the internal walls, and tufo di Tuscolo in the internal pillars.<sup>269</sup> Different phases of construction or repair cannot account for all of the variability encountered in Roman tufo architecture.

For full understanding of the Roman tufo industry, therefore, and in order for tufo to be seen as more than a mere chronological marker, we need to develop a model that takes into account the various activities and choices associated with tufo extraction, transportation, and construction. The above studies have laid the foundation for such an endeavor, especially as

---

<sup>268</sup> Jackson et al. 2005, 506, fig. 6; Jackson and Marra 2006, 428; Roman expertise in the selection of volcanic building material has also been emphasized in the study of hydraulic concrete and concrete vaulting: see, e.g., Gazda 2001; 2008; Lancaster 2005.

<sup>269</sup> As documented by Jackson and Marra 2006. This study misidentified Tufo di Tuscolo elsewhere, and it is possible that blocks in the Tabularium are in fact tufo lionato, but I believe the point stands regardless.

regards the source of different tufo and their various uses in Roman construction. But we also need to take into account the labor and resources needed for extraction at quarry sites and for transportation by land or water. This approach will permit a greater understanding of the dynamics of the tufo industry and the ways in which it tied the capital to its immediate hinterland. The study of Roman quarries has long focused on these issues with respect to marble and decorative stone, without consideration for more commonplace dimension stone, even when it supplied the monumental construction of the imperial capital. It remains unclear how exactly the organization of the “marble” trade can be compared with that for tufo. In the remainder of this dissertation I address these issues with relation to a single stone, *lapis Gabinus*, in an attempt to develop a model with which to understand the tufo construction industry more broadly.

## Chapter 4: *Lapis Gabinus*: The Stone, the Quarries, and Related Archaeological Features

### Introduction

The quarries from which *lapis Gabinus* was extracted have long been noted in and around Gabii. T. Ashby described several quarry faces in the early nineteenth century, and every subsequent scholar of Gabii has at least noted their existence.<sup>270</sup> Along the eastern rim of the crater they have modified the topography to such an extent that they can hardly be missed, even though today they are frequently overgrown with vegetation. However, as with other tufo quarries around Rome, the chronology and organization of extraction have not been considered in any detail. In this chapter, I assess the surviving evidence for quarrying at Gabii. I first describe the geology of *lapis Gabinus*, including the formation and extent of the deposit, before considering the existing quarry faces. I then present the new archaeological evidence for quarrying found as a result of the excavations by the Gabii Project between 2009 and 2013. The integration of this data allows for an analysis of extraction techniques, quarry morphology and organization, stone transportation, and chronology, which are dealt with at length in the following chapters.

---

<sup>270</sup> Ashby 1910, 180-197.

## Geological Background and Stone Identification

*Lapis Gabinus* is the result of volcanic activity associated with the Alban Hills Volcanic district southeast of Rome. Eruptions from this volcano, along with those from the Monte Sabatini district to the northwest and the actions of the Tiber, are largely responsible for the topography of the region.<sup>271</sup> Around 285,000 years ago, a pyroclastic ground surge erupted from the Castiglione crater, depositing a layer of ash, crystal, glass, and fragments of lava and other rocks in an area around the crater.<sup>272</sup> Over thousands of years, mineral cements formed which lithified the material into solid tufo. The resulting deposit is localized around the rim of the crater, extending up to a few hundred meters to the south, east, and north of the crater's edge. While it reaches depths of up to sixty meters, outcrops are mainly accessible along the rim of the crater, as erosion has largely covered the deposit further down the slope.

Pyroclastic eruptions such as this are often explosive, shattering the surrounding rock, fragments from which are subsequently incorporated in the consolidated tufo. Compared to other types of tufo, *lapis Gabinus* typically contains more numerous fragments of lava, limestone, and other rock, embedded in a dark gray matrix of abundant, coarse-grained ash particles. It is sometimes characterized by alternating coarse- and fine-grained layers which can easily be distinguished macroscopically if present. The stone is also strongly grain-supported, meaning that its particles are in three-dimensional contact with one another, and strongly cemented with white zeolite cement.<sup>273</sup> Combined with the abundance of rocky material, this made *lapis Gabinus* a strong and durable building stone.

---

<sup>271</sup>Jackson and Marra 2006 provide a short summary of the various tufo deposits as they relate to the architecture of Rome.

<sup>272</sup> Marra et al. 2011; Marra et al. 2003.

<sup>273</sup> Jackson and Marra 2006.



Between the abundant large inclusions and frequent occurrence of visible layering, *lapis Gabinus* can sometimes be macroscopically rather distinct from other kinds of tufo. In other cases, however, it can appear quite similar to the other gray-colored varieties, such as *lapis Albanus*, Tufo di Tuscolo, and even cappellaccio. Various laboratory analyses have been employed to ensure accurate identification of tufo in the past, as I discussed in the previous chapter. Of these, the use of inductively coupled plasma mass spectrometry, which accurately determines the amount of a number of trace elements, allows for the most thorough compositional analysis.<sup>274</sup> In particular, the ratios between certain immobile elements, such as Zr/Y and Nb/Y, can serve as geochemical signatures for particular types of tufo.<sup>275</sup> A number of publications provide databases of the trace element compositions of the volcanic products of central Italy, which can be used for comparison.<sup>276</sup> *Lapis Gabinus*, however, is not well represented in these databases. Samples were therefore collected from the quarries described below and subjected to this kind of analysis in order to determine a reference point for comparison with samples taken from Roman monuments.<sup>277</sup> The latter are discussed in chapter five, and full results are presented in the appendix.

## The Quarries

### *General Topography*

While the jagged landscape of the area east and south of the Castiglione crater clearly indicates the presence of quarries, they are for the most part overgrown with a great amount of

---

<sup>274</sup> Pollard et al. 2007.

<sup>275</sup> Marra et al. 2011; Lancaster et al. 2011.

<sup>276</sup> Sonck-Koota et al. 2008; Boari et al. 2009; Lancaster et al. 2011; Sottili et al. 2004.

<sup>277</sup> The analysis was conducted by Activation Laboratories, Ltd., of Ancaster, Ontario, and interpreted by Dr. Fabrizio Marra, geologist at the Istituto Nazionale Geofisica e Vulcanologia (INGV). Dr Marra also assisted me with the collection of samples at Gabii.

vegetation, hindering survey. Fortunately, this was not always the case, and F. Piccarreta reconstructed their topography based on aerial photography taken in the late 1970's.<sup>278</sup> Many quarry faces were clearly visible in the photographs, while others could be reconstructed based on depressions and discolorations by using standard methods in the analysis of aerial photography. The resulting map (fig. 10) provides the most detailed and comprehensive record of the quarry faces, the accuracy of which I was able to confirm during the Gabii Project field seasons of 2011, 2012, and 2013.

The quarries extend along the entire eastern edge of the crater, in some areas right alongside the rim itself, and in others up to three hundred meters to the east or south. The bulk are situated beyond the city walls, where open areas between the faces suggest the removal of a significant amount of stone, but some were also clearly visible further south, well within the ancient urban area. Since the *lapis Gabinus* deposit is covered only by topsoil, all the quarries were open-cast pits, with extraction taking place directly on the surface; there are no indications of any subterranean galleries. Comparing Piccarreta's map with the visible remains today, it is clear that erosion has substantially buried some quarry remains, and many of the low faces still visible may represent the higher elevations of larger faces. The exposed faces themselves are remarkably well-preserved, considering the centuries of erosion and plant activity. However, the surfaces show some erosion and are often covered with moss or lichen, to the extent that it is not usually possible to observe the stone itself without removing a sample. As a result, few tool marks are visible throughout the quarries.

---

<sup>278</sup> Piccarreta 1987; Guaitoli 1981

### *Quarry Descriptions*

For convenience, I will describe the quarries from southwest to northeast—that is, moving counterclockwise around the rim of the crater, beginning at the western limit of the circuit of city walls. There is little visible evidence of extraction in this western part of the city but there are signs that the topography has been substantially modified. Piccarreta's map indicates several long cuts running roughly parallel with the rim of the crater, apparently all that remains of a significant amount of rock which has been removed from the area. The shape of these cuts suggests that they may have respected roads or tracks which the quarrymen were reluctant to destroy. Just southwest of the Temple of Juno is another area modified by quarry activity, consisting of an open area surrounded on several sides by low quarry faces (fig. 10, a). These areas now sit on private property and I was unable to inspect them in person.

Between the temple and the city wall to the east, there are more numerous indications of stone extraction, all within a narrow band extending about one hundred meters from the crater rim (see fig. 8). Quarry faces are visible in many areas, though they are frequently limited in both length and height. Closer to the crater extraction seems to have taken place in a broad trench paralleling the rim, with faces occasionally preserved on either side (on the north and south) (fig. 10, b). The largest of these consists of two faces forming a nearly ninety-degree angle, located along the rim of the crater just north of the Gabii Project excavations (fig. 10, c; fig. 11). The N-S face extends thirty meters along the rim, while the E-W face stretches for nineteen meters, and the greatest preserved height is just less than three meters. Faces on the opposite side of the trench are also preserved, though they are too overgrown for detailed study. In some places, large, rectangular cavities were cut into the face for the removal of very large blocks (fig. 12). In fact, one roughly finished square block sits not far from this, on the very edge of the crater.

Additional quarry faces are preserved to the south of this area, in what may have been another broad trench with extraction on both sides (fig. 10, d). Only the faces on the north side are at all visible, all of which are rather low (less than two meters tall). While Piccarreta indicates several quarry faces on the south, these cannot be seen today and may have been buried by erosion. One area on the map, however, appears to relate to the buried quarry remains excavated by the Gabii Project (for which see below). In light of this, it is likely that more of the area was subject to extraction than can be observed, even beyond what Piccarreta's map suggests.

The more impressive quarry remains lay to the north, just beyond the circuit of the city walls. Here, just north of the so-called Regia, a path descends steeply into the crater to the west (fig. 10, e), as well as more gently down the slope toward the Santuario Orientale to the southeast. With the exception of the area around the modern road to the Soprintendenza offices, this path is bounded on each side by steep walls cut into the bedrock, apparently the result of quarry activity. The face on the northern side of this path continues well into the crater itself, where it is preserved to a remarkable height for a distance greater than 100 meters along the interior of the rim (fig. 10, f; 13). This area is one of the most inaccessible due to plant growth, but nevertheless encompasses some of the most impressive of the preserved extraction sites. Much of the interior of the crater's rim lacks any indication of quarrying, however; the difficulty of hauling stone up and out of the crater may have discouraged extraction.

Back at the entrance to the city, a road heads north atop the crater's rim (fig. 10, g; fig. 14). This road is cut into the bedrock for a distance of nearly 400 meters and lined on either side with irregular walls of bedrock up to two meters high which appear to have been subject to extraction on the other sides. In some places, these have been built into modern rubble field

walls. Ashby identified this as the *cardo* of the ancient city, despite its preservation only beyond the fortification walls, noting that it was seemingly left untouched by quarrying.<sup>279</sup> In fact, the main road of the city left the walls some distance to the east of this, as revealed by the recent magnetometry survey.<sup>280</sup> The road described here may have been more directly associated with actual quarry operations, as it leads almost due north into the areas of most extensive extraction. Interestingly, raised shelves of bedrock along the sides of the road have been left in place by the quarrymen, and these could have been used to facilitate the loading of blocks on to carts for transport into Gabii or beyond. Further to the north, however, the road sits atop some of the largest quarry faces at the site, and so is unlikely to have been used for stone transport in the later phases of extraction in this area.

The entire area along this road, from the city wall to just north of the Castiglione tower, is riddled with quarry faces. Most of these are located on the slopes of the crater, where the elevation of the deposit facilitated the removal of the stone. As shown on the map produced by Piccarreta, quarrying proceeded unevenly on either side of the road, following the topography of the area as was convenient. Quarrymen left high points untouched, while natural slopes were taken advantage of, producing separate quarry zones on either side of the road, scattered among the hills of the site. The methodical removal of blocks eventually created the uneven landscape seen today, following the topography of the deposit.

The quarry faces along the highest slopes of the crater are almost entirely hidden by vegetation for up to 500 meters beyond the city wall, creating difficult study conditions. This is unfortunate, since these are among the tallest of the existing quarry faces, with some up to six meters in height. Elsewhere in this area, small outcrops can still be found, though most are

---

<sup>279</sup> Ashby 1902, 190.

<sup>280</sup> Becker et al. 2009.

covered with small copses of trees and shrubs. At one of these (fig. 10, h; fig. 15), this vegetation has partially shielded the face from erosion, and diagonal grooves can be seen which represent the cutting of the rear trench to remove the blocks; in this instance, the quarry worker stood to the left of the face, cutting down and toward himself, allowing his right (and probably dominant) hand to guide the pick. Linear horizontal marks indicate the height at which the blocks were split from the face with wedges—here, these can be found every 45-50 centimeters, representing the approximate height of the individual blocks. Even an extremely small outcrop such as this would have supplied at least four large blocks in a single row of extraction. Similar small outcrops appear throughout this northern quarry zone.

This can give some idea of the massive output represented by the surviving faces which are much, much larger, such as that pictured in figure 16, which represents a more typical quarry face at Gabii. In fact, its image has represented the quarries as a whole in several previous publications.<sup>281</sup> It lies between the gravel road to the Soprintendenza offices and the crater's edge, south of the medieval tower (which is visible in the image, on the far left) (fig. 10, i). This quarry face is nearly 10 meters tall and over 25 meters long. In other words, the extraction of a single row of blocks of average size (say, 0.59 m wide by 0.59 m high by 1.77 m long, the size of the *lapis Gabinus* blocks in the forum of Caesar as discussed in chapter five) would provide 239 blocks totaling 147.5 m<sup>3</sup>. In reality, of course, many rows would have been extracted from what is now represented by a single vertical face, and the total amount is inestimable without a more systematic survey of all the visible faces. The main point to make here is that a single such quarry face might supply the necessary stone for important projects which utilized moderate amounts of *lapis Gabinus*, such as the Forum of Caesar. There may have been far more material quarried, that is to say, than can be seen in the extant monuments today.

---

<sup>281</sup> E.g., Jackson and Marra 2006.

Other faces in this area preserve evidence of extraction techniques. That in figure 17, for instance, appears to have “steps” cut into it, a result of the trench-and-wedge method of block removal. Elsewhere, trenches can be seen on at least three sides of emerging individual blocks (fig. 18), cut before extraction ceased in this area. The size of individual blocks can also be ascertained at another quarry face (fig. 19) where blocks in the final row were removed on an angle, suggesting that, for whatever reason, the quarrymen wished to maximize the number of blocks of a certain size while minimizing the distance cut perpendicularly into the deposit. This face lies near the road described above, and the area may have been used for loading stone on to carts or other related quarry activities. I discuss the extraction methods of *lapis Gabinus* more completely in chapter six.

Further to the north, just east of the medieval tower, a massive ravine represents what was once a large quarry zone (fig. 10, j). This extends for more than 425 meters, with quarry faces of varying heights along each side. To the north this ravine is rather narrow, with tall faces rising up to four meters or more, though they are completely obstructed by vegetation (fig. 20). Further to the south the faces, while smaller, are more visible, particularly those along the eastern edge of the quarry zone (figs. 21, 22). Small outcrops within this broad trench represent what must have been high points in the natural topography, reduced by extraction to almost nothing (fig. 23). A similar but much smaller trench parallels this to the northeast (fig. 10, k). Finally, there are also some indications of small quarries along the north side of the crater.

### *Sampling*

In order to better understand the potential variation within the deposit, and to acquire a more thorough geological characterization of *lapis Gabinus* to compare with Roman monuments,

I and my collaborator, Dr. Fabrizio Marra, acquired geological samples from most of the surviving quarry faces. These samples were sent to Activation Laboratories, Ltd., and subjected to ICP mass spectrometry, allowing the measurement of trace elements such as Zirconium, Yttrium, Niobium, Thorium, and Tantalum. The ratios between these elements can provide a geochemical signature which is unique to a given tufo deposit, thus allowing for the accurate identification of tufo in Roman monuments. A map of sample locations can be found in figure 24.

Dr. Marra interpreted the results of these analyses, which are displayed in figure 25 and are more completely presented in the appendix.<sup>282</sup> As the figure shows, when these ratios are plotted against one another, samples from different tufo quarries fall into different zones or fields. Despite some variation within the samples from the *lapis Gabinus* quarries, these are nonetheless clearly distinguishable from comparative samples taken at the *lapis Albanus* quarries and from the Tufo del Palatino outcrop on the Capitoline Hill. In fact, this variation within a single deposit may allow samples of *lapis Gabinus* from Roman construction to be sourced more specifically *within* the quarries at Gabii. Regardless, this process definitively identifies various tufos, in a far more scientifically rigorous manner than macroscopic visual identification or even thin section analysis. In the following chapter, samples of alleged *lapis Gabinus* derived from several Roman monuments are compared with these results.

## **The Gabii Project Excavations**

In 2009 the Gabii Project began long-term, open-area excavations within a central area of the city. Quarry activity was immediately apparent, since it occurred in the later phases of the

---

<sup>282</sup> While Dr. Fabrizio Marra of the Istituto Nazionale Geofisica e Vulcanologia (INGV) interpreted the results of these analysis and provided many figures and tables, any error in their presentation here is entirely my own.



site and frequently destroyed the archaeological stratigraphy. The excavations are ongoing, but a number of different features and artifacts related to extraction have already emerged.

### *Excavated Quarry Face*

A magnetometry survey of the ancient city was conducted in 2008, before the Gabii Project excavations began.<sup>283</sup> This work revealed a large rectangular anomaly just south of the current access road to the SAR offices, the shape of which seemed to suggest a podium for public architecture. Subsequent excavation instead revealed a large quarry face, which was partially exposed in 2009. Further exploration occurred during the 2012 season, but the remains proved too extensive to be fully uncovered. A sounding was dug to the base of the face, and the top edge was uncovered for a considerable distance before backfilling became necessary.

The quarry face extends southwest perpendicularly from one of the city's N-S roads, seemingly respecting its orientation. At its western limit it turns abruptly to the south for at least one meter before disappearing at the edge of our excavation. Another face appears just to the west, oriented N-S, but it could be traced for less than a meter before it became necessary to backfill. While the entire face could not be fully excavated, a small trench was dug in order to investigate further. The face proved to be at least four meters in height (fig. 26). Few tool marks were apparent on the vertical surface, probably due to erosion which occurred before the face was buried. At the base, a very narrow (10 cm or less) trench had been excavated in the underlying rock, undoubtedly for the removal of a block, before the extraction was abandoned. This suggests that we may not have reached the true bottom of the face, though excavation had to cease for reasons of safety. Interestingly, the lower fill within our excavation, at the base of the

---

<sup>283</sup> The results are presented in Becker et al. 2009, Terrenato et al. 2010, and Kay 2013. For further detail, see chapter two.

face, consisted of medium to large angular pieces of tufo which must be debris from the processes of extracting blocks. Some pieces show worked sides and relatively sharp corners, perhaps resulting from breakage during the initial shaping process. Once extraction at this quarry ceased, the area was used for the disposal of this debris from operations elsewhere, probably from nearby.

Samples were acquired from this buried quarry face and analyzed in the same way as those from the other quarries. The results are presented in figure 25. The samples clearly match those from the *lapis Gabinus* quarries to the northeast, and fall into the same fields when plotted on the chart; however, analysis also revealed slight differences, which suggest that it may be possible to distinguish, in Roman monuments, blocks from different areas of the *lapis Gabinus* quarries.

While the discovery of this buried quarry face was unexpected, re-examination of Piccarreta's map indicates that two quarry faces were visible in the aerial photographs of this area in the 1970s. One of these appears to match the location and orientation of the excavated face, while the other lies to the west and has a NW-SE orientation. The area around the latter was not explored in the excavations, but is undoubtedly to be associated with a linear feature along the same orientation identified in the magnetometry survey, and may in fact represent an additional face within this open-area quarry. This northernmost area of our excavations seems to have been an integral part of the quarry landscape in later periods.

#### *Possible Crane Emplacements*

To the immediate south of this quarry face, excavations revealed several interesting features cut into the bedrock. Near the top edge of the face, pairs of post-holes and other cuts

suggest the placement of lifting machines for raising blocks from the quarry floor. These cuts could have held the two-beamed jib of a crane similar to that described by Vitruvius.<sup>284</sup> There was little datable material within these features, and it remains possible that they relate to some habitation or structure not in phase with the quarrying activity. In this area of the excavations, quarry features, domestic structures, and burials form a palimpsest which is difficult to interpret. Complicating this further is the fact that there was very little undisturbed stratigraphy in this area between the plough zone and the bedrock. At any rate, the archaeological correlates of ancient cranes are not well-understood, and our knowledge is based primarily on textual and sculptural evidence.<sup>285</sup> In addition, once extraction in this area had created tall quarry faces it is more probable that blocks were transported from the base of the face, perhaps up a more gradual incline.

### *Trail Quarry Pit*

Also in this area is a feature which appears to be an abandoned quarry assay pit (fig. 27). Inside the pit which measures 3.27 by 1.74 meters, trenches were dug separating a single large block from the surrounding bedrock on four sides. The pit was apparently abandoned before final removal of this block from the underlying rock, perhaps due to the poor quality of the stone in this area. The soil filling this pit also contained many large, cut pieces of tufo interpreted by the excavators as quarry debris, which may have been re-deposited in the pit after it was determined to be unsatisfactory. The block itself has been heavily eroded on three sides but measures about 1.2 meters long on the southern side, while the trenches have been dug to a height of 52 centimeters. At the base of the trench the width appears also to measure 1.2 meters, which would

---

<sup>284</sup> Vitruvius 10.2.1-10.

<sup>285</sup> See Landels 1978, 84-98. The archaeological evidence is limited to the Lewis holes, spurs, grooves, and other cuts which were made into individual blocks in order to attach ropes from these cranes.

make for an improbably large square block; however, quarrying may have followed natural fault lines in the stone, with large blocks broken up further after initial extraction, a common practice in ancient extraction.<sup>286</sup> Ceramic material from the fill of this pit suggests a date in the first two centuries CE, which is somewhat later than the traditional chronology for extraction at Gabii, based on the first century BCE construction dates of Roman monuments with *lapis Gabinus*. This might suggest that quarrying continued at least into the imperial period. However, based on the level of erosion visible, the pit may have been left open for some time or backfilled gradually, and the quarrying activity may have occurred considerably earlier—a date in the first century BCE is no certainly possible.

### *Debris Field*

Unfortunately, aside from the physical cuts into the bedrock there is little stratigraphy that can be securely associated with quarry activities. The most significant exception is a very large deposit in Area B, composed almost entirely of medium-sized, angular chunks of the local stone which can only be characterized as quarry debris (figs. 28, 29). This deposit lies about 20 meters southeast of the buried quarry face described earlier, along the same city road. The deposit was too large to fully uncover, but the debris covers an area of at least 50 square meters. A small trench dug across this found depths averaging about a meter, so we can estimate at least 50 m<sup>3</sup> of debris, though the deposit seems to extend further to the north and to the southwest. The layer sits directly on the bedrock, which preserves rectangular cuts possibly to be associated with block removal, though the limited area of our trench precludes more definite interpretation.

Pottery finds from the bottom of this trench suggest the deposition of this material sometime in the first or second centuries CE. The layer was sandwiched between an un-datable

---

<sup>286</sup> Adam 1994, 29-30.

post-abandonment layer and the bedrock, limiting our understanding of the stratigraphical relationships with other features. However, further chronological data and organizational information can be inferred from the horizontal relationship between this deposit and surrounding features. The deposit seems to respect the alignment of the road to the east, which was in use until the first or second centuries CE (see more below). To the west, the deposit ends just short of the area occupied by the first and second century CE burials atop the house in Area B. The earliest of these burials, dating to the mid first century CE, which included the lead sarcophagus, is just two meters from the edge of the debris. The formation of the cemetery and the development of extraction may have occurred more or less simultaneously in this area. In fact, the skeletal remains buried here show signs of physical stress, injuries incurred from repetitive motions, and physical trauma which subsequently healed, and it has been suggested that these individuals may have even worked in the nearby quarries.<sup>287</sup>

Like the trial quarry pit, then, here we have evidence for quarry operations in the early imperial period. Unlike the trial pit, this particular debris deposit documents such quarrying on a more substantial scale.

### *Access Road*

It is possible that this debris field is a direct result of stone extraction from the buried quarry face to the north. The material could easily have been transported down the adjacent road, which magnetometry has revealed to be part of the larger urban grid. Sections of three streets run through the Gabii Project's excavation area, and excavation in each has allowed for a general idea of their chronologies. For the most part, there is little evidence for the use of these roads after the first century BCE, but the western road alongside the quarry features is an exception. At

---

<sup>287</sup> Mogetta and Becker 2014, 185.

some point, the eastern retaining wall of this road was rebuilt with concrete in a technique not seen at Gabii before the imperial period. The level of the road was also raised, and pottery finds (including African Red Slip) suggest that it may have remained in use into the late first or even second centuries CE. At any rate, both the quarry face to the north and the debris deposit to the south (the latter dated by pottery finds to the first-second centuries CE) seem to respect the alignment of this road. In fact, rectangular cuts for block removal from the bedrock immediately west of the road were made at an angle rather than perpendicular to the face, so as to maximize the number of blocks removed while preserving the edge of the road (fig. 30), as was also observed in the quarries to the north (fig. 19). It seems that those organizing extraction were reluctant to destroy the road, which was no doubt useful for the subsequent transport of the stone.

### *Related Artifacts*

Our excavations have uncovered few artifacts which can be definitively associated with quarry activities. A significant exception is an iron wedge discovered in a nearby context (fig 31). The head preserves a large surface (7.5 by 6 cm) for striking, and the body tapers from 5 by 3.5 cm at the head to 4.5 by 2.8 cm at the point where it is broken off. The wedge has a preserved length of about 10 cm, but based on the taper we might extrapolate another 5 to 10 cm. Unfortunately, this artifact was found in a disturbed post-abandonment layer which was near the plow zone and cannot be accurately dated. The quality of the craftsmanship and of the iron itself is quite high, and it remains possible that the wedge dates to modern times. If so, it would represent the only solid evidence of post-antique extraction at Gabii. However, the shape and dimensions of this wedge are quite similar to other published examples from antiquity,

particularly in the relatively thick body as compared to more modern wedges.<sup>288</sup> Another iron artifact may represent a point chisel, but other interpretations are possible.

There is also evidence that iron-working took place in the vicinity. Quarry operations would have necessitated the regular supply and repair of iron tools such as picks and chisels. Iron slag has been found in substantial amounts across the excavation area, especially in later phases of Area C where the industrial complex was located in late Republican times. Particularly interesting, however, are three large, circular chunks of slag, approximately 20 cm in diameter, the shape of which suggests that they came from a smithing furnace or crucible and attests to the working of metal in the immediate area. One of these (fig. 32) came from a large post-abandonment context in Area B, just to the southeast of the features discussed so far, and again, bordering the same road. Another ( $\Delta$ 585) came from a similar context just to the south. The third was discovered some distance to the east, in a post-abandonment layer in Area E. While these cannot be definitively associated with the phase of quarrying, their proximity to the excavated quarry features is suggestive.

## Conclusions

Cumulatively, the evidence presented here has a number of implications for the ancient extraction of *lapis Gabinus*. Many of these are more fully considered in chapter six, but a few general comments can be made here. For one thing, the Gabii Project excavations provide support for the chronology of *lapis Gabinus* quarrying into the first century CE if not later. The chronology of quarrying at Gabii has in the past been based primarily on the construction dates of public monuments in Rome which include the stone, which cluster almost exclusively in the

---

<sup>288</sup> Other published examples can be found in Bessac 1996, 214-225 (see especially 215, fig. 136) and in Bedon 1984, 125-6, figs. 27 and 31.

first century BCE. Subsequent and possibly private use of the stone is attested primarily by a brief reference in Tacitus concerning construction following the fire of 64 CE.<sup>289</sup> The excavated quarry face at Gabii is not directly datable, but the ceramic finds found within the debris field and trial quarry pit corroborate this later extraction. However, it is impossible to say whether the resulting product was transported to Rome on the same large scale as in the preceding century—it may have been used locally or in the surrounding countryside. Regardless, it is clear that extraction continued beyond the dates traditionally thought.

The evidence also suggests that large quarry faces might remain buried elsewhere at Gabii. The area of stone extraction could very well extend beyond the "quarry zone" previously identified with aerial photography. Magnetometry or other remote sensing techniques may be able to reveal these, but the interpretation of these results may not be straightforward in an area also likely to contain unrelated large, rectilinear features – that is, in an urban environment like Gabii. In any case, the full scale of operations at Gabii may be underestimated by examining only the exposed, visible quarry faces.

These quarry faces spread over a huge area in and around Gabii. They attest to the vast scale of extraction which occurred over the course of several centuries, with blocks destined for projects at Gabii, Rome, and sites between. In connection with the extent of this industrial landscape, it is important to emphasize the correspondingly long timescale. As we shall see in the next chapter, the use of *lapis Gabinus* has a deep history, and the present state of the quarries is the cumulative result of activity beginning as early as the seventh century BCE. However, it is in the first century BCE that extraction began to take place on a scale not seen before, in order to supply the important Late Republican monuments of Rome. A rather large area *within* the city of Gabii seems to have been dedicated to stone extraction in this period. Quarry activity began to

---

<sup>289</sup> *Ann.* 15.43; see discussion in chapter 2.



encroach upon the urban fabric, taking place directly adjacent to (and undoubtedly in areas formerly occupied by) residential space and funerary use. The Gabii Project excavations document an interesting liminal zone on the edge of the larger quarry landscape, a dynamic environment which we should not be too quick to characterize as the death throes of a dying city. The extent of the visible quarry faces, some of which must have been worked in this same period, certainly suggests a great amount of activity in the area, but in order to more fully describe this we need to understand the particulars of *lapis Gabinus* use and the distribution of the stone at Gabii and Rome.

# Chapter 5: Building with Lapis Gabinus: Catalogue of Ancient Monuments

## Introduction

Archaeologists have been identifying *lapis Gabinus* in Roman monumental architecture for over a century. In this chapter, I present a catalogue of all the buildings and monuments of Rome in which ashlar *lapis Gabinus* has been identified, as well as the details of its architectural use. A full list of such monuments, along with their date (when known) and the specific location of the stone can be found in table 1. The structures are listed below in rough chronological order, in order to assess the development of extraction. Though lists of tufo use in Rome are common in the archaeological literature, no study has attempted a systematic collection of this information in one place, which is necessary to appreciate the importance of individual quarries. I next discuss attestations of the stone at rural sites in the eastern *suburbium*. Most of these were reported in older, unsystematic surveys, and could not be confirmed in person. Here they are organized geographically, since most lack all but the most general chronology. Finally, I discuss the presence of the stone in the urban architecture of Gabii itself, as revealed by the recent excavations of the Gabii Project. While it is completely unsurprising to find *lapis Gabinus* in the buildings and monuments of Gabii, the stone has always been seen through the filter of Rome, and the use of the stone at Gabii has not received much attention. Only by investigating the full distribution of the stone, both in and beyond Rome, can we hope to understand the economic patterns surrounding *lapis Gabinus*.

As I have shown, however, the macroscopic appearance of this tufo can be quite similar to others, particularly the other hard, gray tufos from east of Rome, like *lapis Albanus* and Tufo di Tuscolo. As a result, scholars have sometimes mistakenly identified these stones, especially in the early-twentieth century, and this problem has been compounded by the tendency to accept previous attributions without question.<sup>290</sup> In order to begin to correct this, I acquired samples from monuments whenever possible, which were analyzed using the methods discussed in the previous chapter. In the event, issues of access and permission prevented the collection of samples from many of these structures, but samples from the Forum of Caesar, Forum of Augustus, and Sant’Omobono were analyzed.<sup>291</sup> The results (again interpreted by Dr. Fabrizio Marra) were compared with the samples taken from the quarries at Gabii in order to establish a secure provenance. Where samples could not be obtained, I discuss the likelihood of *lapis Gabinus* presence based on other factors.

*Lapis Gabinus* was undoubtedly used in other monuments which have not survived, and I do not claim that this catalogue represents a complete distribution. It may also have gone unreported in extant structures. In this context, it is worth remembering that *lapis Gabinus* has sometimes been described as a *peperino*, a vague term which can also include *lapis Albanus*, Tufo di Tuscolo, and even *cappellaccio*. As such, it proved impossible to investigate every attestation of *peperino*, and this catalogue is limited to more specific terms which have been used of the stone, including *lapis Gabinus*, *pietra Gabina*, *sperone*, and Gabii tufo or (incorrectly) tufa.

---

<sup>290</sup> Often ignored are the comments of earlier scholars who recognized the difficulty of accurately identifying the stone. For example, the index to Blake 1947 includes the entry: “Gabine stone (not always distinguishable from *peperino*)...” while Van Deman 1934 (see discussion below) noted that *lapis Gabinus*, *cappellaccio*, and *peperino* had all been confused in the past.

<sup>291</sup> I have since acquired permission to sample several other monuments, including the Cloaca Maxima; samples will be acquired in a future field season and incorporated into my further work.

## Lapis Gabinus at Rome

### *Sarcophagi in the Tomb of the Scipios*

Coarelli identifies “sperone” in two elements of the famous Tomb of the Scipios on the via Appia.<sup>292</sup> The first is in the inscription of P. Cornelius Scipio, son of Publius, Flamen Dialis, which now rests in the Vatican Museums; the corresponding sarcophagus has been lost, but may also have been of *lapis Gabinus*.<sup>293</sup> This is thought to be a son of Scipio Africanus, perhaps that described by Cicero as having died young, though there is some debate on this point.<sup>294</sup> Regardless, he seems to have died sometime before 162 BCE, possibly around 175. The second is the sarcophagus of Lucius Cornelius Scipio, a son of Scipio Hispallus (consul in 176 BCE), who would also have died sometime in the mid-second century BCE.

It is unlikely that these stones truly come from Gabii, however. The large inclusions within *lapis Gabinus* make it ill-suited for inscriptions, for which it is otherwise unattested, even in the first century BCE when it appears widely in Roman construction. The *CIL*, in fact, reports that the epitaph for P. Cornelius Scipio is inscribed “ex lapide Albano”, on *lapis Albanus*, a stone more frequently used for epigraphic or decorative purposes. In addition, this would represent by far the earliest use of *lapis Gabinus* at Rome, and two isolated occurrences here seem improbable. Unfortunately, I have not been able to investigate these in person.

### *Pons Milvius*

Many of Rome’s bridges have been said to include *lapis Gabinus*, and the earliest of these is the Pons Milvius, restored by M. Aemilius Scaurus in 109 BCE. The stone has been

---

<sup>292</sup> Coarelli 1972, 46; Coarelli 2007:370-1.

<sup>293</sup> *CIL* I<sup>2</sup> 10

<sup>294</sup> See Moir, K.M. 1986, 264-266; Tatum, J.T. and K.M. Moir 1988, 253-259.

identified in the revetment of the piers and in the vaulting of the arches, surrounding a core of Grotta Oscura.<sup>295</sup> Delbrück records the block dimensions as about .55 x .55 x 1.10 meters.<sup>296</sup> If the presence of *lapis Gabinus* could be verified, it would represent the earliest architectural use of the stone in Rome. Little remains of the ancient structure, however, and it seems possible that *lapis Gabinus* was used in undocumented repair work at a later date, though Augustus, who restored nearly every other bridge in the city, explicitly denies repairing the *pons Milvius*.<sup>297</sup> The location of the bridge on the Tiber north of the city would have made the supply of *lapis Gabinus* by way of the Aniene extremely simple, perhaps explaining why it appears instead of *lapis Albanus*, which had been quarried for centuries but would have needed to travel further overland.

### *Tabularium*

The construction of the Tabularium in 78 BCE represents the first secure, large-scale use of *lapis Gabinus* within the city. The building occupies the eastern side of the Capitoline, facing the forum, in an area which suffered in the fire of 83 BCE. The identification of this structure with the Tabularium, the state archive, rests on a now-lost inscription recording its construction:

*Q(uintus) Lutatius Q(uinti) f(ilius) Q(uinti) n(epos) Catulus co(n)s(ul) /  
substructionem et Tabularium / de s(enatus) s(ententia) faciundum coeravit eidem  
/ probavit.*

Quintus Lutatius Catalus, son of Quintus, grandson of Quintus, consul, undertook the building and inspection of the foundation and Tabularium in accordance with a resolution of the senate.<sup>298</sup>

Catulus, a supporter of Sulla, was consul in 78 BCE, and was also involved in the reconstruction of the Temple of Jupiter Capitolinus as *ensor* in 65 BCE. Construction may have taken place

---

<sup>295</sup> Delbrück, 1907, 3-11; Frank 1924, 141-142; Balance 1951, 82; O'Connor 1993, 64-65. Coarelli 2007, 539; Jackson and Kosso 2013; Blake 1947, 146; Lugli 1957, 308.

<sup>296</sup> Delbrück 1907, 6.

<sup>297</sup> *Res Gestae* 20-1.

<sup>298</sup> CIL VI. 1314; nearly identical inscription CIL VI. 1313

between 81 and 78 BCE. A further inscription, an epitaph originally found on the via Praenestina, documents an architect who worked with Catulus:

*L(ucius) Cornelius L(uci) filius Vot(uria tribu) / Q(uinti) Catuli co(n)s(ulis) praef(ectus) fabr(um) / censoris architectus.*

Lucius Cornelius, son of Lucius, of the Voturia tribe, prefect of engineers for Q. Lutatius Catulus during his censorship and architect during his censorship.<sup>299</sup>

This Lucius Cornelius must have played an important role in the construction on the Capitoline in these decades, a significant architectural accomplishment, and his marble epitaph, from a large, circular mausoleum, attests to his considerable social status. In fact, these inscriptions provide rare insight into the career of an architect in the first century BCE.<sup>300</sup>

There has been some recent debate over the precise identification of this structure. Purcell argued that it was not the Tabularium, but the *atrium Libertatis*.<sup>301</sup> Later, Tucci re-examined the fragments of architectural decoration found under the nearby porticus of the Dei Consentes, traditionally ascribed to the second story of the Tabularium, and argued that they belong rather to a Republican temple atop what is known as the “Tabularium”, which he identified as the temple of Juno Moneta, relocated after the fire of 83 BCE.<sup>302</sup> Most recently, Coarelli, agreeing that the so-called “Tabularium” actually represents the foundation (*substructio*) of the building inscription, suggests that (1) the Tabularium proper was a building situated in the forum, associated with the *aerarium* of the Temple of Saturn, attached to the lower level of the *substructio* and thus to the Republican mint by way of the interior corridor, and that (2) atop the

---

<sup>299</sup> CIL I2 2961.

<sup>300</sup> Ancestors of this man may have also been employed in the construction business; see Anderson 1997, 26-32; Molisani 1971, 41-49.

<sup>301</sup> Purcell 1993

<sup>302</sup> Tucci 2005.

*substructio* sat a triple temple-complex dedicated to Venus Victrix, the Genius publicus populi Romani, and Fausta Felicitas—a unified group attributed to the vision of Sulla himself.<sup>303</sup>

Regardless of the specific function of the building, it is clear that we have here a large construction project instigated by Sulla, completed by 78 BCE, and, significantly, featuring a fair amount of *lapis Gabinus*. It has long been noted that the façade of the building was constructed with stone from Gabii, and recent work has confirmed that the ashlar foundations and exterior of the second floor pillared arcade consist of *lapis Gabinus* blocks (fig. 33).<sup>304</sup> The foundations on the northern side are the most accessible, where the blocks present the typical appearance associated with the stone (fig. 34). One can appreciate the scale of extraction required for this by viewing the building from the forum, where the lower wall extends over 70 meters long and is nearly 15 meters high. Atop this is an arcade of ten arches (most of which are hidden by more recent construction) with engaged Doric columns framing each. These are also constructed of *lapis Gabinus*, which is notable since the stone seems to have been used only rarely for anything other than parallelepiped, ashlar masonry. Interestingly, several other types of tufo were employed in the interior of the building, including tufo lionato, tufo rosso a scorie nere, and (possibly) Tufo di Tuscolo. Within the arcade, blocks of Gabine tufo reinforce the corners of the tufo lionato interior walls and serve as voissiors for flat arches.<sup>305</sup> The builders here demonstrate that (1) the selection of tufo for construction was based on a detailed knowledge of the mechanical properties of different stones, and (2) that *lapis Gabinus* was appreciated for its strength and load-bearing capacity, as this substructure served as a large podium for up to three monumental temples.

---

<sup>303</sup> Coarelli 2010.

<sup>304</sup> Delbrueck 1907, 23-46; Somella Mura. “L’ esplorazione archeologica per il restauro del Tabularium” *Archeologia Laziale* 4 (1981): 159-63. Jackson and Marra 2006. Lugli 1957, 308. Blake 1947, 143-44.

<sup>305</sup> Jackson and Kosso 2013, 279.

### *Pons Fabricius*

The *Pons Fabricius*, crossing from the Campus Martius to the Tiber Island, was first built in 62 BCE, and restored in the Augustan period by M. Lollius and Q. Lepidus, consuls in 21 BCE.<sup>306</sup> As in the *Pons Milvius*, scholars have identified *Lapis Gabinus* in the facing of the piers and the vaulting of the arches.<sup>307</sup> Though much of the facing has been covered over with seventeenth-century brick, *lapis Gabinus* can be seen clearly in the *intradors* and in the facing at the eastern end along the bank of the river, where the brick is lacking. Here the tufo presents its most distinctive appearance, with frequent large rocky inclusions and well-defined layering (fig. 35). Several blocks of reddish tufo lionato from the Aniene quarries can also be seen in the facing where it meets the eastern bank.

### *Theater of Pompey*

In 55 BCE Pompey built his theater-temple complex in the Campus Martius, which was restored by Augustus in 32 BCE as well as at numerous later dates. *Lapis Gabinus* has been identified in the external portico and in several piers with engaged columns, which may have decorated parts of the temple podium; however, *peperino* has also been reported for the piers.<sup>308</sup> Frank assumed that reports of *peperino* must actually refer to *lapis Gabinus*, apparently based on the construction date of the theater, since he believed that *peperino* went out of use between about 80 BCE and 64 CE.<sup>309</sup> As I have already argued, this kind of chronological argument is problematic and unconvincing. Furthermore, the recent work of J. Packer, including examination

---

<sup>306</sup> Dio Cassius 37.45; *CIL* 6.1305

<sup>307</sup> Lugli 1957, 308-309; Jackson and Kosso 2013, 279; Frank 1924, 142;

<sup>308</sup> *Lapis Gabinus*: Coarelli 2007, 539 (though no location is specified); Lugli 1957, 308; Colini 1937, 129. *Peperino*: Lugli 1957, 325; Bull. Inst. 1865, 201-3.

<sup>309</sup> Frank 1924, 131, n. 10.



of previous research and small scale excavations in several locations, documents only “peperino”.<sup>310</sup> Since this term is often used in an intentionally vague or inclusive manner, further research is needed to determine whether *lapis Gabinus* or *lapis Albanus* is present.

### *Porta Viminalis*

Near Termini station, extending along almost the entire eastern side of the Piazza dei Cinquecento, sits the most impressive surviving stretch of the Servian Walls. The two long segments here, which combined stretch over 120 meters, are constructed primarily of *tufo del Palatino* and *tufo giallo della via Tiberina* and are clearly associated with the mid-Republican defensive construction. In the center of this stretch, on the other hand, two walls composed of ashlar blocks of *lapis Gabinus* extend into the city perpendicular from the wall, and several additional types of tufo (including tufo lionato, *lapis Albanus*, and *lapis Gabinus*) can also be observed in the wall to the north.<sup>311</sup> The few blocks of the perpendicular walls are the meager remains of the Viminal Gate (figs. 36, 37).

The use of *lapis Gabinus* and other tufos in both the gate and parts of the nearby wall suggests a later date of construction than that of the mid-Republican sections. Frank suggested that defensive fortifications in this stretch of the wall may have been reinforced during the civil wars of the first century BCE, perhaps around 50 BCE in preparation for Caesar’s march to Rome, while Säflund proposes a slightly later date, following Caesar’s assassination.<sup>312</sup> S. Bernard offers the far earlier date of 144, attributed to the construction of the Aqua Marcia,

---

<sup>310</sup> Packer et al. 2007; Galgiardo and Packer 2006.

<sup>311</sup> Frank 1924, 122-3; Lugli 1957, 308; Säflund 1932, 156; Coarelli 2007, 16.

<sup>312</sup> Frank 1918, 180-181. Frank 1924; 122-123. The argument for the earlier date rests on the presence of the thick concrete wall associated with the circuit at Via Volturmo, and the robust nature and mixed construction of nearby towers. Säflund 1932: 155-56, 246-67.

which entered the city here.<sup>313</sup> In light of this uncertainty, I submit another possibility, that these tufo were utilized in the Agrippan repairs associated with this aqueduct, as we shall see that Augustan repair work also features *lapis Gabinus*.<sup>314</sup> The presence of Gabine tufo, in any case, supports the intermediate date in the mid-first century, when the stone saw extensive use in the city. An association with the figure of Caesar may also be appropriate, since the builders of his Forum also utilized a significant amount of *lapis Gabinus*, as I show below, and as a result the stone was already being brought to the city. As in the Tabularium, the stone was used here for its strength, an essential quality for fortifications. Frank reports on the enormous size of the blocks, each measuring 75-90 cm high and nearly 1.5 m long.<sup>315</sup>

### *Forum Iulium*

By the mid-first century, the mechanical properties of *lapis Gabinus* seem to have been fully appreciated by Roman builders, as Jackson and Marra have demonstrated with reference to the Forum of Caesar.<sup>316</sup> The stone was used in the piers and flat arches of the *tabernae*, supporting lighter tufo lionato blocks above (fig. 38). Five blocks can also be seen in the existing corner of the podium, though tufo lionato ashlar make up the other remaining segments. It is likely that the other three corners were also reinforced with *lapis Gabinus*. Elsewhere, Amici reports peperino (used also to describe the piers, and therefore presumably referring to *lapis Gabinus*) in string courses within the dividing walls of the *tabernae*, which otherwise utilize tufo lionato.<sup>317</sup> The stone in all of these positions presents its typical appearance, with many large

---

<sup>313</sup> Bernard 2012: 14-15.

<sup>314</sup> *Res Gestae* 20 documents the rebuilding of aqueducts, including work on the Aqua Marcia.

<sup>315</sup> Frank 1924, 122-3.

<sup>316</sup> Jackson and Marra 2006, 428. Many others have also noted the presence of the stone: Lugli 1957, 308; Blake 1947, 152; Frank 1924, 25, 46; Coarelli 2007, 539; Fiorani 1968, fig. 27.

<sup>317</sup> Amici 1991, 33, 49-58, and 51, fig. 59.

colored inclusions and distinct layering. This can be seen most clearly in the smoothed blocks of the piers, but is also apparent in the rusticated ashlar of the podium.

Scholars are divided on the precise dating of the individual features within the forum, in part due to the inconsistencies of the literary evidence. The necessary land was purchased in 54 BCE, as Cicero attests, and Suetonius notes that construction was ongoing in 52, but the temple to Venus was not even vowed until the Battle of Pharsalus four years later.<sup>318</sup> The temple was inaugurated two years later, in 46 BCE, but the forum as a whole remained unfinished until completed by Augustus.<sup>319</sup> Ulrich reconciles this by proposing that the forum was originally conceived not as a glorification of Caesar, but as an enlargement of the Forum Romanum, and that it is only after Pharsalus that the temple to Venus and the other structures were re-planned as unified complex celebrating the dictator.<sup>320</sup>

The physical remains offer little help in dating the use of *lapis Gabinus*, as numerous modifications were made after the time of Caesar. Anderson suggests that the tabernae were completely reconstructed at some later date, though it may be that the blocks were merely redressed.<sup>321</sup> In fact, the *Res Gestae* suggests that the forum was “almost finished” (*profligata*) by Caesar, and the work of Augustus may have been limited to the application of marble revetment. Ulrich argues that the similarity in building materials of the tabernae and the temple podium suggest that they were built in the same period, thus after the temple was vowed in 48 BCE. Amici re-examined the archaeological reports and the phasing of the complex, proposing that in the first phase (before 46) a perimeter wall encircled the area, which was then removed

---

<sup>318</sup> Cicero *Att.* 4.17; Suet. *Iul.* 26.

<sup>319</sup> *Res Gestae* 20. Cassius Dio 45.6.4

<sup>320</sup> Ulrich 1993, who notes that the remark of Suetonius, which is the main problem here, is well after the fact and could simply imply the planning stages of the project.

<sup>321</sup> Anderson 1984, 48; Ulrich 1993, 70.

for the construction of the tabernae in a second phase.<sup>322</sup> These hypotheses would suggest that the builders employed the *lapis Gabinus* blocks (and, indeed, constructed the majority of the original complex) only in the brief later phase between 46 and 44 BCE.

Construction with *lapis Gabinus* may not have begun until 46, but the quarrying of all the necessary stone could have begun as early as 54, when the need for a considerable amount of durable tufo must have been recognized. In fact, it is possible to reach a rather rough estimate of the *lapis Gabinus* present in the forum. It is difficult to say how many total blocks are present in the podium, as only one corner of the podium exists, with five visible blocks. We can hypothesize a further three courses beneath these hidden by the surrounding concrete, by analogy with the preserved podium wall in tufo lionato to the northwest. If each of the four courses was similarly constructed of *lapis Gabinus*, the podium would contain some forty-eight blocks, each measuring about 0.59 m wide by 0.59 m high by 1.77 m long (about 2 by 2 by 6 Roman feet), for a total of 29.57 m<sup>3</sup> or 53.5 metric tons<sup>323</sup> In the tabernae, excavations revealed nine piers, each consisting of ten blocks of similar dimensions (seven up to the travertine block level with the first flat arches, and three above this to the second). Reconstructions typically assume eighteen or nineteen piers in total, based on the distance to the Curia Julia, creating a total of one hundred and ninety blocks, equivalent to 117.066 m<sup>3</sup> of tufo, or about 212 metric tons.<sup>324</sup> In addition, eight sets of two flat arches are preserved. Though not all retain their original *lapis Gabinus* voussoirs, each seems to have consisted of six, with travertine keystones. If the published reconstructions are accurate, there were originally up to eighteen sets of these arches, for a total of two hundred and sixteen blocks. These are smaller than those of the arches, similar in width

---

<sup>322</sup> Amici 1991.

<sup>323</sup> .616 m<sup>3</sup>/block x 48 = 29.57 m<sup>3</sup>, x 1.81 = 53.53 metric tons

<sup>324</sup> Amici 37-42, 47-58. Ulrich 68. According to Jackson and Marra 2006, 424, the specific gravity of *lapis Gabinus* is G = 1.81. Each block's volume is 0.616m<sup>3</sup>, times 190 blocks = 117.066m<sup>3</sup>.

but only about 110 cm long, making for 82.71 m<sup>3</sup> or 149.7 metric tons.<sup>325</sup> We can estimate the total amount of *lapis Gabinus* in the monument, then, at 454 individual blocks, equaling 229.34 m<sup>3</sup> or about 415 metric tons. This estimate does not include the string courses of the stone reported in the tabernae walls, but an even more conservative estimate limited to the preserved evidence would put the total at 104.96 m<sup>3</sup> or about 190 metric tons. The implications of these figures for quarry activity will be considered in chapter six.

In order to compare the *lapis Gabinus* of the Forum of Caesar with that at the outcrops near Gabii, I collected samples of stone from the piers of the tabernae, which were subjected to inductively coupled plasma mass spectrometry as described in chapter four. The results of this analysis can be seen in figure 39, and are more completely presented in the appendix. The ratios of Nb/Y and Zr/Y fall well within the range of those from the quarries at Gabii and are clearly distinct from samples of *lapis Albanus*.

#### *Tomb of Caecilia Metella*

The well-known Tomb of Caecilia Metella sits on the via Appia just beyond the Circus of Maxentius. The monument dates to the early Augustan period, perhaps between 30-21 BCE as Gerding suggests, and consists of a huge cylindrical drum of concrete, faced with travertine on the exterior and brick on the interior, sitting on a square concrete base.<sup>326</sup> Between the drum and this base, however, sits a ring of ashlar blocks which have been identified as *lapis Gabinus*.<sup>327</sup> A single course of blocks protrudes inward into the space of the cella and seems to have served as a way to correct for any errors in the placement of the foundations vis-à-vis that of the interior

---

<sup>325</sup> .383 m<sup>3</sup>/block x 216 = 82.71m<sup>3</sup> x 1.81 = 149.70 metric tons

<sup>326</sup> For the date, see Gerding 2002, 71-72. Gerding also supplies the most complete bibliography and archaeological summary.

<sup>327</sup> Gerding 2002, 27-28; Lugli 1957, 308; Frank 1924, 144.

cella walls. Elsewhere, Gerding notes that the doorway in the upper corridor also consists of ashlar *lapis Gabinus*, with six blocks on either side and five voussoirs in the flat arch above.<sup>328</sup>

Unlike the stone of the Forum of Caesar described above, the few blocks of this tomb are relatively insignificant in quantitative economic terms. Their real significance lies instead in the location and type of the monument in which they are present. Caecilia Metella belonged to an important late Republican family; she was the wife of Marcus Crassus, thus the daughter-in-law of the fabulously wealthy triumvir and mother of the M. Licinius Crassus to whom Octavian denied the *spolia opima* in 30 BCE. If *lapis Gabinus* is present in her tomb, it would represent the only documented use of the stone in a private monument (that is, not funded by the state for public use, as the other bridges, fora and temples in this catalogue). This has important implications for the availability of the stone more generally, as it suggests that it was not limited to state or imperial projects.

The location of this tomb on the Appian Way is also significant, as it is some distance from the Tiber, the most likely means of transport from the quarries at Gabii. In fact, it is somewhat surprising that *lapis Albanus* was not used instead, which would have been transported to Rome right along the via Appia. Gerding attributes this to an economic choice, as *lapis Albanus* would have had to travel further over land and therefore would have been more expensive, but numerous other tombs along the road utilize this stone.<sup>329</sup> *Lapis Gabinus* may have been preferred for its strength and durability, since it served here as an important foundation course supporting the huge drum above it. I would also suggest that it was more economical *not* because the *Albanus* quarries were further by land (or, at any rate, not *only* because of this), but because travertine was already being transported to the site to be used as

---

<sup>328</sup> Gerding 2002, 36.

<sup>329</sup> See, e.g., Coarelli 2007, 394-5, who describes several tombs in peperino (specified in an appendix as referring to *lapis Albanus*).

facing. *Lapis Gabinus* would have been loaded onto barges on the Aniene River near Collatia (modern Lunghezza) just across from the tufo lionato quarries and downriver from the travertine quarries near Tivoli. These three stones often appear together in monuments, as in the Forum of Caesar above. If travertine was needed for the facing of the tomb, the choice of stone from Gabii over that from the Alban Hills may have reduced transaction costs, since the builders of the tomb (or the patrons) would have had to deal with fewer suppliers or middlemen involved in river transportation. Alternatively, it is possible that there was simply an abundance of both travertine and *lapis Gabinus* in Rome at this time. Both had been used extensively in the Forum of Caesar a few years earlier, as well as in the construction of the rear fire wall in the Forum of Augustus, described below. In fact, the Forum of Augustus may have been under construction more or less simultaneously with the Tomb of Caecilia Metella. Builders working in Rome may therefore have had relatively easy access to stockpiles of these stones.

#### *Cloaca Maxima and Petronia Amnis*

The complicated drainage system in the area of Rome began to be modified by human activity in the sixth or even seventh century BCE.<sup>330</sup> While the literary tradition ascribes the construction of the *cloaca Maxima* to the Tarquins, Agrippa undertook massive repairs and reorganization beginning in 33 BCE, and much of what remains owes its appearance to this period.<sup>331</sup> *Lapis Gabinus* has been identified in several locations within the city sewers, most notably in the three concentric arches of the outlet draining into the Tiber.<sup>332</sup> It has also been described in sections between the outlet and via Alessandrina, where enormous blocks (3-4 x 1 x

---

<sup>330</sup> Ammerman 1990; Hopkins 2007.

<sup>331</sup> Strabo 5.3.8; Pliny 36.104; Cassius Dio 49.43. For the archaeology of the Agrippan repairs see Blake 1947, 159-163.

<sup>332</sup> Jackson and Marra 2006; Frank 1924: 142; Coarelli 2007: 539; Blake 1947, 38.

1 m) make up the walls and vault.<sup>333</sup> In addition, Narducci describes a sewer discovered at Piazza Mattei, running from there to the Tiber at a depth of 9.5 meters beneath the modern ground level, with *lapis Gabinus* in the walls and vault.<sup>334</sup> The side walls were made up of two courses of large blocks, each measuring 0.9 meters high, 0.7 meters wide, and up to 2.5 meters long. The vault was constructed of five similarly sized wedges. This structure has been identified as the Petronia Amnis, which crossed the Circus Flaminius here. Another section is described near the Via dei Fienili, with large blocks of *lapis Gabinus* of the same dimensions as above.<sup>335</sup>

While the chronology of the sewers of Rome is complicated, the presence of *lapis Gabinus* in these sections points to a date in the first century BCE, when we know that Agrippa undertook a massive scheme of inspections and repairs.<sup>336</sup> The quarries at Gabii were being intensively worked in the second half of the first century, as shown by the use of the stone in Forum of Caesar (constructed in the 40's BCE) and of the Forum of Augustus (built shortly thereafter, see below). *Lapis Gabinus* must have been readily available in these years. Its use in the vaults of the sewers suggests that Roman builders appreciated the strength of the stone, and possibly believed it to be appropriate for damp environments.

### *Pons Aemilius*

The piers for the Pons Aemilius were first built in 179 BCE, with the remaining stone structure following in 142.<sup>337</sup> Augustus rebuilt the bridge sometime after 12 BCE.<sup>338</sup> Today the

---

<sup>333</sup> Blake 1947, 159;

<sup>334</sup> Narducci 1881; Wiseman 1974; 1976.

<sup>335</sup> Narducci 1889, 40-41; Blake 1947, 160.

<sup>336</sup> Cf. Frank 1924, 142, who suggests a date around 100 BCE for the outlet into the Tiber, based on the presence of *lapis Gabinus* and Grotta Oscura tufo. As Blake notes, however, the outlet may have been later rebuilt re-using some of the earlier material.

<sup>337</sup> A wooden bridge preceded the stone arches.

<sup>338</sup> CIL 6.878



remains can be seen as the single arch known as the Ponte Rotto, in the Tiber between the Ponte Palatino and the Tiber Island. Frank identified *lapis Gabinus* in fifteen courses of the arch, arguing that it had been misidentified by Delbrück as “peperino”, and later scholars have agreed.<sup>339</sup> He suggests that only the cores of the piers, of “Grotta Oscura” tufo (tufo giallo della via Tiberina), date to the second century, with the *lapis Gabinus*, travertine, and concrete construction dating to Augustan reconstruction. The remains are difficult to access today, but the blocks of the arch facing the eastern bank present the typical appearance of *lapis Gabinus* (fig. 40).

### *Forum Augustum*

The most impressive surviving structure consisting of *lapis Gabinus* can be found in the Forum of Augustus (fig. 41, 42). The centerpiece of this forum, the Temple of Mars Ultor, was vowed in 42 BCE at the battle of Philippi, but the complex took over forty years to finish, being inaugurated (still unfinished) in 2 BCE.<sup>340</sup> It is generally thought that construction could not have begun much before the 20’s BCE, however, with the building of the temple commencing only after the retrieval in 20 BCE of the military standards lost to the Parthians.<sup>341</sup>

Stone from Gabii can be seen in several elements. The impressive boundary wall behind the temple, still today rising to thirty-three meters, is composed primarily of *lapis Gabinus*, occasionally reinforced with single courses of travertine. The wall, built with alternating courses of headers and stretchers, extends southeast from the wall connected to the western hemicycle, along the modern Via Tor de’ Conti. It jogs several meters to the northeast at the northern gate to

---

<sup>339</sup> Frank 1924, 139-141; Blake 1947, 178; Lugli 1957, 308; Coarelli 2007, 539

<sup>340</sup> Suet. *Aug.* 29.1-2; Ovid *Fasti* 5.569-78.

<sup>341</sup> See Anderson 1984, who suggests that Augustus moved slowly before 20 BCE in order to avoid associating the temple of the god of war with Marc Antony.

the forum, the piers and arches of which utilize exclusively *lapis Gabinus*. From here the wall continues southeast for twenty meters until turning slightly to the south at the rear apse of the temple. Following this twenty-eight meter stretch, broken by the large eastern entrance with a travertine arch, it again turns southeast, ending with a small room adjacent to the eastern hemicycle. In addition, the flat arch over the gate exiting the forum in the eastern corner is made up of five *lapis Gabinus* voussoirs, similar to those in the Forum of Caesar and Tabularium (though lacking a travertine keystone), and the walls of the small room thus entered are also of this stone. In the hemicycles, *lapis Gabinus* is used in the lower levels for the piers and statue niches, again in conjunction with travertine; the upper levels of the western hemicycle are clearly tufo lionato, however, while those of the eastern appear to be *lapis Gabinus*.<sup>342</sup> Several blocks can also be seen reinforcing both front corners of the podium, which is otherwise faced with tufo lionato, exactly as in the Forum of Caesar. The builders seem to have favored *lapis Gabinus* here for its strength and durability, as a stone which was not quite as robust as travertine but far easier to work and to transport.

The general view of the rear wall of this forum holds that it was meant to block the view of the residential area to the northeast, but also, more importantly, to serve as a protective firewall, based on the fire-resistant qualities of *lapis Gabinus* noted by Tacitus and largely confirmed by recent geological tests.<sup>343</sup> Fires were frequent in Rome, and several occurred in the reign of Augustus. A fire in 31 BCE, shortly before construction of his forum, burned the Circus Maximus, temple of Ceres and other buildings on the Aventine, and the Forum Holitorium.<sup>344</sup> Roman builders may have seen that structures of *lapis Gabinus* survived such conflagrations

---

<sup>342</sup> Jackson and Marra (2006, pg. 428 n. 115) note that the wall extending southwest from the eastern hemicycle belongs to the construction of the Forum of Nerva and is built of lapis Albanus.

<sup>343</sup> See chapter two, pp. \_\_\_.

<sup>344</sup> Canter 1932.

better than those composed of other tufos. But our other evidence for Roman knowledge of these qualities comes from Tacitus, concerning the fire of 64 CE, and it is possible that this quality was recognized only after that most destructive of fires. It need not have determined the use of the stone here, as *lapis Gabinus* was one of only a few stones suitable for such a heavy, large-scale structure, the others being Tufo di Tuscolo and *lapis Albanus*. Both of these came from quarries to the southeast and required a great deal of transportation overland. Here, as in the forum of Caesar and the tomb of Caecilia Metella, it may have been the need for strong travertine blocks and lighter tufo lionato which decided the use of *lapis Gabinus*, since all three came to Rome by way of the Aniene and Tiber.

Construction of the boundary wall and the temple podium (that is, the elements using *lapis Gabinus*) probably commenced relatively early in the building process, but it is impossible to narrow this much further. If Anderson is correct in suggesting that the project was given fresh impetus in 20 BCE, perhaps it is around this time that these structures were completed. Unfortunately, it is impossible to accurately estimate the total amount of *lapis Gabinus* used in the forum. The area was never fully excavated, and the extent and organization of the southwestern side has been the object of much speculation. It is possible, for instance, that walls extending in this direction from the hemicycles were also constructed of *lapis Gabinus*. Even the elements which are still preserved were subjected to re-use and alterations in later periods, particularly the western hemicycle and related walls, which were incorporated into the Casa dei Cavalieri di Rodi (House of the Knights of Rhodes) beginning in the twelfth century. What we can be sure of, however, is that this was undoubtedly the single greatest expenditure of ashlar *lapis Gabinus*, and must have prompted more activity at the quarries than ever before. The implications of this are considered further in chapter six.

As in the Forum of Caesar, I sampled *lapis Gabinus* from two areas within the Forum of Augustus. The first came from the lower wall of the eastern hemicycle, the second from the western corner of the temple podium. These were subjected to inductively coupled plasma mass spectrometry as described in chapter two, and the full results are presented in the appendix. The ratios of Nb/Y and Zr/Y fall well within the range of those from the quarries at Gabii and are clearly distinct from samples of *lapis Albanus*. Interestingly, the geochemical signatures from these samples are most similar to that from the quarry debris within the Gabii Project excavations (see above, chapter 4). This may suggest that stone for the forum was quarried from areas within the city walls, after the abandonment of the area, though further analysis of more samples would be needed to confirm this. The further implications of this are considered in chapter six.

### *Pons Aelius*

*Lapis Gabinus* has been identified in the facing of the Pons Aelius, both in the foundations and the intrados of the arches.<sup>345</sup> The bridge, built in 134 CE, was otherwise constructed of concrete and faced with travertine. This is exceptional as the latest attested use of *lapis Gabinus* in a large scale construction project, by the huge margin of over a century. As such, it deserves greater skepticism, and in fact, upon examination the stone appears macroscopically more similar to *lapis Albanus*. *Lapis Albanus* can be attested in many other second century contexts, such as the podium of the Temple of Antoninus and Faustina built in 146 CE. In fact, it has also been identified in the exterior and cella walls of the Mausoleum of Hadrian, now the Castel Sant'Angelo, which sits at the east end of the Pons Aelius and was

---

<sup>345</sup> Blake and Bishop 1973, 54-55; Lugli 1934, 312; Borsari 1892, 413. Lugli may have later reconsidered this, as the bridge does not appear in his later (1957, 308) list of monuments with *lapis Gabinus*.

dedicated in 139 CE, just a few years after the bridge.<sup>346</sup> *Lapis Albanus* seems to have been the tufo of choice whenever durable ashlar masonry was needed in the second century CE.

### *Other Attestations*

*Lapis Gabinus* has been found, or at least attested, in a number of other locations in the city of Rome, most of which have been re-buried or lost and therefore unavailable for further investigation in person. Lugli, in a sparsely documented list of monuments with ashlar blocks of Gabine tufo, includes quays on the Tiber near the Forum Boarium, presumably destroyed by construction of the modern bank.<sup>347</sup> Frank notes a curb of Gabine stone near the Arch of Titus in the forum, a foot beneath the Augustan pavement.<sup>348</sup>

Frank also identified a few blocks of the stone in the tabernae on the south side of the Basilica Aemilia, dating them to a reconstruction of 78 BCE by Aemilius Lepidus.<sup>349</sup> The evidence of a substantial reconstruction at this time is slight, however, and these walls may reflect instead the well-documented work between 54 and 34 BCE by Aemilius Paulus, or even later after the fire in 14 BCE.<sup>350</sup> *Lapis Gabinus* would have been available in large quantities at Rome at any of these times, as shown by the construction of the “Tabularium”, the Forum of Caesar, and that of Augustus.

Elsewhere, excavations in the 1930s revealed a second-century CE residence under the Piazza del Campidoglio, in which *lapis Gabinus* was recognized in piers topped by corbels

---

<sup>346</sup> Lugli 1957, 306; Jackson and Marra 2006, 434.

<sup>347</sup> Lugli 1957, 308, citing Lanciani 1897, 62, who does not describe the type of tufo used. Blake 1947, 125, referring to these same structures, describes “an embankment consisting of blocks of gray tufa (59 cm. high) arranged in headers and stretchers”, based on earlier notes made by Esther Van Deman.

<sup>348</sup> Frank 1924, 88

<sup>349</sup> Frank 1924, 71 n. 9

<sup>350</sup> The evidence for a reconstruction ca. 80-78 BCE rests on a coin of 59 BCE which depicts the basilica and the legend *M. Lepidus ref(ecta) S.C.*, but Aemilius Lepidus is known to have embellished the basilica with clipei (Pliny), to which this coin might refer.

supporting a balcony.<sup>351</sup> As in the Pons Aelius, stone from Gabii seems unlikely in so late a building, and in fact the piers were originally identified as “sperone”, which can refer to multiple tufos (though it is rarely used in this way). It is more likely that *lapis Albanus* has been misidentified here.

Finally, excavation plans of the remains in the area sacra di Sant’Omobono indicate *lapis Gabinus* in a short staircase leading west from the level of the road on the east side of the church (fig. 43).<sup>352</sup> Samples were acquired from these blocks and subjected to trace element analysis, which confirms that they consist of *lapis Gabinus*; the full results can be found in the appendix. The staircase seems to have been uncovered in the excavations of the 1930s, which were imperfectly documented, and the original chronology and function of this staircase cannot be reliably determined.<sup>353</sup> Other areas along this street appear to date to a late Imperial phase, as the fourth century CE pigment shop to the south.<sup>354</sup> It seems likely that the staircase represents late imperial or even late antique construction, probably re-using *lapis Gabinus* blocks from a nearby structure. The nearest monument thought to include such blocks is the Pons Aemilius less than 200 meters to the southeast, though the Pons Fabricius and the imperial fora are not much further. The possibility also remains that they hail from some unknown monument built with *lapis Gabinus*, perhaps private construction.

Intriguingly, other walls at S. Omobono give the false appearance of *lapis Gabinus*. This is the case in the wall along the eastern edge of the excavations. The blocks are labelled as peperino on excavation documentation, but macroscopically resemble stone from Gabii very closely. Trace element analysis of samples from this wall, however, suggests an entirely different

---

<sup>351</sup> Blake and Bishop 1973; Colini 1939.

<sup>352</sup> I am grateful to I. Cangemi for originally guiding me to these blocks and to and D. Diffendale for providing documentation and discussion.

<sup>353</sup> On the excavations see Terrenato et al. 2012 with full bibliography.

<sup>354</sup> Beeston and Becker 2013.

type of tufo. The results (see sample labelled SO-1 in figure 25) plot most closely to those for cappellaccio (tufo del Palatino), though the blocks must come from a very well-lithified deposit of the stone if this is the case. Such a deposit can be found near Grottarossa in northern Rome, "Peperino della Via Flaminia", though there might be similar outcrops on the Palatine.<sup>355</sup> In any case, this analysis further demonstrates the immense difficulty of accurately identifying stone from Gabii, as well as other varieties of hard, gray tufo, based only on visual observation.

## **Lapis Gabinus in the Eastern *Suburbium***

### *Aqueducts*

Scholars have long identified *lapis Gabinus* in several of the important aqueducts bringing water to Rome from east of the city. It has been cited in the Anio Vetus, the Aqua Claudia, and, most commonly, the Aqua Marcia, though specific locations along the course of these structures are not always provided.<sup>356</sup> However, many have disagreed over the specific type of tufo employed, again illustrating the difficulty of macroscopic identification and the problems caused by the vague terminology sometimes used by archaeologists.

*Lapis Gabinus* is frequently identified in portions of the Aqua Marcia close to Rome. Already in the seventeenth century, the clergyman and antiquarian Raffaello Fabretti noted the stone in a stretch of arches at Settebassi, at the fifth milestone of the via Latina, where it was used in the ashlar blocks of the piers.<sup>357</sup> Frank identifies it in the arches near Porta Furba, employed as large slabs (ca. 210 x 75 x 30 cm) on the top and bottom of the *specus*, with the interior lined with hydraulic cement.<sup>358</sup> Lanciani saw "pietre Gabine ed albane" (both *lapis*

---

<sup>355</sup> Fabrizio Marra, personal communication.

<sup>356</sup> E.g. Coarelli 2007, 539.

<sup>357</sup> Fabretti 1680 (See trans. By Evans, 2002. Fig. 6).

<sup>358</sup> Frank 1924, 137-39. Lugli 1957, 308, who appears to follow Frank.

*Gabinus* and *lapis Albanus*) in the walls of the underground channel between Via Castro Pretorio and Via Milazzo, with blocks 26 cm high and 47 cm long.<sup>359</sup>

Others have disagreed with these attestations. Ashby identifies the *specus* of the Porta Furba arches as composed of peperino, which he frequently identified elsewhere in the aqueduct and which he differentiates from “sperone” from Gabii.<sup>360</sup> Van Deman argues that the *specus* between Via Castro Pretorio and Via Milazzo is actually *cappellaccio*, “mistaken frequently, as here, for peperino or the stone from Gabii”.<sup>361</sup> Coarelli and Ashby describe “peperino” in the Aqua Marcia near Settebassi.<sup>362</sup> More recent excavations along the Aqua Marcia near the city document mainly Grotta Oscura tufo (tufo giallo della via Tiberina) and arches built of “peperino”.<sup>363</sup> These examples clearly illustrate the problematic nature of early tufo identification.

Stone from Gabii has also been recognized in other aqueducts, though again with some disagreement. In 1861 it was noted in the Anio Vetus between the via Prenestina and the via Labicana, about 450 meters from the Porta Maggiore, where it formed the walls of the *specus*.<sup>364</sup> Van Deman, however, again suggests that this is in fact *cappellaccio*.<sup>365</sup> It has also been identified in the *specus* of the same aqueduct closer to the city, near Via Carlo Alberto just northwest of the Porta Esquilina.<sup>366</sup> Finally, construction in 1890 of the railway between Vicolo

---

<sup>359</sup> Lanciani 1874, 204-206; Lanciani 1880, 92; Ashby 1935, 147.

<sup>360</sup> Ashby 1935, 138

<sup>361</sup> Van Deman 1934, 122

<sup>362</sup> Coarelli 2007, 410; Ashby 1935. Blake 1947, 38, already recognized the discrepancies: “Frank...and Saflund... call it Gabine stone; Van Deman...and Ashby...report it as peperino”.

<sup>363</sup> Volpe 1996.

<sup>364</sup> Rosa 1861, 73; Lanciani 1874, 203; Ashby 1935, 80, calls it “tufa or sperone”.

<sup>365</sup> Van Deman 1934, 53.

<sup>366</sup> Not. Scav. 1877, 86. Lanciani, 52, refers to “sperone”, as does Ashby 1935, 86.



del Mandrione and Podere Saccardo revealed foundations for the piers of arches carrying the *aqua Claudia* and Anio Novus, which consisted of ashlar *sperone* resting on concrete.<sup>367</sup>

The aqueducts of Rome provide excellent examples of the difficulty of working with tufo identifications made by previous researchers. Most of the portions said to include *lapis Gabinus* are inaccessible today, and its presence cannot be regarded as certain. It is generally impossible to favor the identifications of one scholar over another; all distinguish between stone from Gabii (variously referred to as *pietra Gabina*, *Gabine stone*, or *sperone*) and other varieties like *cappellaccio* and *peperino*, but the criteria for such distinctions are not usually provided, and the authors themselves sometimes note the difficulty involved. Frank, who devoted an entire monograph to distinguishing between and dating the various tufos, correctly identified the stone in every other case, with the possible exception of the Tomb of Caecilia Metella, but this is no guarantee of accuracy.

While this makes it difficult draw any firm conclusions, some points can be made concerning the likelihood of the presence of *lapis Gabinus* and the potential implications. The stone appears to have been identified in two elements: the *specus* (either the slabs forming the bottom and the cover, the walls, or both) and the piers of arches (above ground or in their foundations). Both accord well with the usage of *lapis Gabinus* elsewhere in Rome, where it was employed in areas of potential water exposure, as in the Cloaca Maxima and bridges over the Tiber, as well as in building elements supporting great weight from above, as in the piers of the Forum of Caesar. The potential weaknesses of tufo when exposed to water could be ignored, at any rate, with the application of the cement which covered the interior of the *specus*. *Lapis Gabinus* could have served well in either of these positions.

---

<sup>367</sup> Lanciani 1890, 11; Ashby 1935, 239.

In addition, the quarries at Gabii would have been conveniently located to provide stone to various points along the course of these aqueducts. Those cited here had their sources high up in the Aniene valley, which they followed west to Tivoli. Here they turned south to the via Prenestina, gradually curving west again to enter the city at its highest point, near Porta Maggiore. It is therefore somewhat surprising that these attestations are rather close to the ancient city, which would have diminished any advantage in stone transportation. Any *lapis Gabinus* would have had to come via the Aniene and Tiber, or take the long land route over the via Praenestina. There are no attestations of the stone in portions of these aqueducts further to the east, as might be expected. In general, Roman builders quarried stone for the aqueducts as locally as possible to reduce costs, and quarries or suitable outcrops along their courses have been noted in the past.<sup>368</sup>

Finally, we might consider the chronology of aqueduct construction. The Aqua Marcia was first built in 144 BCE, but substantial repairs were made many times in subsequent centuries, including those of Agrippa in 33 BCE, those of Augustus between 11 and 4 BCE, and those of Titus in 79 CE. In general, aqueducts required nearly constant upkeep and frequent repairs. According to the traditional dates of *lapis Gabinus* use in Rome, the stone might have been employed at any of these times, though this catalogue has not found any monument including the stone later than the Forum of Augustus in the late-first century BCE; the Aqua Marcia, moreover, is usually cited as the earliest structure to include the stone, with the next being the Milvian Bridge in 109 BCE. It seems possible that any *lapis Gabinus* in the aqueduct may have resulted from the restorations of Agrippa or Augustus, both of whom appear to have

---

<sup>368</sup> Ashby 1935 *passim*.

made substantial repairs.<sup>369</sup> This is further supported by the presence of the stone in other works which were commissioned by these men (as discussed above) and possibly built at the same time as their aqueduct repairs.

The intriguing possibility remains, however, that the construction of the Aqua Marcia led directly to the intensive development of the quarries at Gabii. The search for nearby stone suitable for the cut-stone masonry of the aqueduct may have led to greater knowledge and understanding of the *lapis Gabinus* outcrops. Even if these eventually proved inconvenient for the construction of the aqueduct, Roman builders may have recognized the potential advantages of a well-lithified tufo so close to Rome, perhaps also seeing it employed in the monuments at Gabii (for which see below).

The use of *lapis Gabinus* in the Anio Vetus so close to Rome, if accurate, must also relate to a repair or reconstruction, as its initial construction beginning in 272 BCE precedes the large scale use of the stone at Rome by at least a century. Restorations are documented in 144-44, 33, and 11-4 BCE as with the Aqua Marcia.<sup>370</sup> The *aqua Claudia*, on the other hand, was built mainly in the 40's and 50's CE, and repaired under the Flavians and several times thereafter. Such a late use of *lapis Gabinus* seems unlikely.

### *Via Praenestina*

*Lapis Gabinus* is attested at a number of sites along or in the vicinity of the *via Praenestina*, all within about seven kilometers of Gabii (fig. 44). Nearly all of these were located as a result of survey by Lorenzo Quilici conducted between 1969 and 1974 and published in the

---

<sup>369</sup> For the Agrippan repairs: Frontinus 9; Dio xlix 49; for more see Evans 1982. For Augustan: *Res Gestae*; CIL 6.1244

<sup>370</sup> Frontinus, 7; Pliny xxxvi,121; Frontinus 9

Collatia volume of the *Forma Italiae*.<sup>371</sup> Many have been affected by the later development of the area, and could not be investigated in person. In addition, there is usually little to indicate the date of occupation or construction, though most show signs of imperial-period occupation, and a few date to the late Republic. However, despite these obstacles the distribution suggests some interesting patterns and must be considered in any study of the stone. Three sites along or near the *via Praenestina* (the Ponte di Nona, the Ponte Amato, and a bridge over the Fosso di Tor Angela) are discussed separately in the following sections.

The majority of these sites contained only a few scattered blocks—and sometimes only a single block—of *lapis Gabinus*, usually in a setting interpreted either as a *villa rustica* or a funerary monument.<sup>372</sup> In these cases it is difficult to say more about the context of the stone's use, except that it was only noted in ashlar form. Other cases are somewhat more interesting, due either to the way in which the stone was employed or the quantity of stone present. At two locations, for instance, blocks of *lapis Gabinus* seem to have been used to construct large retaining walls. Near the sixteenth kilometer of the modern *via Prenestina* Quilici documented the remains of a long retaining wall on the north side of the ancient road, which the modern street follows here.<sup>373</sup> The wall extended at least 38 meters, descending relative to the modern street, and while portions of only a single course were preserved in situ, numerous blocks were scattered around the modern ground surface above and must have made up additional courses. The blocks themselves are large, measuring 75 cm high, 110 cm wide, and between 150 and 220

---

<sup>371</sup> Quilici 1974; the main exceptions here are the villa described by Kahane and Ward-Perkins and the bridge described by Fabretti, though other sites were described by Quilici but also noted in less detail by previous scholars.

<sup>372</sup> This is the case for site numbers 192 (two blocks from probable tombs), 202 (a few blocks around a cistern), 204 (fragments around medieval tower), 245 (one block at a villa rustica), 254 (a few blocks, probably from a tomb), 334 (blocks of a probable tomb), 347 (fragments at a villa rustica), 362 (scattered blocks at medieval tower and earlier villa), and 380 (a single block at a villa rustica).

<sup>373</sup> Quilici 1974, 403-4, no. 261, figs. 857-59.

cm long. There is nothing to provide chronology for this wall, and it remains unclear whether it might relate to a villa, tomb, or even the construction of the road, the pavement of which was visible nearby. These remains can still be seen today, at the intersection of the via Prenestina with the via Samassi, where over 30 blocks (or large fragments) remain on the surface and are often used as benches for the nearby bus stop. Those still *in situ* are barely visible where they sink below the level of the modern road. The blocks present the typical appearance associated with *lapis Gabinus*, with distinct layering. A similar wall of *lapis Gabinus* was found extending six meters along the ancient road further west, in an area now covered by the modern development of Colle Prenestina.<sup>374</sup> Two courses of blocks were preserved, with each block measuring about 55 cm high, 50 cm wide, and 130 cm long. Quilici suggests that the wall pertained to either a tomb or a retaining wall for the road.

Another site lies just north of the larger wall described above, along an ancient road which once led from Gabii to Salone. Quilici describes the bases of two tombs, sitting within about twenty meters of each other and composed of large *lapis Gabinus* blocks.<sup>375</sup> The tombs are square in plan, measuring 5.5 and 6.6 meters on a side, though that to the south was only partially preserved. Based on their general characteristics, the tombs belong to the third or second centuries BCE. Interestingly, the blocks of the northern tomb preserved molding along their exterior faces. With very few exceptions, *lapis Gabinus* does not seem to have been used in Rome when carved decoration was desired, but this may not always have been the case closer to the quarries, where the easy availability might have outweighed any concerns over its ability to hold an edge.

---

<sup>374</sup> Quilici 1974, 319-330, no. 194.

<sup>375</sup> Quilici 1974, 399-400, no. 255. The tombs were also noted by Ashby 1902, 175-176.

Three other sites in this area are noteworthy for the large amounts of *lapis Gabinus* present. A few kilometers south of the Praenestina, on the modern Via di Rocca Cencia, Quilici documented a villa site which had suffered clandestine looting, resulting in a great number of *lapis Gabinus* blocks strewn about.<sup>376</sup> The total number of blocks is not provided, but samples dimensions are: 160 x 75 x 23, 160 x 70 x 30, 110 x 90 x 30. Also reported in the vicinity was a tomb in *opus quadratum* as well as a carved threshold, both in *lapis Gabinus*. Back on the via Praenestina, Quilici identified another villa site with about 80 blocks or large fragments of *lapis Gabinus*, possibly the remains of a large terrace wall which was identified here on a nineteenth-century map.<sup>377</sup> Finds of marble, tile, and other ceramics in this area suggest an imperial occupation.

Stone from Gabii was identified in several locations in the area of Ad Nonum, site of a mid-to-late Republican sanctuary and later road station on the via Praenestina, just east of the Ponte di Nona (for the bridge itself, see below). Much of the site was disturbed by agricultural activity, clandestine looting, and, in 1963-64, by the working of a large pozzolana quarry, which completely destroyed the main area of the sanctuary. Quilici summarizes our understanding of the site, based on a short excavation in 1912, brief surveys and collections of material conducted earlier, and his own observations.<sup>378</sup> The early excavations revealed a small building between the Ponte di Nona and the temple, interpreted as the *mansio* of the road station, which included a courtyard paved with irregular slabs of *lapis Gabinus*. A few meters to the east the excavators discovered a circular construction, possibly a pool associated with the sanctuary, built in *opus*

---

<sup>376</sup> Quilici 1974, 608, no. 528.

<sup>377</sup> Quilici 1974, 386, no. 229. Rosa (*Carta topografica del Lazio* redatta in scala 1:20.000, Roma 1850-1870, originale manoscritto conservato all'Arch. Sopr. Roma).

<sup>378</sup> Quilici 1974, 363-381, no. 224. The excavations of 1912 are described by Pasqui 1912 and Mancini 1912, both of whom discuss the presence of *lapis Gabinus* (or "sperone"). Excavations by the British School in Rome in 1975-6 focused on dumps of terracotta votives, as most of the structures had been obliterated: Potter 1984 and 1989.

*quadratum* of “sperone”. Further east along the road, Quilici observed a small tomb faced with *lapis Gabinus* blocks, and an area with a large concrete structure surrounded by a great number of blocks, including *lapis Gabinus*, travertine, marble, and other tufos.

Tufo from Gabii has also been identified in a *villa rustica* just north of the via Gabina, about 1.5 km from Osteria dell’Osa, where the road deviates south from the via Prenestina. Kahane and Ward-Perkins describe several rooms and a corridor uncovered in 1964, built partly in concrete and partly in *opus quadratum*, with blocks of friable brown tufo reinforced in a few places with *lapis Gabinus*.<sup>379</sup> Only three such blocks are visible on the sketch provided, though they also note the presence of elements of an oil press carved in *lapis Gabinus*. Quilici seems also to refer to this press, describing a block of Gabine stone from a torcularius, which was later re-used to cover a well.<sup>380</sup> Notably, however, Quilici refers only to *cappellaccio* in the ashlar construction of the building. Kahane and Ward-Perkins date the structure to the first century BCE, based on limited pottery collection.

### *Ponte di Nona*

The ancient Ponte di Nona still carries the modern via Prenestina, at the ninth mile marker just west of the site of Ad Nonum described above. The bridge is more or less intact, though it has been repaired or modified frequently in the last two centuries, and is often cited as our best preserved example of late Republican bridge construction (fig. 45).<sup>381</sup> Seven arches stretch some 70 meters across the valley, resting on massive piers which thin as they rise and

---

<sup>379</sup> Kahane and Ward Perkins 1972, 115. The site is also described in Quilici 1969, no. 1681, and Quilici 1974, 456-7. The plans provided in these publications are similar, but impossible to match precisely, as that in Kahane and Ward-Perkins 1972 is a mere sketch not drawn to scale. These authors also appear unaware of excavations which took place in 1955 and which are described by Quilici, while Quilici himself does not mention their work in 1964.

<sup>380</sup> Quilici 1974, 457, fig. 957.

<sup>381</sup> See e.g., Laurence 2013, 304. For the repairs, see Quilici 1974, 375-381.

carry the road 16 meters above the stream bed. It was constructed with concrete faced with *lapis Gabinus*, with travertine keystones and tufo lionato facing at the bridge heads.<sup>382</sup> The blocks from Gabii are generally rusticated and vary in size; those in the arches are a uniform 110 cm long, while others vary from about 130 to 280 cm long, with an average height of 60 cm. One arch of a smaller, earlier bridge, also composed of *lapis Gabinus*, was built into the two central piers. This earlier bridge must have been far smaller, requiring travelers to descend into the small valley. The stone presents its typical appearance, and layers within the blocks are especially distinct at the bottom of the piers where they have been subject to differential weathering.

Despite the prominence of this bridge in archaeological guides and manuals, its chronology has never been very precise. The smaller bridge may have been built in the early-second century BCE, perhaps in 173 BCE when Livy notes the construction of bridges by the censors.<sup>383</sup> This would make it the earliest project outside of Gabii to utilize the stone. The larger bridge is generally dated either to the late second century BCE, when the importance of the sanctuary of Fortuna Primigenia at Praeneste led to increased traffic on the road, or to the early first century BCE, when the sanctuary was monumentalized. However, these dates are extremely uncertain. In any case, the bridge seems to represent one of the earliest large-scale monuments beyond Gabii to include the stone. In fact, its construction would have made more feasible the transport of *lapis Gabinus* to Rome along the via Praenestina (if the route along the Aniene had not yet developed, see further below), as ox-carts would not have needed to descend into the valley and climb back out.

*Lapis Gabinus* was obviously preferred here for its load-bearing strength, as the use of tufo lionato in non-essential elements like the bridgeheads makes clear. This tufo lionato could

---

<sup>382</sup> For other descriptions and attestations of *lapis Gabinus*, see Quilici 1974, 373-383; O'Connor 1993, 69-70; Gazzola 1963, 25-26, 44 (where the stone is called *peperino*); Lugli 1957, 198, 356; Ashby 1902, 171-2.

<sup>383</sup> Livy 41.27.5; Blake 1947, 212.



have been quarried from the area of the bridge itself—Ashby noted traces of quarry activity on the east side of the valley near the bridge and further to the south.<sup>384</sup> The builders must have already developed an appreciation for the strength of *lapis Gabinus*, in order to justify the greater cost of transporting the stone from the quarries nearly six kilometers away. In addition, they employed here, for the first time, the combination of *lapis Gabinus*, travertine, and tufo lionato which was later to be found in monuments in Rome such as the fora of Caesar and Augustus.

### *Ponte Amato*

Further east on the *via Praenestina*, near Gallicano, the Ponte Amato carried the road over the Fosso Collafri. This single-arched bridge was well-preserved into the twentieth century, but was damaged during the Second World War and restored in 2002 (fig. 46).<sup>385</sup> The arch above the streambed is six meters wide, with solid walls extending to either side carrying the road the rest of the way across the gully. The blocks of the facing have been identified as *lapis Gabinus*, covering a core of concrete, as in the Ponte di Nona.<sup>386</sup> The walls on either side of the arch are faced with seventeen courses of blocks, each about 60 cm tall, with rusticated exteriors. There is no solid evidence with which to date the construction, but it is usually assigned to the first century BCE. This is the only attestation of *lapis Gabinus* east of Gabii, and is somewhat surprising, considering that the quarries are over eight kilometers from the bridge.

---

<sup>384</sup> Ashby 1902, 172

<sup>385</sup> The extent of damage and restoration can be seen by comparing the photograph in Ashby 1902, 206, fig. 17, with those in Gazzola 1963, 26, and with the appearance of the bridge today. The restoration is also noted by Balance 1951, 89, n. 6.

<sup>386</sup> O'Connor 1993, 70-71; Gazzola 1963, 26; Blake 1947, 212; Ashby 1902, 209; Lugli 1957, 309

### *Bridge over Fosso di Torre Angela*

About one kilometer south of the *via Praenestina*, where both the *via Gabina* and the *aqua Alexandriana* once crossed the Fosso di Torre Angela, Fabretti noted a single arched bridge composed of *lapis Gabinus* which he attributed to the third-century CE *aquae Alexandriana*.<sup>387</sup> Scholars have since discovered no trace of any bridge, but many accept his description. There is some debate as to whether such a bridge would have carried the aqueduct or the road of the *via Gabina*, as the aqueduct is faced elsewhere with brick and rarely carried on *opus quadratum* arches.<sup>388</sup> However, it could very well represent a late restoration—Fabretti does describe the blocks as “rough” (*crassis*). If the bridge carried the road, it is impossible to assign a date to its construction, though it must be rather early, before the primacy of the *via Praenestina* (laid out in perhaps the early second century BCE), or rather late, associated with the construction and maintenance of the aqueduct.

### *Via Labicana*

*Lapis Gabinus* has been observed at a few locations along the *via Labicana*. Near the eleventh milestone it was reported in the substructures of a large bath complex discovered in the late-nineteenth century.<sup>389</sup> Blocks have also been identified, though not *in situ*, at the site of Ad Quintanas, the road station on the *via Labicana* which replaced the ancient center of Labicum fifteen miles from Rome.<sup>390</sup>

---

<sup>387</sup> Fabretti 1680, trans. by Evans 2002, Diss. 1 Tab. 1: “*arcus unicus ex crassis Gabinis lapidibus super hoc rivo*”.

<sup>388</sup> Ashby 1902 identified the *specus* elsewhere in the stream bed and suggested that the bridge carried the road; he was followed by Kahane and Ward-Perkins 1972, 99-100, though he later (Ashby 1935, 311) seems uncertain. See also Quilici 1974, 462, no. 370.

<sup>389</sup> Tomassetti 1897; Blake and Bishop 1959, 158.

<sup>390</sup> Tomassetti 1899, 292; Ashby 1902, 258-9; Dennison 1909.

## Lapis Gabinus at Gabii

### *Santuario Orientale (Eastern Sanctuary)*

The excavations in the Santuario Orientale just beyond the walls of Gabii revealed several structures in *lapis Gabinus* (see fig. 6).<sup>391</sup> Construction in the early phases of the sanctuary utilized a reddish stone, probably locally quarried tufo lionato, but in the reorganization of the latter half of the fourth century BCE the stone began to appear in *opus quadratum* walls surrounding the central building, as well as in several altars and a nearby pavement surrounding a well. By the early-second century BCE, the sanctuary had gone out of use, but the roof of the portico to the east was supported with *lapis Gabinus* pilasters with engaged columns, and *lapis Gabinus* curbs bordered the nearby street.

### *Temple of Juno Gabina*

The Temple of Juno Gabina is the most monumental structure to survive at Gabii (see fig. 5). The excavations conducted between 1956 and 1969 by a Spanish team provide an excellent understanding of the sanctuary and its chronology, which I have already described in Chapter 2.<sup>392</sup> The excavators described *lapis Gabinus* in a number of elements throughout the complex. Most significantly, the entire podium, frontal staircase, and cella walls are built with blocks of the stone. The podium consists of four courses of stone 1.79 meters high, covering an area 17.62 meters wide and 23.64 meters long. The cella itself is 14.7 meters long and 8.37 meters wide, with walls rising in at least 14 courses to a height of about 8.4 meters. The stone has also been identified in the *temenos* wall, the pavement of the access ramp and other areas, and the foundation of the altar. It also seems to have been used for carved elements such as fluted

---

<sup>391</sup> Guaitoli 1981, 169-71; Zaccagni 1978, 44; Mancini and Pilo 2006, 89.

<sup>392</sup> Almagro-Gorbea 1982. A more detailed description of the remains can be found in Chapter 2.

column shafts and elements of the entablature, as well as the section of the Doric frieze decorating the altar, which contained the partial inscription *CETHEGVS*.

The use of *lapis Gabinus* at the sanctuary in part reflects the use to which it was put at Rome, in load-bearing elements like temple podia and monumental walls. However, at the Temple of Juno builders also carved the stone for decorative elements such as moldings and the frieze, uses which are unattested in the capital. The cheap cost of transporting the stone from the local quarries apparently offset any concern over the ability of *lapis Gabinus* to hold an edge. The inscription is particularly interesting, as the only other attested use of stone from Gabii in this way (at the Tomb of the Scipios) appears to be erroneous.

The monumentalization of the sanctuary, to which the extensive use of *lapis Gabinus* is attributed, seems to have occurred in the mid-second century BCE (probably in the years 160-150 BCE) with some restorations under Augustus and in the second century CE. The complex has rightfully assumed a place of some importance in the history of the development of late-Republican sanctuaries, together with the sanctuary of Hercules at Tibur and that of Fortuna at Praeneste. The builders were clearly well-versed in the Latin vernacular of Hellenistic architecture, and participated in the same architectural tradition which would go on to create the temples and monuments of first century BCE Rome. In addition, the building of this sanctuary, like the construction of the Aqua Marcia nearby, may have played a role in exposing Roman builders to such a useful dimension stone so close to Rome.

### *Survey Finds*

Surface survey at Gabii has led to the attestation of *lapis Gabinus* at numerous other locations in and around the city, usually as blocks or slabs which have been moved from their

original context or were associated with the quarry faces.<sup>393</sup> Little can be said of the original use to which such material was put, but the presence of such blocks across a wide area of the city suggests extensive use. Quilici also describes a tomb to the northeast of the city which was faced with *lapis Gabinus*.<sup>394</sup>

### *Gabii Project Excavations*

The excavations of the Gabii project, begun in 2009, have revealed a substantial part of several city blocks and a number of burials and structures dating from the late-eighth century BCE into the third century CE.<sup>395</sup> As such, they have brought to light more than a few examples of how the residents utilized the local tufo outcrops. A geological survey of exposed structures was conducted during the 2012 summer field season, continuing into the excavations of new areas in 2013.<sup>396</sup> The macroscopic appearance of blocks throughout the site was documented, with occasional samples taken to ensure accurate identification, and the results suggest some interesting patterns.

The earliest structures, part of the elite complex in area D dating to the late seventh to early fifth centuries, were built with small, very roughly shaped blocks of a friable gray tufo laid in irregular courses (fig. 47). Both rooms, as well as the precinct retaining wall, were constructed in this way. The appearance of this tufo is most similar to what would be called cappellaccio in Rome; however, our excavations in this area also uncovered portions of the bedrock in the immediate area, which looked very similar to the stone in the archaic structures. Samples of each

---

<sup>393</sup> Guaitoli 1981, 55-57, catalogue pertaining to the maps on Tav. I and II.

<sup>394</sup> Quilici 1988, 149.

<sup>395</sup> For a summary see chapter two.

<sup>396</sup> I conducted this survey while an assistant trench supervisor with the Gabii Project. I gratefully acknowledge the assistance of Fabrizio Marra, whose identifications during a more limited survey formed the basis of macroscopic identification across the site.

were acquired and subjected to trace element analysis, and the results prove that both have similar geochemical signatures to *lapis Gabinus* from the quarries and the monuments of Rome.<sup>397</sup> It appears that the residents quarried stone from nearby, where the *lapis Gabinus* deposit exhibits few of the “typical” characteristics of the stone as seen in the architecture of Rome.

Perhaps the most impressive of the structures to be discovered in the Gabii Project excavations are those in area F, where a monumental civic-religious complex has been discovered. While the northern sections of this complex were found in 2012, the 2013 season revealed far more, and the interpretation of the chronology and stratigraphy of the remains are still in the preliminary stages; the discussion which follows can only be preliminary. From the south, a ramp leaves the *via Praenestina* and ascends to the north, between two substantial rooms which were, at some later date, remodeled into *tabernae*. The ramp continues to the next terrace level, where several rooms branch out, seemingly mimicking domestic architecture, though on a much larger scale, with pristine floors and an altar in the rear space. At the back of this last area is a monumental ashlar wall several meters tall (figs. 48, 49), atop which is a large space which seems to have been robbed out of building material in antiquity; a monumental staircase unites these different levels. The later walls of the upper level, and in fact the position of the staircase (if central) might suggest that this complex extended even further to the west. The complex seems to date to the third or second centuries BCE.

While the precise interpretation of this intricate complex is still under discussion, the use of *lapis Gabinus* in its construction is not – the stone appears in many of the pavement slabs of the ramp, the gigantic piers of a gate in the lower entrance, some blocks and columns reused in later walls on the lower terrace, curbs and piers along the street, the massive retaining wall to the

---

<sup>397</sup> The full results can be found in the appendix.

north, and the staircase leading to the next terrace. Interestingly, tufo lionato blocks are utilized in many of the walls of the rooms on either side of the ramp and in the walls on the next level—*lapis Gabinus* appears to have been reserved for high traffic areas or the most crucial weight bearing elements. This is incredibly significant, as the earliest archaeologically attested, large-scale use of *lapis Gabinus* in the region. It is abundantly clear that by this time the quarries fully operational, supplying stone for high-quality ashlar masonry.

In the later courtyard houses of areas B and C (ca. 200-100 BCE), most of the walls were constructed with large, well-dressed ashlar blocks, though only the lowest course has been preserved. The builders of the house in area C utilized tufo which is reddish or yellowish in color, frequently peppered with small white inclusions. It appears to be a kind of tufo lionato, perhaps quarried from a facies which is transitional with more poorly cemented pozzolana.<sup>398</sup> While the famous tufo lionato quarries are about ten kilometers to the northwest along the Aniene River, the deposit is extensive, and outcrops have been identified along the Fosso del Ossa, which runs from Osteria dell'Ossa just west of Gabii northwest to the Aniene at Lunghezza.<sup>399</sup> The stone could therefore have been acquired quite locally. The builders also utilized crushed tufo lionato in the floor paving of several rooms, covering it with a layer of low-quality plaster as a kind of *opus signinum*. *Lapis Gabinus* is only occasionally present in this area, in walls to the south of the house, which are constructed with smaller, irregular blocks and which may relate to a later phase. In the house in area B, on the other hand, which is roughly of the same period, the walls were built mainly of ashlar *lapis Gabinus*. Even in those walls which were constructed with irregular blocks of various materials, such as those on the north and east of the courtyard, the corners were reinforced with larger *lapis Gabinus* blocks. Tufo lionato in

---

<sup>398</sup> Fabrizio Marra, personal communication.

<sup>399</sup> Quilici 1974, 427 (n. 313), 434-5 (n. 327). The former site shows signs of ancient extractions, while the latter might be more recent.

this house is limited to a few large slabs in the courtyard, covering the well and the drain, while *lapis Gabinus* was also carved for the threshold block of the main entrance.

*Lapis Gabinus* rarely appears in later phases, and then usually as small, irregular blocks which may have been reused from previous structures. This is the case in the late Republican industrial zone in area C, where the stone can be found in the rubble walls around the paved area and road, and in the circular feature beyond the wall to the west. There are two notable exceptions: the monolithic wellhead at the center of the paved court of the industrial area, and three of the slabs of the pavement in the courtyard of area E (other slabs appear to be tufo lionato). Ashlar blocks also appear in the late buildings in the southern part of area F, but there they are re-used (sometimes *in situ*) from the earlier structures.

## Conclusions

This catalogue cannot claim to represent a complete distribution of *lapis Gabinus* in the monuments of Rome, Gabii, and the surrounding region, and it is dangerous to draw specific conclusions. However, a number of interesting patterns have emerged which shed light the development of the quarries, the market for the stone, and the uses to which it was put by Roman builders.

The use of *lapis Gabinus* at Gabii provides evidence of the early exploitation of local stone. In the archaic period, residents seem to have quarried stone from the immediate area, even if this proved to be inferior in quality compared with elsewhere in the same deposit. It was adequate for their purposes as far as domestic structures were concerned. Likewise, in the early phases of the Santuario Orientale, tufo lionato from nearby was utilized. By the second half of the fourth century BCE, however, high-quality ashlar *lapis Gabinus* begins to appear in local



civic and religious architecture. Builders used it to replace the earlier stone in Santuario Orientale, and to construct the monumental retaining wall and associated structures in area F. Over the course of the fifth and fourth centuries, a tradition in skilled stone quarrying and construction must have developed, based around the local *lapis Gabinus* quarries. By the second century, *lapis Gabinus* appears in local private architecture alongside tufo lionato, perhaps suggesting that, with the development of the urban area, the transport costs from quarries for both were roughly equivalent. The construction of the monumental Temple of Juno in the middle of this century represents the culmination of local *lapis Gabinus* construction, even as the importance of the city diminished.

This project is one of several in the mid-second century BCE which may have first brought the stone to the attention of builders from Rome. The building of the Aqua Marcia took place shortly thereafter, and would have necessitated the scouting of suitable deposits in the surrounding area. Likewise, the first Ponte di Nona may have been erected in the early-second century, with the larger bridge possibly later in the century, both of which may have exposed the stone to Roman builders. This later bridge, in fact, would have facilitated the transport of stone to Rome along the via Praenestina. A series of developments in the extended countryside of Rome, then, potentially contributed to the intensification of extraction at Gabii for the ultimate purpose of monumentalizing the city center.

The possible role of the via Praenestina in the transportation of *lapis Gabinus* deserves further thought, based on the distribution of the stone at various sites in the countryside west of Gabii. It seems clear that some blocks, at least, must have travelled by ox-cart along this road, even if they did not make it to Rome. While acknowledging that most of these attestations are unconfirmed, the map displays the distribution we might logically expect, with stone travelling

furthest along the main road, and some deviation to the north and south along ancillary roads closer to the quarries. Most of these villas and tombs show evidence of an imperial date (or are undatable), but a few are certainly Republican; at any rate, the problems of site visibility and reoccupation are well-known to survey archaeologists, and it is possible that the *lapis Gabinus* at these sites belongs to first century BCE phases. In any case, private individuals using the stone for tombs and domestic architecture would have been able to supply their own carts and labor for transportation, decreasing the cost. Despite the proximity of the quarries, however, the stone is not as widespread as we might expect, perhaps due to the fragmentary nature of our knowledge. On the other hand, serious development of this area of the *suburbium* really only began in the first century BCE, and by this time the bulk of the blocks quarried at Gabii may have been needed at Rome.<sup>400</sup> Perhaps the stone was only available to local builders during periods between the large projects under construction in the capital, when the quarries may have been worked on a smaller scale. Indeed, this might explain how a villa site on the *via Praenestina* could end up with a huge number of large blocks, as the development of quarry infrastructure and related commercial relationships may have encouraged the seeking of new markets for the stone.

Back in Rome, the private use of *lapis Gabinus* is not well documented, as the presence of the stone in the only possible examples—the sarcophagi of the Scipios, the tomb of Caecilia Metella, and the second century house under the Campidoglio—is unlikely, or at least unconfirmed. The stone was preferred instead for public buildings and infrastructure, appearing in most of the large-scale construction projects of the first century BCE. Several of these projects would have required significant activity at the quarries, over a period of months or even years. The scale of extraction required must have brought an influx of labor to Gabii, with the associated need to supply the industrial activity as well as feed and shelter the quarrymen.

---

<sup>400</sup> As noted also by Quilici 1974, 26.

Furthermore, these projects were commissioned by the most powerful men of the late Republic – Sulla, Caesar, and Augustus. The connection with Sulla (with the construction of the Tabularium and the later Ponte di Nona in *lapis Gabinus*) is especially interesting, as it might provide some indication of how the stone began to arrive in Rome. It is worth remembering that Sulla fortified Gabii itself at some point, an action which would certainly have brought the quarries to the attention of his engineers.<sup>401</sup> More broadly, though, this raises issues of access, as the stone may have been initially limited to construction involving the state (or the leaders thereof). Quarrying of *lapis Gabinus* thus represents state investment in the rural space of the imperial capital and in the free labor of the region.

As far as builders were concerned, the stone appears to have been desired mainly for its strength, durability, and fire-resistant properties. At Gabii, for instance, local architects employed it in the retaining wall of the monumental complex in area F, and in others along the via Praenestina outside the city. Even in private construction at the site it appears in pavements and thresholds which would have seen substantial foot traffic. At Rome it appears in load-bearing elements and foundations, as in the foundations of the Tabularium, the piers and flat arches of the *tabernae* in the Forum of Caesar, and the arches of bridges over the Tiber. By the time of Augustus the stone was also used in utilitarian repairs to the sewer system and to bridgework. It is difficult to say to what extent the fire-resistant properties of *lapis Gabinus* were appreciated at this time, but the presence of the stone in the boundary wall of the Forum of Augustus seems to indicate some knowledge of this. The stone was rarely used for carved decoration, with the significant exception of the Temple of Juno at Gabii, where it may have been the only option available. In general, stoneworkers at Gabii may have been more willing to experiment with the local stone when better alternatives were unavailable, using it for decorative molding,

---

<sup>401</sup> See above, chapter two.

inscriptions, oil presses and more. The semi-columns of the Tabularium, and possibly those of the Theater of Pompey, are the only similar examples at Rome, probably due more to the increasing availability of travertine and marble in the city at this time than to any defect in *lapis Gabinus*. In any case, tufo from Gabii, as with other varieties, was often covered with plaster and painted, or faced with decorative stone, both to protect it from the elements and to achieve a more aesthetic appearance. In other cases, the surface was left rusticated, perhaps so that plaster could more easily adhere to it. Alternatively, Frank suggests that plaster did not adhere well to *lapis Gabinus* due to the coarseness of its inclusions.<sup>402</sup>

In many of the monuments of Rome, *lapis Gabinus* appears together with tufo lionato from the Aniene quarries and travertine from Tivoli further up the river; in fact, only in the Cloaca Maxima does it appear without at least one of these other stones. In one sense, this may have been driven by architectural design, since the combination of these three stones (strong but difficult to work travertine, durable *lapis Gabinus*, and light-weight tufo lionato) allowed for resilient yet lofty structures. But this also makes excellent and practical sense in light of Strabo's claim that the river was used to transport blocks from each of these quarries to Rome. The use of a single route would have facilitated transportation and decreased costs. The men, boats, and even upstream loading cranes could potentially be shared, and contractors would need to deal with fewer middlemen, limiting transaction costs.<sup>403</sup> This might explain the use of *lapis Gabinus* in the foundation of the Tomb of Caecilia Metella, a monument which sits much closer to the *peperino* quarries at Marino but which involved a significant amount of travertine. It may be, in fact, that this route was first developed in order to transport highly prized travertine and

---

<sup>402</sup> Frank 1924, 25.

<sup>403</sup> More discussion of these aspects of stone transportation is provided in chapter six.

multipurpose tufo lionato, and only at some point after this was the intensive exploitation of *lapis Gabinus* feasible, when it could “piggy-back” on the same route.

The monuments themselves provide little to explain why the stone ceased to be used into the first century CE. While it may have appeared in monuments which do not survive, it is telling that later builders relied on other durable gray tufos for load-bearing elements. Tufo di Tuscolo, for instance, appears in the Colosseum (70-90 CE), and *lapis Albanus* in the Mausoleum of Hadrian and the Temple of Antoninus and Faustina. *Lapis Gabinus* ceased to appear in construction at Rome at the very end of the last century BCE.

## Chapter 6: The Operation of the Quarries

### Introduction

The evidence gathered in the previous chapters allows for a comprehensive analysis of the operation of extractive activities at Gabii. In the following pages I discuss issues related to extractive techniques, transportation methods, the nature and amount of labor and infrastructure involved with both, as well as ownership and the overall chronological development of the quarries. Reorganizing the data in this more narrative manner permits additional insights and a more complete understanding of the particulars of *lapis Gabinus* extraction. Some of the ideas presented here are more tentative than others, as they are based on quantitative estimation or on comparative evidence from other sources. Nevertheless, the results provide the best picture available for tufo quarrying around Rome. By understanding more specifically how *lapis Gabinus* was quarried and transported, we can get a better sense of the construction industry more generally and better understand the resulting economic interactions between Rome and her countryside.

### The Extraction Process

As at all stone quarries, the methods of extraction at Gabii were largely determined by the nature of the deposit and the characteristics of the stone itself. First, since *lapis Gabinus* forms the uppermost geological layer beneath the topsoil, extraction took place on the surface in open-pit quarries. While today only sheer quarry faces remain visible, extraction would have

proceeded in steps, in a process which is more readily visible at other quarries such as, for instance, those on the Aniene for tufo lionato and several quarries along the southern coast of France.<sup>404</sup> After isolating a horizontal and vertical surface, blocks were removed individually in steps one course in height. Once several rows of blocks had been removed, extraction could continue on multiple steps, allowing multiple teams to work a single outcrop in order to increase the rate of production. Once a level was exhausted, workers would move further down the slope and begin again on new level. This process would eventually result in vertical faces at the back of the pit, along the line at which extraction ceased, provided that the outcrop was fully exploited. At Gabii, these “steps” can still be observed at several outcrops (see chapter four).

Several quarry faces, including that excavated by the Gabii Project, preserve evidence of the more specific extraction methods used to extract blocks. The trench-and-wedge method was clearly preferred, as in other tufo quarries, since the stone is soft enough to be cut relatively easily with a simple pick. First, trenches were dug separating a block from the surrounding rock on three sides, including the rear. Trenching can be seen at the base of the excavated quarry face, where a thin channel was dug into the rock along the face for the removal of the next row of blocks. It is also apparent in the assay pit to the south, where the trenches are wider, more typical in their size as compared with other tufo quarries.<sup>405</sup> Holes were then cut along the lower plane of the intended block and wedges driven into these holes with a hammer, eventually causing the block to fracture from the rock beneath. Wedge holes have not been identified in the existing faces, but the excavated iron wedge (if ancient) indicates that this method was employed.<sup>406</sup>

---

<sup>404</sup> Quilici 1974, 168, fig.311; Bessac 1996, 89-112; Adam 1994, 22-23, provides a summary of the overall process. See also Ward-Perkins 1971, fig. 1.

<sup>405</sup> One can compare the trenches at the Aniene quarries: Quilici 1974. While extraction in this trial pit did not follow the step-process outlined above, the basic block removal techniques were the same.

<sup>406</sup> I discovered square holes in one face north of the city, but they are spaced far apart, suggesting that they may have been associated with later built structures rather than extraction.

In the first stage after extraction, stonemasons would roughly shape the blocks, removing some of the excess stone if necessary. This was done to reduce the weight, and therefore transport costs, as much as possible while retaining enough excess stone to guard against potential damage in the transport process. Workers would have moved blocks with crowbars and wooden rollers only a limited distance from the point of extraction, probably to somewhere on the quarry floor, before masons shaped the stone. Areas where this activity occurred are difficult to identify at most quarries, and impossible at Gabii without further excavation in the quarry zones. On the other hand, both this process and the cutting of trenches would have produced a significant amount of lithic debris of the kind discovered at several locations at Gabii, including in the debris field in Area B, filling the lower parts of the Area A quarry face, and possibly in several lithic scatters in fields around the faces north of the city. Lithic material such as this was potentially useful for rubble construction, concrete aggregate, and other purposes, particularly for local needs, but the amount produced would undoubtedly have exceeded these needs. It was therefore collected and transferred to out-of-the-way locations—the debris filling the Area A quarry, for instance, must have been deposited after extraction had ceased in this area.

These activities would have required a few basic tools, mostly made of iron. Such tools have rarely been found in the archaeological record, but they can be observed in several tomb reliefs carved for Roman stonemasons and their effects can be seen on partially worked blocks.<sup>407</sup> The tool kit seems to have changed little until modern times. Quarry workers removing blocks used picks to dig trenches, as well as hammers, wedges, and levering instruments to free blocks from the deposit. Saws were also sometimes used, particularly when breaking up harder stone such as marble into smaller blocks; however, this process took more time than other

---

<sup>407</sup> For the effects of tools on blocks and rock faces, see Bessac 1993. See also Rockwell 1993; 1990. Roman reliefs depicting stonemason tools include that of Diogenes Structor from Pompeii (see Adam 1994, 32, fig. 48; Cuomo 2007, 97-98) and a funerary monument now in the Museo della Civiltà Romana (Adam 1994, 33, fig. 51).



methods and was not strictly necessary for a soft stone such as tufo. Stone-mason's axes (also called kivels, featuring two blades on perpendicular planes), chisels, mallets, and hammers would also be needed for the initial shaping prior to long-distance transportation. Lithic debris from these activities would have been moved by shovel and by hand, probably with sacks or baskets to accelerate the process. A tomb relief from the Isola Sacra shows the use of baskets for moving small blocks.<sup>408</sup>

At Gabii, these tools are represented by a single wedge and an iron artifact which may be a point chisel (several other interpretations are possible), though neither is securely dated. While a number of fragmentary iron instruments of indeterminate function have also been found, they cannot be definitively identified as stone-cutting tools or securely linked to quarry features.

## **The Transportation Process**

It is somewhat misleading to treat the transportation of quarried stone as a category separate from extraction, since some transportation was required immediately after separating blocks from the deposit and took place at the quarry itself. However, the moving of heavy blocks, especially over longer distances, presented unique challenges and required specialized tools, labor, and expertise.<sup>409</sup> At the *lapis Gabinus* quarries, blocks were first transferred within the quarry site to loading areas, where they were loaded on to carts, travelling by road and/or water to Gabii, Rome, or other building sites in the eastern hinterland of the capital.

---

<sup>408</sup> Adam 1994, 32-33, fig. 49.

<sup>409</sup> In general, see Burford 1960; Landels 1978; Kozelj and Kozelj 1993; Peacock and Maxfield 1997, 261- 63; Russell 2008; Delaine 1995.

### *At the Quarry Site*

Blocks were initially moved to a small workshop area where extraneous stone was removed, and thence to a loading area for further transport. This could be accomplished relatively easily using crowbars, tow ropes, and human labor in combination with sledges or wooden rollers. The same laborers who worked the quarries could perform these activities, at least within short distances.

Carts drawn by teams of oxen hauled roughly formed blocks from the quarries to building sites, whether at Gabii or further afield. Loading these carts called for the use of cranes such as those described by Vitruvius.<sup>410</sup> The holes in the bedrock discovered in Area A at Gabii may relate to such cranes. Supported on a two- or three-beamed jib and utilizing pulleys and winches to reduce the energy required, this kind of crane could be used by a single worker to lift up to two tons of stone—more than enough for even the largest blocks of *lapis Gabinus*, and additional workers or animal labor would accelerate the process.<sup>411</sup> Cranes could be relatively stationary, as a block could be maneuvered beneath one and lifted before the oxen drove a cart beneath it.<sup>412</sup> There are several methods of attaching lift ropes to blocks, the simplest using rope wrapped around the block and possibly protruding spurs or carved grooves. However, the blocks of *lapis Gabinus* which were used to construct the retaining wall in Area F at Gabii have two small symmetric holes carved into two vertical surfaces, clearly for the use of iron forceps to lift the blocks. These holes may have been carved after the arrival of blocks at the construction site, and need not have been used for loading at the quarry; nevertheless, this indicates that such

---

<sup>410</sup> Vitruvius 10.2.1-10.

<sup>411</sup> Landels 1978, 89. Kozelj and Kozelj 1993, 126-27, figs. 35-36, calculate that a relatively simple winch and pulley crane worked by two men could raise 720 kilograms, while four men working a crane with a capstan could raise up to 2800 kilograms.

<sup>412</sup> Cranes with two-beamed jibs had some limited mobility, as they could be tilted forward or backward; those with three beams were completely stationary.

techniques were known and utilized at the nearby city by the third or second century BCE, and there is no reason that they could not have been employed simultaneously at extractions sites. Similar holes for forceps can be seen in blocks of *lapis Gabinus* at Rome, most easily in those of the Porta Viminalis and the *tabernae* in the Forum of Caesar. For blocks which ultimately needed to remain visible, such as those in the façade of the Tabularium, holes for forceps may have been carved into the hidden sides or carved away once the blocks were placed; alternatively, methods such as ropes or Lewis holes may have been used.<sup>413</sup>

### *From Gabii to Rome*

Transport of blocks to and around the adjacent settlement of Gabii was relatively simple, as the quarries all lie less than a kilometer from the city walls. From here, carts could travel along the *via Praenestina* to the other sites in the countryside said to include *lapis Gabinus*, the most distant of which (as far as we know) were about six kilometers away. In later periods, when stone was being extracted from within the city walls, laborers could take advantage of the roads built as part of the urban grid before moving on to other sites.

The route to Rome required much more time and labor, as the capital was eighteen kilometers west along the *via Praenestina* and overland transport by ox-cart was expensive and slow. Maintaining oxen required substantial resources, in terms of feed, pasture, and stable-room, and drivers needed to be paid (or supported, if slaves).<sup>414</sup> These animals were investments, and the importance that landowners attached to them is reflected in the agricultural writers.

---

<sup>413</sup> Lancaster 2005b, 66-7, suggests that tufo was too weak for Lewis holes, which concentrate the weight of a block at a single point. See also Kozelj and Kozelj 1993.

<sup>414</sup> A working ox required about 6.8 kilograms of hay and 10-15 kilograms of mash (a mixture of agricultural waste products) every day, and each pair needed a stall of about 6-11m<sup>2</sup>: Cato *De agricultura* 54; Vitruvius *De Architectura* 6.6.2; Palladius *Opus agriculturae* 1.21. In comparison to maintaining horses, however, oxen were far cheaper: Landels 1978, 177-79. White 1970, 280-83 summarizes the ancient sources on the care of oxen.

Varro recommends that an owner buy certain breeds (which made better workers than others) and require the seller to certify the health of the animals, while Cato actually advises treating teamsters indulgently so that they might treat the animals well.<sup>415</sup> Two pairs of oxen could haul about 1400 kilograms, but they are slow creatures, and carts could travel only about eight to thirteen kilometers a day on well-kept roads.<sup>416</sup> The *via Praenestina* and other paved roads would have sufficed, but unpaved roads would have proven difficult for heavy loads, and impossible in rainy weather. Steep slopes (both ascending and descending) were also problematic. Interestingly, the later Ponte di Nona, itself constructed of *lapis Gabinus*, dramatically improved the feasibility of the *via Praenestina* as a transport route, as it removed the need to descend into the small valley and climb back out. Thus, while hauling blocks to Rome along this route may have been expensive, it was certainly possible. One might compare the transport of *lapis Albanus* over twenty kilometers from Marino to Rome along the *via Appia*. At any rate, ox-carts could have easily carried *lapis Gabinus* to the rural sites near Gabii at which blocks are attested.

For transport beyond this, however, the evidence of Strabo suggests that blocks were first hauled north to the Aniene River and then shipped downstream to Rome.<sup>417</sup> The benefits of such a route are clear. Most significantly, this would cut the distance travelled overland by up to two-thirds. Collatia (modern Lunghezza), the most obvious destination for embarkation on barges to Rome, was a mere six kilometers to the northwest, while Salone, another possibility, was only eight kilometers distant. Since many tufo lionato quarries were located at Salone, *lapis Gabinus* could have shared facilities for loading blocks on to river barges. Travel distance may have been

---

<sup>415</sup> Varro 2.5.9-11; Cato 5.6.

<sup>416</sup> Landels 1978, 177. Others estimate the speed of a loaded cart at between 1.67 and 2 kph: Delaine 1997, 108; Cifani 2010, 41. See further below.

<sup>417</sup> Strabo 5.3.11; see chapter two. Pliny the Elder (*Nat. Hist.* 3.9) also notes the navigability of the Aniene.

the deciding factor, however, and Collatia no doubt had similar docks. At any rate, both locations were within a day's travel for a loaded ox-cart, in contrast with Rome, making the care and feeding of the animals far more practical.

These possible routes can be traced in the modern topography of the area, reconstructed based mainly on aerial photographs, though small portions have been identified archaeologically. The road to Collatia is best documented.<sup>418</sup> This began from the east side of the Castiglione crater—that is, just north of the most extensive *lapis Gabinus* quarries—and proceeded northwest, more or less directly from the area of the medieval tower to modern Lunghezza. The road would have been well-suited to heavy-transport, as basalt paving was found along several stretches and the elevation generally declines to the Aniene. Another road to Collatia seems to have left the area from the southern part of the crater, travelling along the Fosso dell'Osa. The route to Salone would have required travel through the urban area of Gabii to Osteria dell'Osa, where a side road separated from the *via Praenestina* and travelled roughly parallel to it for about a kilometer before turning to the northwest. Basalt paving has also been found along this road, and traces of a bridge survive crossing the Aniene, which would have made it possible to utilize loading facilities constructed for the tufo lionato quarries.<sup>419</sup>

Once ox-carts reached the Aniene, the blocks were transferred to river vessels. Processes of trans-shipment in the ancient world—that is, moving blocks from one means of transport to another prior to their final destination—have generally been considered unproblematic, but this may not have been the case. Cranes such as those at the quarry site would be required, and laborers dedicated to this activity, both of which may not have been readily available at all river ports. The costs could be significant. Analysis of a sixteenth century text suggests that in a

---

<sup>418</sup> See Quilici 1974, 196-197, 421-427; also Ashby 1902.

<sup>419</sup> Quilici 1974, 142, 389-90.

journey involving 24 kilometers overland, 19 kilometers by river, and a final 56 kilometers overland, the price of trans-shipment might bring the overall costs to equal those of a single overland trip.<sup>420</sup> Nevertheless, the trip for *lapis Gabinus* involved significantly less travel by land and comparatively more on the water: 7 kilometers by land, about 34 kilometers by river, and a final short distance (less than 2 km) within the city of Rome itself. The relative cost reduction attainable by the use of river transport must have been significant, making up for any additional trans-shipment costs.

Several scholars have estimated more specific values comparing land transport to river transport in pre-modern economies. In the Roman world these efforts are complicated by a lack of evidence, as very few texts are explicit about transport rates, and anyway scholars have primarily been interested in comparing land and sea travel.<sup>421</sup> Duncan-Jones uses the cost of transporting wheat down the Nile, as documented in a papyrus from 42 CE, to estimate a ratio of transport costs for sea : river : land of 1 : 4.7 : 42.<sup>422</sup> Delaine, using rates provided by Diocletian's Price Edict, estimates a ratio of 1 : 3.9 : 7.7 : 42 for sea : downstream river : upstream river : land transportation.<sup>423</sup> These are equivalent to rates of 1 : 8.9 and 1 : 10.8, respectively, for transportation downstream river : ox-cart—in other words, moving a cargo by river cost only about one-tenth as much as moving it the same distance overland by ox-cart.<sup>424</sup> Applying these figures to the transport of *lapis Gabinus*, the Aniene route would provide a significant savings of about 37%, though this does not include transshipment costs. In addition to

---

<sup>420</sup> Russell 2008, 114-116.

<sup>421</sup> In addition to the papyrus and Edict discussed here, Cato compares the cost of acquiring a mill-stone for his villa from two locations, one 25 miles distant and the other 75 miles distant, and this information has been used by Yeo 1956 to determine the cost of land transport (though cf. Laurence 1999, 95-100). Other texts occasionally provide travel times for individuals, but these are of dubious value for determining the transport of goods.

<sup>422</sup> Duncan-Jones 1982, 369.

<sup>423</sup> Delaine 1997, 211.

<sup>424</sup> I cannot determine how Laurence 1999, 99 converts these to a ratio of 1 : 5.

trans-shipment, river travel required payment for the services of the river pilot and vessel, as well as further travel by cart within Rome (though the resources for this may have been provided by the construction team). The mere fact that more parties were involved, in fact, would have increased transaction costs. Regardless, the overall ease of river travel clearly made this the most economical route for large loads.

Blocks of *lapis Gabinus* would have been loaded onto river vessels and floated down the Aniene to the Tiber (about 23.5 kilometers) and thence to Rome (a further 10 kilometers).<sup>425</sup> The lower Aniene can be 20 meters wide and up to 1.5 meters deep, so could accommodate a number of different vessels.<sup>426</sup> Roman river boats and barges are fairly well-understood, despite having seen less scholarly attention than ocean-going vessels. The types which might have plied the Tiber are known from textual references and artistic depictions, while a few have been excavated in the provinces of Gaul, Germany, and Britain.<sup>427</sup> For the transport of *lapis Gabinus*, the shallow depth of the Aniene necessitated flat-bottomed or other low-draft vessels, powered by oars, poles, or simply the current of the river. In fact, navigation may have been limited to the rainier seasons of winter and spring, as Pliny suggests for the upper reaches of the Tiber.<sup>428</sup> Suitable river craft would already have been in use on this stretch of the Aniene, however, since the tufo lionato quarries between Tor Cervara and Salone had been in use since at least the second century BCE. In addition, travertine from the quarries near Tivoli, just upstream, begins appearing in Rome in large quantities in the first century BCE, more or less simultaneously with

---

<sup>425</sup> The first of these figures is based on the current course of the Aniene and can only be a rough estimate, as there have been no satisfactory reconstructions of the ancient course.

<sup>426</sup> Solimini et al. 2001, 422.

<sup>427</sup> Casson 1971, 331-335; Casson 1965.

<sup>428</sup> Pliny, *Epist.* 5.6.12. On the effects of these seasonal fluctuations for the *lapis Gabinus* industry, see further below.

*lapis Gabinus*.<sup>429</sup> By this period, a substantial transport industry dedicated to the supply of building materials had developed on the Aniene, one which is only hinted at in the textual and epigraphic sources which tend to focus on travel on the lower Tiber between Ostia and Rome. Stone from Gabii could thus take advantage of the labor and infrastructure already present in order to facilitate transportation to Rome, which would have had the effect of limiting transshipment and other costs.

A major problem with riverine traffic in the pre-modern world was the return trip upstream, which required that boats or barges be towed, by men or animals. In fact, the most economical means of transport down river would have been in temporary rafts which could be broken up afterward and sold for timber or fuel. Rafts were used in this manner as recently as the mid-nineteenth century for the upper Tiber north of Orte, and recreational rafting (with modern equipment) takes place on both the Tiber and the Aniene today.<sup>430</sup> The practice is only rarely discussed for the Roman world, but has been suggested by L. Holland, who herself rafted from Orte to Rome.<sup>431</sup> She argues that it must have been far more common than usually thought, noting the benefits of such a shallow-drafted vessel made of expendable material. In fact, she notes the particular suitability of such craft for moving stone from quarries along the Tiber's tributaries, by which she must mean those along the Aniene.<sup>432</sup> In addition to shallow draft, low-sided rafts would be easy to load, with the added benefit of bringing additional goods (fuel or timber) to city. This last point has especially interesting implications for the building industry,

---

<sup>429</sup> Travertine appears in earlier monuments, but only in the first century BCE does it see a more widespread distribution.

<sup>430</sup> Smith 1877, 35.

<sup>431</sup> The arguments are set out in Holland 1949, and the trip itself is described in Holland and Holland 1950. See also Holland 1955. The practice is also suggested in Eubanks 1930, 689-90, who emphasizes the importance of barges on the Aniene for the transport of travertine.

<sup>432</sup> Holland 1955, 86.



since the simultaneous arrival of both timber and building stone would expedite further transportation within the city and save on overall labor costs for a given building.

### *Transport at Rome: From the River Port to the Construction Site*

Moving blocks within Rome was perhaps the most unproblematic segment of the transportation route for *lapis Gabinus*. The Tiber was always a crucial route for goods from the Tiber River Valley such as wine, timber, and brick, and downstream transport must have occurred more or less continuously.<sup>433</sup> Excavations in Rome have revealed well-developed port facilities at several points along the river dating to Augustan and later times, while textual sources document extensive development already in the early second century BCE.<sup>434</sup> Much of this was dedicated to the importation of goods from around the Mediterranean, which were often transferred to river vessels at Ostia for towing upstream to the city. The area known as the Marmorata, for instance, was so-named for receiving luxury stone from various quarries throughout the Roman world and included cranes and wharves suitable for the moving of large blocks.<sup>435</sup> The wharves seem to have been built up mainly under Trajan, however, well after the period of *lapis Gabinus* construction.

Additional port facilities were available further upstream, and it was probably at these that blocks of *lapis Gabinus* were unloaded, since they are much closer to the monuments that include large amounts of the stone and would thus minimize overland transport within the city.<sup>436</sup>

The best candidates are the facilities at the Forum Boarium and those adjacent to the Pons

---

<sup>433</sup> For the brick industry see Graham 2006; Graham 2005; for timber, Meiggs 1980 and Meiggs 1983, who I believe over-emphasizes the trans-Mediterranean trade, at least for early periods.

<sup>434</sup> Castagnoli 1980 provides a good overview; see also Le Gall 1953, 194-204.

<sup>435</sup> Fant 2001; photos in Castagnoli 1980

<sup>436</sup> Maischberger 1997, 178, suggests that the riverbanks from Emporium to the northern Campus Martius were probably lined with port structures.

Fabricius, from which blocks could travel up the Velabrum to the Roman and Imperial fora less than a kilometer away. At the Pons Fabricius, an *opus quadratum* wall was constructed along the river at the same time as the bridge (61 BCE), though it is uncertain whether it was utilized as a port facility.<sup>437</sup> The Forum Boarium, on the other hand, is usually considered the original river port of the city, and textual sources document the construction of extensive port facilities beginning in the early second century BCE; the few structures documented archaeologically date to a reorganization under Trajan which seems to have significantly altered or destroyed the earlier port.<sup>438</sup> Of course, any *lapis Gabinus* incorporated into the city's bridges could have been unloaded directly at the construction sites, perhaps using temporary docks.

Once blocks were unloaded from river vessels, they were again hauled by ox-cart to the construction site, where masons finished them as needed before ultimately placing them in the structure. The necessary equipment and labor for this final transport was no doubt provided by the contractors responsible for the construction of the monuments. Depending on the location of the port facilities used to unload the cargo, the route taken by these carts may have been either the Vicus Iugarius, along the base of the Capitoline, or the Vicus Tuscus, along the Palatine. Both led to the Roman forum, from which it would have been a relatively simple matter to reach the Tabularium, the Forum of Caesar, or that of Augustus, while to reach construction sites further afield, such as the Porta Viminalis over two kilometers away, would have required far more labor.

---

<sup>437</sup> Castagnoli 1980, 35; Le Gall 1953, 202.

<sup>438</sup> Colini 1980.

## Labor

As described above, the processes of extraction and transportation of *lapis Gabinus* required significant human and animal labor, which deserves further discussion. How much labor, more specifically, was required? From where were workers and oxen drawn? What was the status of quarry workers? The evidence from Gabii and other sources permits a more thorough discussion of these topics, providing a more complete picture of how *lapis Gabinus* extraction affected the area of Gabii and traffic between the quarries and the capital.

### *Legal and Economic Status of Laborers*

The existence of convict and slave labor at some quarries in the ancient world is well-documented. Textual sources suggest that it was commonplace by the late second century CE for convicts to be condemned *ad metella* for their crimes, presumably referring to imperially owned mines and quarries.<sup>439</sup> Most famously, Christian martyrs were sentenced thus in the third century CE, but evidence is scarce for earlier periods. Two references in Pliny's *Letters* suggest that the practice may have been unremarkable in the early second century, and Suetonius reports that men were condemned to *metella* under Caligula, but almost nothing can be said of the Republican period, before the existence of imperial quarries as we understand them.<sup>440</sup> The only exception is Plautus' *Captivi*, in which the slave Tyndarus is sent to the quarries as punishment.<sup>441</sup> However, the setting is Greek and the milieu Comedy, and in any case most scholars agree that the play is derived from an Attic model; applying such evidence to mid- or

---

<sup>439</sup> See Millar 1984; Gustafson 1994; Davies 1958.

<sup>440</sup> Pliny Epist. and Suet.

<sup>441</sup> *Captivi* 721-38.

late Republican Roman practice is methodologically hazardous.<sup>442</sup> On the other hand, such plays were produced for and intelligible to a Roman audience, and must have reflected to some degree a Roman understanding of slavery and punishment. It is certainly possible that convicts were forced to work at Gabii, but there is no solid evidence to support this.

The use of slave labor is another possibility. Once again, in later periods slave labor was clearly standard at many quarries, particularly those owned by the state.<sup>443</sup> Much of the manual labor was unskilled, but even skilled positions could be occupied by slaves or freedmen.<sup>444</sup> At Gabii, yet again, there is no evidence with which to determine whether slave labor was employed, though it seems possible. However, a number of factors may have discouraged this. For one thing, quarry activity did not occur at the same rate over time, or from year to year, but was determined by the development and timing of large-scale building projects (see further below). Slave labor was inefficient in these sorts of situations, since work schedules were irregular and workers could not be continuously employed. Even with continuous activity, in economic terms slave labor could entail greater expense than that provided by free workers, since owners needed to supply food, shelter, and care rather than merely wages. Perhaps more significantly, the proximity of Gabii to Rome meant that extractive activities could draw on the huge labor market of the capital, which had an abundance of landless, free-born laborers who needed to supplement the receipt of the grain dole with some kind of additional income.<sup>445</sup> By the first century BCE, the city must have supported a substantial number of workers, both skilled and unskilled, with experience in the construction industry. These factors encouraged the use of cheap, free-born labor from the broader labor market of the city and its immediate hinterland,

---

<sup>442</sup> Cf. Stewart 2012, who shows that at least some insight concerning the ideology of slavery can be gleaned from Plautus.

<sup>443</sup> Slaves at imperial quarries.

<sup>444</sup> In the *Captivi* (733-40), the privately owned quarries were supervised by a freedman.

<sup>445</sup> Brunt 1980; Treggiari 1980.

though slaves or freedmen may still have been employed for some skilled positions. By comparison, Imperial quarries in later periods were frequently characterized by a combination of free and slave labor, and skilled positions could be filled by slaves, freedman, or free-born individuals.

That some stonemasons (whatever their legal status) achieved relative economic success is clear from two funerary reliefs found at Rome and now residing in the Museo della Civiltà Romana and the Capitoline Museum.<sup>446</sup> These simply display the tools of the trade such as mallets, stone hammers, and levelling squares, but the fact that the men could afford such monuments speaks to their social and economic success. Similar reliefs have been found elsewhere in Italy and Gaul. Skilled masons seem also to have been proud of their work—a relief from Pompeii, found high up on a garden wall, displays mason’s tools and the name of Diogenes Structor and is commonly interpreted as a sort of signature.<sup>447</sup> Successful masons would most likely have worked at construction sites in the city rather than in the quarries, but the reliefs attest to the social mobility which was possible for skilled stoneworkers, and those supervising extraction at Gabii would certainly have been skilled.

#### *Labor Requirements at the Quarry*

Quarrying tufo required several types of labor. The most basic was unskilled, manual labor such as that employed in hauling debris, working lifting devices, and moving blocks. While animal power could have assisted in some of these processes, it was not strictly necessary and would not have been economical in most cases. For the most part, extraction of blocks required scarcely more skill, as digging trenches and hammering wedges was relatively straightforward.

---

<sup>446</sup> Adams 1994, 32-33, figs. 51 and 52.

<sup>447</sup> See Cuomo 2007, 97-98.

The majority of quarry workers would have been employed in these sorts of activities, and since few skills were required, workers could be drawn from the larger Roman labor market. More skilled stonemasons were needed for certain daily activities, including placing wedges and roughing out individual blocks. Finally, supervisors would have overseen regular work, making any important decisions regarding the overall extraction process. This was particularly so early in the working of a given outcrop, when decisions needed to be made concerning the suitability of the deposit, the precise location of quarry zones and the direction of extraction.

Other activities were needed to support extraction, though they did not directly concern stone removal. Carpenters were needed (though perhaps irregularly) to construct cranes and provide other wooden implements such as mallets and rollers. Blacksmiths were crucial, since iron tools needed to be supplied and must frequently have required sharpening after repeated use in the quarries. Their importance can be seen in the documentary *ostraka* from Mons Claudianus, which record similar wages for both smiths and stonemasons.<sup>448</sup> Uniquely, these texts also provide specific information on the number of smiths operation at the quarries.<sup>449</sup> There was typically one smith for every twelve quarry workers, each assisted by one worker at the bellows and another tempering the metal. The stone quarried at Mons Claudianus was a very hard granodiorite, and iron tools had to be sharpened very frequently; *Lapis Gabinus*, by contrast, was relatively soft, and fewer smiths would have been required. Finally, some unknown (and nearly impossible to estimate) number of people must have been involved in supporting all these workers with lodging, food, firewood, and other goods. In Egypt, for instance, the difficult

---

<sup>448</sup> Cuvigny 1996.

<sup>449</sup> Bülow-Jacobsen 2009.

conditions necessitated a great number of laborers merely to supply water.<sup>450</sup> At Gabii, on the other hand, such needs may have been met by the local populace, perhaps bringing goods from nearby villas.

The extraction of individual blocks may have taken place in small teams of two or three workers, as it would not have been safe for many workers to crowd the quarry face. For large scale extraction, productivity could have been increased by having one team excavate trenches in advance, followed by workers employing wedges to finish removal. The speed of extraction was thus influenced by the physical limits of human labor, the area of extraction at any one time, and the number of teams employed. Attempts have been made to estimate the amount of stone which a worker could quarry in the ancient world, but these have usually been calculated for marble and other luxury stones, which are so much harder than tufo that they cannot be relevant.<sup>451</sup> Construction handbooks and experimental archaeology provide some guidance, however. In a recent experiment at a German tufo quarry, two men were able to remove a single large block of 0.972 m<sup>3</sup> over an eight-hour day; they assume that it would take another day to break this into smaller blocks.<sup>452</sup> J. Delaine, relying on nineteenth century construction manuals to estimate the production of tufo for *caementa* in the Baths of Caracalla, used a value of 0.250 man-days per m<sup>3</sup> of quarried tufo.<sup>453</sup> In this case, however, the extraction process was far simpler since large blocks were not required and every piece of debris produced could be utilized in construction.<sup>454</sup>

---

<sup>450</sup> O.Claud. 4.725, a daily list of those working in the quarries, lists three “water-carriers in the quarries” for between nine and fifteen “workers in the quarry”. This is in addition to thirty-four men “carrying water skins”, presumably between the quarries and the water source.

<sup>451</sup> Delaine 1997, 121, citing Pegoretti 1869, 159, 280-83, states that a “1-m cube of ordinary marble would take a skilled quarryman and two assistants 4 days to quarry and a stonecutter 7 ½ days to square” or (to simplify drastically) an astonishing 19.5 man-days per m<sup>3</sup>. In an experiment, Kozelj 1988, 36-39, took 22.5 hours to quarry a 0.125 m<sup>3</sup> block of Thasian marble, while Röder 1993, 47-50, calculates the time to extract a 0.5m<sup>3</sup> squared block of Numidian marble as 66 hours.

<sup>452</sup> Schaaff 2011.

<sup>453</sup> Delaine 1997, 110-11.

<sup>454</sup> Delaine 1997, 110-11.

G. Cifani, on the other hand, has considered the extraction of blocks of tufo granulare grigio (usually known as cappellaccio) for the construction of the Temple of Jupiter Capitolinus, accounting for the rough shaping required and the volume of stone lost in the process of extraction.<sup>455</sup> He estimates that in a working day of ten hours, a team of three workers (a skilled mason and two assistants) could remove about 2 m<sup>3</sup> of tufo, or eight blocks of about 0.16 m<sup>3</sup> each.

These values can be used to estimate the time and manpower required to extract the blocks of *lapis Gabinus* destined for the Forum of Caesar, the quantity of which was calculated in chapter five as 454 individual blocks equaling 229.34 m<sup>3</sup>. In order to account for waste debris, this would require the extraction of 327.63 m<sup>3</sup>, which would take a single team of three workers 164 days to quarry. Alternatively, it would take three teams 54 days and five teams 33 days. These estimates are undoubtedly low, as *lapis Gabinus* is harder than cappellaccio and the amount of stone needed has been minimized, but even if we double the amount, a team of fifteen workers could extract the necessary stone in a few months. This can probably be seen as representative of most building projects which include the stone, suggesting that relatively small teams of fifteen to twenty-five quarry workers, plus supporting staff, would suffice to extract the needed blocks within a single season of construction.

By contrast, the estimated amount of *lapis Gabinus* in the Forum of Augustus (5041 m<sup>3</sup>) would require that five teams work for 504 days, ten teams for 253 days, or twenty teams for 127 days. This project, which used more *lapis Gabinus* than any other, would have brought a huge workforce to Gabii, possibly over a period of several years.

---

<sup>455</sup> Cifani 2010, 38-41.



### *Labor Requirements for Transport*

The transport of blocks to Rome also required significant labor, both human and animal. The first stage of the journey was by ox-cart to the Aniene. In the ancient world, oxen were the only animals capable of hauling heavy loads, and a cart pulled by a single pair of oxen with one driver could carry a maximum of about 700 kilograms.<sup>456</sup> A block of *lapis Gabinus* from the Forum of Caesar weighs approximately 1150 kilograms, however, requiring that two pairs of oxen be yoked to pull a single block. The smaller blocks of the arches each weighed about 690 kilograms, so two pairs of oxen could transport at least two blocks per trip. These carts then traveled 7 kilometers to the river, at a speed of between 1.67 and 2.4 km per hour, depending on the load; a single trip would have taken between three and four and half hours.<sup>457</sup> Transport within Rome was undertaken the same way, but the limited distance between the Tiber and the construction site was quickly crossed in less than an hour, once the blocks had been loaded.

River transport is more difficult to estimate, since the speed of rafts would depend on the speed of the current, which itself can vary depending on rainfall and on how close the vessel is to the center of the channel, where flow rates are usually higher. Several scholars have estimated the speed of the Tiber at about 3 miles per hour, or 4.83 kilometers per hour, and measurements of the Aniene suggest that about 5 kilometers per hour is a good average for the tributary as well.<sup>458</sup> Using oars or poles to propel the raft would not significantly speed the process, and anyway would not have been an economical use of labor; a single worker could provide the needed power to steer. At this rate a raft would take about 7 hours to make the trip from Collatia to Rome, or 1.14 man-days per m<sup>3</sup>.

---

<sup>456</sup> Cifani 2010, 41; Delaine 1997, 108. See also, Burford 1960 for a comprehensive discussion of the Greek sources on heavy transport.

<sup>457</sup> Cifani 2010, 41; Delaine 1997, 108, 128.

<sup>458</sup> Davies 1875, 2; Holland and Holland 1950, 91. Modern measurements of the Aniene: Solimini et al. 2001, 422.

In addition, blocks of *lapis Gabinus* needed to be loaded, transshipped, or unloaded a total of four times in the process of transport to Rome: raised onto a cart at Gabii, transferred from the cart to a raft at Collatia, and from the raft to another cart at the Forum Boarium, and finally unloaded at the construction site in Rome. These actions were accomplished with some combination of cranes and manual manipulation with crowbars and log rollers, and it is therefore almost impossible to estimate the time or manpower requirements. Cranes made it possible to load or unload ox-carts with only a few laborers, since tufo is much lighter than other stone such as marble, but larger blocks may still have been problematic. Landels estimates that it would take one worker using a Vitruvian crane about half an hour to lift a block weighing 2 tons 10 feet high, though this could be hastened with multiple laborers.<sup>459</sup> Kozelj and Kozelj calculate that it would take two men to lift 780 kilograms and four men to lift up to 2080 kilograms with different cranes, but do not include the time necessary for this.<sup>460</sup> For the sake of argument, if we assume that four men (including men to guide the block in addition to lift or move it) could load and unload most blocks of *lapis Gabinus* from ox-carts or barges in about one hour, transshipment processes over the course of the journey to Rome would require four hours, or 1.6 man-days per block (equivalent to 2.6 man-days per m<sup>3</sup>). This cannot include the labor required for the transport of blocks from the quarry face to the loading area, which must have varied somewhat.

Based on these estimates, each block of *lapis Gabinus* took a total of at least fourteen hours to reach a construction site in Rome and required the labor of at least twelve men (allowing that some workers could have fulfilled multiple unskilled roles) and four oxen. This is

---

<sup>459</sup> Landels 1978, 89. The reasoning for this estimation is not provided, and the author's wording is speculative. Most scholars of ancient construction have focused on the immense loads which could be raised with much grander and more complicated types of cranes than would have been used for the transport of *lapis Gabinus*; see, e.g., Lancaster 1999 on the Column of Trajan.

<sup>460</sup> Kozelj and Kozelj 1993.

equivalent to 3.74 man-days per m<sup>3</sup>. In practical terms, this means that transport would have been divided over at least two and possibly three days. On the first, carts would be loaded at Gabii and travel to Collatia, where blocks would be unloaded and the oxen could return to the quarry. On the second, rafts would be loaded and float down to the docks at Rome, where blocks could be stored or move on to the building site, based on the needs of construction. For periods of large-scale construction with *lapis Gabinus*, this suggests a great number of men, oxen, and rafts in a steady stream back and forth between the quarries and the construction site. The stone for the Forum of Caesar, for instance, would require 346 individual trips (including the two trips by ox-cart and one by river as a single trip), while that for the Forum of Augustus would require thousands.

### **Seasonality and Cyclicity**

The quarrying of *lapis Gabinus* as described above did not take place at the same rate over time, but varied based on a number of factors. For the large blocks of *lapis Gabinus* demanded for many of these projects, those managing extraction could not count on regular demand. The most extensive extraction was therefore carried out only during or in anticipation of large-scale building projects at Gabii or Rome, and was linked directly to cycles of construction activity. Based on the chronology of the buildings discussed in chapter five, we can estimate periods when quarry activity would have been more intense; these periods are summarized in table 2. Admittedly, these are estimates only, and periods of quarrying may have varied based on the rate of construction and other factors. In addition, it is possible that there were other, unknown buildings including *lapis Gabinus*, though large-scale construction projects are unlikely. Thus, even allowing generous time for quarrying, it is clear that long periods, decades

even, might pass between projects demanding significant quantities of *lapis Gabinus*. The most intensive exploitation of the deposit would only have taken place during such projects.

However, the complete cessation of extraction between these construction cycles is unlikely. For one thing, a number of smaller projects which utilized *lapis Gabinus* were undertaken over this period, including the outlet of the cloaca maxima, the tomb of Caecilia Metella, and the Porta Viminalis. These structures may have been built concurrently with the larger monuments in table 2, and so may have benefited from the supply chains already in place. That is, with so much *lapis Gabinus* already coming to Rome, a surplus may have accumulated which could be made available to other builders or individual contractors. In fact, once such supply chains were in place (including the infrastructure for extraction and transportation, the financial relationships between the various parties, and the presence of a skilled labor force), even relatively slight demand would have been sufficient for activity to continue after the completion of the initial projects, though probably on a smaller scale. Those who owned the quarries or who had otherwise invested in extraction would have been eager to find additional profits without relocating or repurposing the land. In the modern study of economic geography, this well-understood phenomenon—the tendency of industrial activity to remain in a location once it has been established—is referred to as industrial inertia.<sup>461</sup> Thus, even in the face of low demand, extraction at Gabii would have continued for some time. The quarrying of *lapis Gabinus* must have therefore proceeded with some combination of cyclical large-scale and (more or less) continuous small-scale extraction.

In relation to construction activity we ought also to consider the ramifications of Vitruvius's advice that tufo be quarried two years prior to building and left exposed in order to

---

<sup>461</sup> Pitzl 2004, 111-12.

assess the effect of weathering on individual blocks.<sup>462</sup> Such a prescription would require either that stone for particular projects be ordered well in advance, or that a standing supply of building material be available as is sometimes suggested for the marble trade in later centuries.<sup>463</sup> The latter is unlikely for the large blocks of *lapis Gabinus* found in Roman monuments, however, which were limited in their application. As for the alternative, builders would find a two-year delay in the supply of construction material rather onerous. Cicero shows his concern for timely construction in a letter complaining about the foreman supervising the building of his villa, and a similar concern on the part of state agents can be seen in an inscription from Pergamon documenting delays in the erection of buildings—delays which the proconsul of Asia had to intervene in order to fix.<sup>464</sup> Vitruvius might be describing an ideal situation from his point of view as an architect, which may not reflect actual practice. Alternatively, such procedures may have been followed upon the initial extraction at a recently discovered tufo deposit in order to understand the characteristics of the stone, but not thereafter. *Lapis Gabinus* had been in use in Rome since at least the early first century BCE, and far earlier at Gabii—its properties must have been well-known by Vitruvius’ lifetime. In any case, stone of poor quality was sometimes mistakenly used in Roman construction, suggesting that such routines were not always practiced.<sup>465</sup>

Periods of extraction were determined by more than just construction cycles. In addition, quarrying did not take place at the same rate throughout the year, as a number of factors led to a certain amount of seasonality. Most obviously, temperature and weather affect what sort of outdoor activities can occur. Vitruvius, in fact, is explicit in stipulating that tufo extraction occur

---

<sup>462</sup> *De Architectura* 2.7.5.

<sup>463</sup> Most famously by Ward-Perkins 1980.

<sup>464</sup> *Ad Quintum fratrem* 3.1.1-2; Buckler 1923, 33-34.

<sup>465</sup> Pliny (Epist. 58) suggests that the poor condition of the theater under construction in Nicea might be due to the light and crumbly stone used.

only in the summer and not in the winter, presumably for weather-related reasons.<sup>466</sup> The construction industry as a whole tended to slow down during the winter months if not cease entirely, with the bulk of the work taking place in the summer. Frontinus suggests that building is best done between April and November, with a hiatus for the hottest period of summer.<sup>467</sup> Certain activities, such as concrete construction, required moderate temperatures for the concrete to successfully set. While stone quarrying and transportation, on the other hand, could conceivably take place throughout the year, warm and particularly dry weather were ideal, possibly discouraging winter extraction. The heat of summer may have similarly stopped work. Cato suggests that construction in the country cease in the height of summer if the area is unhealthy, probably referring to a combination of heat and malarial conditions.<sup>468</sup> At Gabii, extraction along the interior of the crater would have taken place along the edge of the lake, where malaria may have been a concern in summer.<sup>469</sup>

The Aniene River was also affected by seasonal variations. Higher rainfall from late fall into spring usually raises the levels of the Tiber and its tributaries, facilitating navigation in their higher reaches, as both ancient and modern sources show. Pliny notes that the northern stretches of the Tiber were navigable only in winter and spring, when boats could bring farm produce to the city.<sup>470</sup> Similarly, in the nineteenth century, rafts were used on the Tiber north of Orte only during autumn and winter.<sup>471</sup> However, by the time the Aniene reaches Collatia, where blocks of *lapis Gabinus* embarked, it is deep enough for rafts even in the summer. The problem would lie in the transport of logs from further upriver, and these may have been stockpiled during the

---

<sup>466</sup> *De architectura* 2.7.5.

<sup>467</sup> *De aquis* 123.

<sup>468</sup> *De agricultura* 14.5

<sup>469</sup> While Roman doctors did not understand the connection between malaria and mosquitos, there was certainly an awareness that marshy areas were unhealthy: Sallares 2002.

<sup>470</sup> *Epist.* 5.6.12.

<sup>471</sup> Davies 1875, 35.

rainier seasons, perhaps at Tibur. These could then be fashioned in to rafts and floated further downriver for the transport of *lapis Gabinus* and tufo lionato.

The availability of labor may have been another factor affecting seasonal extraction. Skilled stonemasons were available throughout the year, but workers such as manual laborers and ox-cart drivers, as well as the oxen themselves, were often needed for more essential activities. From April to September many casual laborers were occupied unloading cargo at the docks, for instance, particularly the grain of the *annona* shipped in from across the Mediterranean.<sup>472</sup> Agricultural activities in general were more essential than the construction of monuments and would have taken precedence in labor allocation. Workers themselves may have preferred the more regular (though still seasonal) agricultural work to the uncertainties of the construction industry. Regardless, the large-scale farming taking place in the Roman countryside required great numbers of both men and draft animals at several points during the year. This can be seen clearly in the Greek world, where building accounts sometimes preserve more specific chronological data. Robin Osborne notes that the expenditures for construction at the sanctuary of Demeter at Eleusis were greatest between July and September and in February, when agricultural activities requiring the labor of men and oxen (such as plowing, harvesting, and threshing) were not taking place.<sup>473</sup> Another account records more specifically that the transport of stone for construction of the portico of the main cult building occurred from July through mid-September.<sup>474</sup> Construction was thus integrated with the broader agricultural regimes of the Greek *polis*.

---

<sup>472</sup> Brunt 1980.

<sup>473</sup> Osborne 1987, 14-16. The absence of several months' records makes this conclusion less definitive than one might like, but the pattern holds for the extant accounts.

<sup>474</sup> Osborne 1987, 15-16.

A similar situation may have applied in the Roman world, particularly with respect to oxen. While some animals may have been dedicated to quarrying or to construction more broadly (perhaps owned and maintained by contractors), the number was limited by the expense of maintaining the animals throughout the year when they might only be employed for a portion of it. These would not have sufficed for the large projects which brought huge quantities of stone from the countryside to the capital in a relatively short amount of time.<sup>475</sup> Additional animals and carts would be needed and could be found in Rome or, perhaps more likely, from the estates in the area around Gabii, where oxen could have been rented out during agricultural downtime. Estate owners or managers who followed Cato's advice to have as many carts as teams of draft animals may have been eager to find work for their animals and drivers.<sup>476</sup> While Columella condemns the letting out of oxen for hire, arguing that it is something which unsupervised slaves on distant farms might undertake, his proscription suggests that it did sometimes occur.<sup>477</sup> It may have been quite normal, in fact, as one legal source uses the ten-day lease of an ox to a neighbor for agricultural work as an example of a rental contract.<sup>478</sup> Contracting out for mules and muleteers is better documented in legal sources, but there is every reason to suspect similar circumstances for oxen, which could haul greater loads such as stone.<sup>479</sup> Arranging such transportation would have been easiest during seasons with less agricultural work.

Taking all these factors into account, the best time for extraction may have been between February and May, avoiding the heat of high summer and the potential frost of mid-winter,

---

<sup>475</sup> A similar argument has been made for slave gangs involved in the maintenance and repair of aqueducts: Brunt 1980, 93.

<sup>476</sup> *De agricultura* 62

<sup>477</sup> *De re rustica* 1.7.6

<sup>478</sup> *Instit.* 3.24.2. The hypothetical terms are somewhat strange, however. A man and his neighbor both own a single ox, which each lends to the other for alternating ten-day periods, and there is no additional payment. Regardless, the example suggests that owners of oxen might lend or lease them to third parties.

<sup>479</sup> For the letting of mules and muleteers, see Laurence 1999, 123-135; Erdkamp 1999, 568-69.



before the grain harvest and the majority of the shipping season, and just prior to and partially overlapping with early construction season. In practice, however, there may have been few non-natural limits on some of the building projects in which *lapis Gabinus* appears. The labor market of greater metropolitan Rome was both massive and flexible, with human and animal labor readily available, especially when the resources of the state (and of the immensely rich men competing to lead it) could be put into play. Delaine has even suggested that a full-time supply system was in place for the construction industry of Rome and Ostia.<sup>480</sup> The primary factors affecting extraction may thus have been the scheduling of the building season and the political will for prompt construction. In the face of pressure, even natural restrictions could be ignored (summer heat) or overcome with advance planning (the shallow waters of the Aniene in some seasons). Things must have been different for small-scale extraction between large state projects, though, when issues of labor availability may have played a larger role.

## Ownership

Unfortunately, there is no concrete evidence for who owned the *lapis Gabinus* quarries. Epigraphic and textual data for other stone quarries in the Roman world demonstrate three possible owners: the state, the city of Gabii, or a private individual.

Imperial quarries have seen much scholarly attention, due to the interest in both the scale and nature of the operation as well as the relatively abundant epigraphic material available. The quarries at Gabii are unlikely to have been owned by the state for a number of reasons, however. First, there is no evidence for state-owned quarries until the late first century BCE, when emperors began to seek control over luxury stones for their building projects. For most of these

---

<sup>480</sup> Delaine 2002, 264, note 12.

quarries, the epigraphic evidence suggesting imperial control begins in the mid-first century CE or later, well after the most intense period of *lapis Gabinus* extraction. Second, it is worth emphasizing that the documented imperial quarries produced *luxury* stones—marbles or others which could take a high polish and which were used for the elaborate decoration of temples, palaces, and other buildings. The emperors desired such stone for its symbolic and decorative properties; there are no known imperial quarries extracting tufo or other mundane building stones. Recent research suggests that the state endeavored to maintain overall control of the supply of luxury stone with as little *direct* involvement in extraction and transportation as possible, even when the logistics of distant quarries obliged it to play a larger role.<sup>481</sup> It therefore seems unlikely that the state would wish to involve itself at all with *lapis Gabinus*, a type of stone (tufo) which was widely available in the immediate region and used for all types of construction, both public and private. In the face of such demand, and with the quarries so close to the city of Rome, private commercial activity would have sufficed.

An alternative is municipal ownership, as attested for the white marble quarries at Carrara. While some inscriptions on blocks of *marmor lunense* demonstrate the involvement of imperial agents already in the 20's BCE, others document the presence of slaves belonging to the *colonia Lunensis* as late as 22 CE.<sup>482</sup> There seems to have been municipal or private ownership of most quarries prior to the imperial period, as well as municipal extraction co-existing alongside imperial in later times.<sup>483</sup> Considering the importance of the *lapis Gabinus* quarries to construction at Gabii during the middle Republic, and the proximity of the quarries to the city itself, a similar arrangement may have been in place here, particularly in earlier periods.

---

<sup>481</sup> Hirt 2010.

<sup>482</sup> Russell 2009, 54; Hirt 2004, 238-39, Dubois 1908, 6-8.

<sup>483</sup> For pre-imperial ownership: Marc 1995, 33; Dworakowska 1983, 26-31; Lambraki 1978, 33-34.

Finally, the *lapis Gabinus* quarries may have been privately owned. Small-scale extraction certainly took place on private land in the Roman world, as the legal sources show (see chapter three), but whether private extraction ever reached the scale characterized by the distribution of *lapis Gabinus* is uncertain. Implicit in much of the scholarship is the idea that any quarries that produced stone on a large scale, or stone that was essential for state construction, were probably imperially owned. Perhaps in support of this, there is only limited evidence for the private ownership of marble quarries with large distributions. J. Clayton Fant suggested that Lucius Licinius Lucullus acquired the quarries of the marble which bears his name (known as Lucullan marble or africano), during his tours in the east, later introducing the stone to Rome as an entrepreneur.<sup>484</sup> The stone may have achieved greater distribution only later, however, when it came to be owned by the state. It has also been suggested (though certainly not proven) that Herodes Atticus owned the Pentelic marble quarries near Athens.<sup>485</sup> Limited distribution of a given stone might itself suggest private ownership, as Gnoli argues for breccia di Settebasi from Skyros and fior di pesco from Eretria, neither of which appears in imperial building in Rome.<sup>486</sup> This highlights the central problem in conclusively identifying specific quarries as privately held: the lack of positive evidence, since the inscriptions which we typically rely on to determine ownership do not seem to have been used on blocks produced privately. There was little need, as these blocks did not need to be identified within the complicated imperial accounting system. However, there is no compelling reason to think that large-scale extraction required state enterprise, especially since the operation of the quarries was often contracted out to smaller outfits .

---

<sup>484</sup> Fant 1989b, 210.

<sup>485</sup> Ward-Perkins 1951, 92. Cf. Fant 1989b, who argues that the inscription which is the best evidence of this actually implies imperial ownership, and the block into which it is cut, which has since been lost, may not even be Pentelic.

<sup>486</sup> Gnoli 1988, 200.

If the *lapis Gabinus* quarries were privately owned, which individuals might have played a role? Civic benefactors presumably owned land in the area and may have been involved, as Reynolds has speculated (in the face of a similar dearth of hard evidence) for the marble quarries of Aphrodisias in Asia Minor.<sup>487</sup> Most of the local notables attested in the inscriptions from Gabii seem to have lived in the first and second centuries CE, and thus well after the period of intensive stone extraction, but the important exception is the *gens Antistia*. I have already speculated that the family may have been involved in extraction, based on their presence at and connections to Gabii, their political rise in the first century BCE, and their connections to Caesar and Augustus, whose building projects made liberal use of *lapis Gabinus*.<sup>488</sup> At this point, however, this cannot be proven.

## **Chronological Development**

Some amount of quarry activity must have begun in and around Gabii by the eighth century BCE, when tufo slabs are found in the burials at Osteria dell'Osa. The earliest stone architecture known from the site, the elite complex in Area D of the Gabii Project excavations, dates to the second half of the sixth century BCE. Throughout these early periods, extraction would have occurred on a very small scale and an *ad hoc* basis, and stone would have been sourced from as close as possible to the intended destination. This conjecture is supported by the geochemical analysis of stone from the Area D structures, which closely matches that from the nearby bedrock. Residents may have been limited to the area under their direct ownership, or may have preferred to exploit this area, as suggested by Varro and Columella in a much later

---

<sup>487</sup> Reynolds 1996, 122.

<sup>488</sup> See chapter two.

period.<sup>489</sup> Since the urban area of Gabii had not yet fully developed, much of this must have occurred within the zone bounded by the fortification walls. One might compare the early quarrying of cappellaccio and tufo lionato from the hills of Rome. Some cuts discovered in the excavation of Area A, for instance, lack clear functions and may reflect early extractive activity. In fact, modification of the bedrock is potentially the most visible evidence of any kind for activity in early periods, when architecture was composed of more ephemeral materials. Such modification is often un-datable, however, and later activity may have disturbed or further altered the evidence. In addition, it is likely that the location of early extraction was influenced more by convenience and accessibility than by the need or desire for specific lithic properties, and locals may have exploited either *lapis Gabinus* or the surrounding tufo lionato deposits interchangeably.

The first large-scale, organized campaign of stone extraction at Gabii must have occurred in the late seventh or early sixth century BCE for the construction of the fortification wall. As I have discussed, however, we know very little about the construction of this wall, as it has not seen dedicated archaeological research. However, it would have required a huge amount of stone, and the outcrops most suitable for such a large endeavor are the *lapis Gabinus* outcrops along the rim of the Castiglione crater. It must have been during this time that the large quarries along the rim just north of the city began to develop. This area was conveniently located just beyond the course of the walls—in fact, extraction at the edge of the city may have supplemented fortification by lowering the elevation beyond the walls.

Several factors can be identified that would have guided the overall development of the quarries from this point until the end of large-scale extraction. These include: the nature of the deposit, the ease of stone transportation, the extraction methods used, the scale of activity

---

<sup>489</sup> Varro 1.2.23; Columella 1.2.4; see chapter three.

required, and the ownership of or previous activity on the necessary land. At Gabii, the last of these is perhaps the most uncertain, as there is little evidence for ownership of the quarries, and landowners may have made individual decisions about the development of their land. The effects of the other factors are more apparent.

First and foremost, the extent and nature of the *lapis Gabinus* deposit would have had the most significant effect. The fact that the deposit was not covered by later volcanic products (or a significant amount of soil) allowed for surface extraction rather than the use of subterranean galleries. The topography of the deposit also mattered. Early extraction no doubt began at higher elevations near the edge of the crater where the deposit was most exposed and easily accessible, only later progressing down the slope to areas covered by a greater amount of soil. Quarrymen may have also been limited to areas where the deposit was more firmly cemented, as poorly consolidated tufo does not make for a reliable building material. A second factor to consider would have been the ease with which blocks could subsequently be transported, since moving building material to the construction site was one of the most significant costs in the entire process.<sup>490</sup> Blocks meant for the buildings of Gabii needed to be extracted from as close to the city as possible, while those meant for Rome required access to the via Praenestina or the roads leading to Collatia or Salone on the Aniene River.

Extraction methods would also have dictated quarry development. As I have discussed above, working in steps in large part explains the morphology of the existing quarries, in particular the presence of tall quarry faces following the topography of the crater. This also helps to explain the expansion of the quarry zone, as the high quarry faces would have made subsequent extraction in the area much more difficult. New quarries would need to be opened, particularly for large projects. I have also argued above that activity at the quarries was

---

<sup>490</sup> Delaine 1997; for more see chapter three.

characterized by a combination of cyclical large-scale extraction and continuous small-scale extraction. This would have important effects on the growth and organization of the quarries. New large projects would have required scouting in order to assess the best location for extraction, based on the above factors (the quality of the stone, access to transportation routes, and the existing topography of the deposit and the surface). We can see hints of such a process in Egypt, where Gaius Cominius Leugas claims to have brought the existence of porphyry outcrops to the attention of the state.<sup>491</sup> Areas with large, accessible outcrops would have been preferred over those with more restricted access to good stone, and this may have led to the abandonment of some outcrops before they were fully exploited, a situation evident in the surviving quarries. Small-scale activity, on the other hand, would have altered the topography only gradually, perhaps taking place at these partially exploited areas after the cessation of large-scale extraction. The quarries would thus have grown on an *ad hoc* basis, in fits and spurts, perhaps exacerbated by the lack of a central authority overseeing extraction as at imperial quarries. Individual landowners or contractors may have had greater latitude in this process.

The growth of the quarries north of the city, dictated by the principles discussed above, took place over a long period, from the sixth century BCE to the late second or early first century BCE. Activity probably first moved north from the city along the edge of the crater, east as far as the limit of the deposit and the amount of topsoil overburden allowed, and perhaps also down into the crater, where the interior of the rim was worked. These areas would have sufficed for all the city's needs prior to the export of the stone for building projects at Rome. Blocks for the Santuario Orientale, the Area F complex, the private houses and other buildings of the third-to-first centuries BCE in the Gabii Project excavations, and the Temple of Juno no doubt came from this zone.

---

<sup>491</sup> Maxfield and Peacock 2001.

At some point, however, quarry activity moved into the urban area within the city walls. This shift is difficult to date precisely. Property within the city had begun to be dramatically repurposed by the late second century BCE, as shown by the development of industrial areas in Areas C and E of the Gabii Project excavations. More concrete evidence of intra-urban extraction is also supplied by these excavations, as the quarry features date to the first two centuries CE. In addition, geochemical analysis of *lapis Gabinus* from the Forum of Augustus (built between 30 and 2 BCE) provided ratios of trace elements which closely match those from the excavated quarry debris. But again, it is likely that the earliest extraction within the city took place close to the crater rim, where the deposit was most easily accessible. Since we know that the city probably began to shrink by the early first century BCE, and that demand for the stone increased dramatically around the same time, there is no reason that quarrying could not have begun in this area at this time, moving further to the south as the northern outcrops were exhausted and other parts of the city were deserted. This fits well with the increased construction activity using *lapis Gabinus* beginning at this time.

The contraction of the settlement made this shift possible, and there are several reasons that quarrying within the city may have been appealing. For one thing, the *lapis Gabinus* deposit occupies a limited area on the eastern side of the crater, mainly near the rim, and this would have forced extraction further to the north or down into the crater. This would have complicated the transportation of extracted material, requiring movement over greater distances or up a steep slope in order to reach the city or the *via Praenestina*. Extraction within the crater may have been undesirable due to swampy and malarial conditions in the summer, depending on the nature of the lake within the crater in antiquity. Such factors may have eventually forced quarry activity into the city, where the deposit extended over a broad area with ready access to transportation



networks. The large building projects of first century BCE Rome required a great amount of stone, and extraction within the walls may have been most economical at this time.

Among the tufo quarries of Rome, extraction at Gabii was unique in taking place in an area which was formerly part of the urban fabric of a major city. Other factors thus become relevant to the development of the quarries, and may have encouraged the shift inside the city walls. For one thing, those directing extraction may have been eager to take advantage of the existing urban infrastructure—in particular the roads, which would have facilitated transportation. Other structures would also have proven useful, for sheltering workers or for blacksmithing facilities. One might also consider a different perspective, that of the owners of property within the city. The progressive abandonment of many urban areas must have caused property values to plummet, and these owners may have been looking for new ways to make profits from their now-deserted plots. With fewer residents and the economy shifting toward supplying goods and services to elite villas and to Rome, urban property unsuitable for agriculture would not have been in high demand. Extraction may have presented the best (albeit short term) opportunity for deriving any sort of income from this formerly urban space.

It is also difficult to determine when the quarries were permanently abandoned. There are no large construction projects including *lapis Gabinus* after the end of the first century BCE, but extraction may have continued for monuments which are no longer preserved or for private projects. The Gabii Project excavations suggest that quarrying continued at least into the first century CE and possibly into the second century. Small scale extraction for rubble or for the facing of concrete walls may also have taken place. However, it seems unlikely that smaller products like this would have been transported to Rome, as other varieties of tufo existed which could be acquired from quarries closer to the city, and which were more suited to this type of

construction since they were lighter and easier to cut. For local construction at Gabii, spoliated stone from deserted buildings must have been plentiful by this time and could have entirely supplanted freshly quarried material. Extraction at Gabii probably ceased completely sometime in the mid-first century CE.

Interestingly, the analysis of stone transport above suggests a possible reason for the eventual abandonment of the *lapis Gabinus* quarries. These quarries were deserted when substantial outcrops of high-quality stone still remained easily accessible, while other hard, gray tufos from the region such as *lapis Albanus* and Tufo di Tuscolo continued to be exploited. This is quite strange, since both of these other stones needed to be transported a great distance overland, *without* the convenience of the Aniene to minimize costs—why would Roman builders abandon what must have been a cheaper, but perfectly suitable, substitute?

While several developments must have contributed to this abandonment, the use of rafts to transport blocks down the river to Rome may have been a crucial factor. Such vessels would have depended on logging in the Apennine forests higher up in the Aniene River valley, forests which had been exploited for centuries in order to feed the construction and fuel requirements of Rome.<sup>492</sup> Recent scholarship suggests that, while deforestation does not seem to have occurred on a vast regional or Mediterranean-wide scale during the Roman period, localized forest depletion around population centers was probably unavoidable, especially for the tall trees needed to produce longer beams for ships and architecture.<sup>493</sup> Since rivers provided cheap and

---

<sup>492</sup> Theophrastus (*HP* 5.8.3) knew of the forests of Latium in the late-fourth century BCE. Dionysius (*Ant. Rom.* 1.37.4) notes the richness of Italy's forests and the utility of its rivers for transport, while Strabo (5.3.7) ties the timber supply specifically to the Aniene and the other tributaries of the Tiber.

<sup>493</sup> Traditional views, influenced by modern forest issues and based in part on the statements of Roman authors, held that large-scale deforestation was a significant issue even by the late Republic; see Hughes 1983; 2011; Hughes and Thirgood 1982. More moderate interpretations can be found in the work of Thirgood (1981) and of Meiggs (1980; 1983), who notes that only in the late Empire did wood shortages become significant, mainly for reasons of fuel consumption. The current consensus, utilizing scientific data from pollen analysis and anthracology,

easy transportation for such logs, woodlands within and near the Tiber valley must have seen extensive logging to supply the capital. W.V. Harris suggests that that the need for long timber for ships and general construction would have put stress particularly on the lower Tiber valley.<sup>494</sup> Indeed, the location of the timber market, the *porticus inter lignarios*, on the Tiber south of the city suggests that already by the early second century BCE much of the timber utilized in Rome had to come *up* the Tiber from elsewhere in the Mediterranean.<sup>495</sup> Along the Aniene in particular, however, the need to transport travertine, tufo lionato, and *lapis Gabinus* on log rafts may have intensified local exploitation in the first century BCE, depleting forests more quickly than they could be replenished.

If these woodlands were becoming scarce by early Imperial times, then the timber needed for the rafts transporting these three stones would have been in short supply. In the face of limited transportation, travertine and tufo lionato may have been prioritized (whether by market forces or by conscious decision) over *lapis Gabinus*. Travertine is a much stronger stone and has a more aesthetic appearance, while tufo lionato is lighter than other tufos and therefore more suitable for a range of uses, including concrete wall facing and *caementa*. At the same time, Roman builders could count on the continuing supply of *lapis Albanus* and Tufo di Tuscolo from quarries to the south, both of which fulfilled the same load-bearing roles as *lapis Gabinus* and had previously developed overland supply routes. The only potential riverine solution—the use of larger boats towed by oxen upstream to retrieve the stone from Gabii—would require an inordinate amount of additional labor and completely negate the savings provided by

---

holds that only localized deforestation can be demonstrated, particularly near metal-producing areas or high population centers; see Harris 2013; for limited deforestation related to fuel consumption, see Veal 2013.

<sup>494</sup> Harris 2013, 189.

<sup>495</sup> Livy 35.41.10.

downstream travel. These conditions may have ultimately contributed to the abandonment of the lapis Gabinus quarries.

## Conclusions

The operation of the *lapis Gabinus* quarries involved a substantial number of men and resources in the supply of a mundane but essential building stone for construction in Rome. It can be seen as a typical example of resource extraction in the Roman hinterland, representative of a host of other industries—of tufo quarrying more generally, of course, but also clay, sand, and pozzolana extraction, and even (in the particulars of large-scale transport) fruit and vegetable agriculture occurring near the city. These economic activities may appear more mundane than the extraordinary production of, for instance, monolithic columns of Egyptian granite, but for this very reason they shed more light on the normal workings of the ancient economy. In the study of the economy, the mundane trumps the monumental.

This is particularly true for the local economy of Rome and, more specifically, the economy of urban construction, both of which were regional in geographic scope but empire-wide in their effects. As such, the construction of the urban architecture of Rome provides insight into the effects of empire on the Roman countryside, since it represents one means by which the proceeds of imperial enterprise were spread *out* from the capital. Despite the fact that Rome, by the first century BCE, could call on the resources of most of the Mediterranean littoral, substantial capital was spent acquiring building materials from the *suburbium*. The quarries at Gabii employed a number of men continuously and far more during periods of large-scale construction—periods which could last decades at a time. In the first century BCE, in fact, tufo extraction may have dominated the local economy of Gabii. The extraction of *lapis Gabinus* thus

documents the complex effects of the construction industry on the surrounding countryside, and the integration of urban and rural economic activity.

This is nowhere clearer than in the process of transportation, the ease of which led directly to the large-scale use of *lapis Gabinus* in Rome. The fact that blocks could be floated down the Aniene and Tiber rivers with minimal effort, as compared to the painstaking importation overland of *lapis Albanus*, is what made *lapis Gabinus* attractive as a building stone in the first place. This was only made possible in the first century BCE, however, with the development of a significant transportation industry on the Aniene River servicing the extraction of *lapis Gabinus*, travertine, tufo lionato, and the supply of timber or fuel in addition to other goods. In fact, the initial popularity of the stone at Rome may be due to the relative ease with which blocks could be transported *directly* to anticipated bridges such as the Pons Milvius and Pons Fabricius and to other construction sites near the Tiber. Once transportation systems were in place, industrial inertia encouraged continuing exploitation. At the same time, this process required a steady stream of many workers moving back and forth along the trade routes of Latium—both between Gabii and Collatia and along the Aniene and Tiber between Collatia and Rome. The development of this “local” transport network, and its continuing importance into imperial times, has not received the attention it merits.

One of the important conclusions to emerge from this analysis is that *lapis Gabinus* extraction was integrated with other industries, mainly in terms of transport economics. Blocks of *lapis Gabinus*, travertine, and tufo lionato all shared supply lines along the Aniene and must have contributed to a shared labor pool of skilled stoneworkers. Indeed, with the concentration of various important stone quarries in this limited area, rivalled perhaps nowhere else in the empire, it is perhaps no surprise that the cult of Hercules Saxanus, a quarry deity otherwise known only

in Germany, appears at Tivoli.<sup>496</sup> Furthermore, the transportation of *lapis Gabinus* was clearly integrated with that of timber or fuel in the form of rafts, a relationship which may have contributed to the eventual abandonment of the quarries, as well as with agricultural regimes more broadly regarding the use of oxen and human labor. The interplay between these various sectors of the economy deserves greater attention, especially since it is one point at which construction and agriculture—that is, probably the two largest sectors of the Roman economy—interact.

Finally, the importance of the Aniene in this industry cannot be understated. The river is often given little attention in studies of Roman transportation, even those which emphasize river traffic.<sup>497</sup> Most such research tends to focus on the Tiber, and particularly on traffic between Ostia and Rome, based ultimately on trans-Mediterranean transport. If anything, the Aniene is thought of as a source for the aqueducts supplying water to Rome, with occasional attention to its role in the transport of travertine. However, the supply of *lapis Gabinus* (as well as tufo lionato) to Rome necessitated thousands of trips along this all-important route, and, moreover, must represent only one of many industries utilizing it for navigation and transportation. But this is just to scratch the surface—it was also a crucial source of water for agricultural activities in the Aniene River Valley, for example.<sup>498</sup> Whether this significance continued into the later imperial period cannot be assessed here, but deserves further consideration. It seems likely that the Aniene was *always* an integral piece in the exploitation of Rome's hinterland.

---

<sup>496</sup> CIL XIV 3543. See Ricci and Granino Cecere 2006.

<sup>497</sup> In *Rivers and the Power of Ancient Rome*, Campbell (2012) occasionally mentions the river, but only rarely (314) in economic terms, with lip-service to the tufo quarries along its course (despite good discussion of quarries and river transport elsewhere).

<sup>498</sup> For the Aniene as an important source of agricultural water, see Thomas and Wilson 1994.

## Chapter 7: Conclusions

### Lapis Gabinus and Rome: The Economy of Urban Construction

This study has provided for a picture of *lapis Gabinus* extraction which has numerous implications for the Roman construction industry more broadly. It puts to rest a number of misconceptions about this industry and brings to light several new ideas worthy of further attention.

First, Gabii must be seen as representative of numerous similar sites in the *suburbium*, the main function of which was to supply the myriad industries of the Roman metropolis in the late Republic and early Empire. The textual sources which write off Gabii as an unimportant backwater in this period betray their authors' concern with superficial appearances and symbolism over economic processes, concealing the essential role of Gabii in the construction industry and the continuing extractive activity at the site into (at least) the first century CE. This *lapis Gabinus* industry was integrated with the labor market of the capital, which supplied both unskilled laborers and skilled stonemasons, in a system which included the other Roman tufo quarries as well as those producing travertine. The production of building stone was also integrated with the supply of wood for timber or fuel as well as with the broad sector of the economy concerned with agriculture. Detailed studies of the systems supplying other resources to the capital are needed in order to better understand the intersections of these various sectors of the Roman economy.

The more specific role which *lapis Gabinus* and other kinds of tufo played in the economy of urban construction can now be more accurately described. The continued use of more accurate techniques of tufo identification, as applied here to alleged attestations of *lapis Gabinus*, will hopefully provide a more accurate picture of tufo distribution, as this study has shown that the various types have been misidentified in the past. In addition, while Tenney Frank ingeniously saw that the use of various tufos as building materials provided a means to estimate the date of monumental construction, a strictly chronological view of tufo is no longer tenable, as *lapis Gabinus* appears in monuments alongside other varieties such as tufo lionato and *lapis Albanus*. Builders clearly had a fair amount of choice in the materials they used, and *lapis Gabinus* was preferred for particular architectural features, especially load-bearing elements and high-traffic pavements or thresholds. These preferences themselves had significant repercussions on quarry activity at Gabii, which waxed and waned in line with large-scale construction projects in Rome. We must imagine that similar processes were taking place at the other tufo quarries supplying the city—those for *lapis Albanus*, Tufo di Tuscolo, tufo lionato, cappellaccio, Grotta Oscura tufo, Fidenae tufo, and even travertine. This study has revealed the complexity of Roman stone construction in the Late Republic.

Above all, perhaps, this dissertation has shown that issues relating to the transportation of *lapis Gabinus* played perhaps the most significant part in the development of the quarries. The ease with which blocks could be moved to Rome attracted builders from the capital to the quarries in the first place, and led to the development of a complex transportation system along the Aniene River that also involved tufo lionato, travertine, and the logging industry. This system was just as important as the physical properties of the stone in determining where and how *lapis Gabinus* was used in construction projects. Most interestingly, it may have been the



failure of this transportation system that precipitated the abandonment of the *lapis Gabinus* quarries, an abandonment which is otherwise difficult to explain. These conclusions illustrate the complexities of stone construction in Rome, as it is only by considering the complete economic life of tufo blocks, from extraction to construction, as well as the intersection of this industry with other economic activities, that the reasons for the exploitation of particular quarries become clear.

### **Lapis Gabinus and Gabii: Suburban Economic Development and the Decline of a Latin Town**

Finally, the “decline” of Latin Gabii that was bemoaned by Roman poets should in fact be viewed in terms of the economic shifts taking place in the Roman *suburbium* as a reaction to the population growth and social and political changes in the capital in the last two centuries BCE. From this point of view, the changes at Gabii are representative of many larger phenomena—migration to the capital, elite villa development, re-orientation of agriculture toward perishable goods for Rome, and (of supreme relevance here) increasingly intensive resource extraction. That dramatic changes were taking place in the hinterland of Rome is unsurprising, and further archaeological work can balance our understanding of this dynamic rural area.

Perhaps most interestingly, the decline of the former city brought about conditions which were actually *conducive* to the extraction of *lapis Gabinus*. The limited size of the deposit, and the fact that the best stone was found most easily closest to the rim of the crater, caused those organizing extraction to look to outcrops beneath the city, in areas which had been conveniently abandoned by the first century BCE. Quarry operations could take advantage of the infrastructure

of the city, including the roads and abandoned buildings, while moving extractive activities closer to the *via Praenestina*. Intra-urban extraction became far more attractive than extraction at more distant sites, the majority of which, at any rate, had already seen significant quarry activity complicating the topography and depleting the resource. The synergy between resource extraction and urban abandonment is striking, and leads one to question whether Gabii is an isolated case or simply the most obvious example of this type of phenomenon. Even in abandoned cities and towns which lacked underlying stone deposits, spoliation and looting would have been important, if short-term, economic activities. The archaeology of urban decline and decay has seen far less attention than the opposite process of urban development, but this study suggest that such research can prove fruitful.

What, then, were the effects of large-scale stone extraction on the history of this disappearing city? On the one hand, quarrying provided jobs and ensured economic activity at Gabii, tying it into transportation networks and allowing it to persist in the face of the disintegrative forces of urban decline. Gabii in the first century BCE may have functioned essentially as a “quarry town” in the sense of the mining towns of the nineteenth-century American West—that is, a town driven economically by a single activity (resource extraction), with other goods and services provided in support of this industry. Comparative studies of such single-industry towns may be able to shed light on Roman extraction sites; conversely, the study of Roman tufo quarries highlights the important role which archaeology can play in the broader study of urban construction. Tufo extraction was one means by which late Republican architecture altered the Roman countryside—the story of Gabii in the first century BCE is in fact the story of Roman ashlar architecture writ upon the rural landscape.

On the other hand, quarrying physically destroyed part of the urban area. The other major role Gabii played was as a rest-stop for travelers between Rome and the sanctuary of Fortuna at Praeneste, travelers who could not have missed the fact that quarry operations were cannibalizing parts of the ancient and noble Latin city of Gabii. Indeed, the noise from the quarry faces discovered within the Gabii Project excavations could undoubtedly be heard from the *tabernae* and inns along the *via Praenestina*. Quarries, like ruins, are evocative places, as a nineteenth century traveler observing the Aniene tufo quarries suggests:

The stone has been cut out, forming large chambers and halls, square columns having been left here and there to support the roof, with apertures at intervals to admit the light. The creeping plants which hang through these apertures, the long ranges of columns, the irregular distribution of the chambers, and the mysterious gloom with which they are pervaded, produce a singularly solemn and picturesque effect. Their stillness summons to the eye of fancy hundreds of busy workmen occupied in removing the stone—slaves under the cruel lash of the overseer falling at their toil; the noise, the bustle, the activity, both within and without, as the distant aqueduct crawls slowly, arch by arch, to its destination, or the temple or palace grows up day by day within the walls of the city.<sup>499</sup>

The process of tufo extraction, as perceived by these travelers, would have exaggerated the decline of the city, and it is this perception which we see reflected in the Roman authors, allowing the town to be appropriated as a potent symbol of total devastation. The quarries of *lapis Gabinus*, then, contributed to the physical deterioration of the city and accentuated its symbolic valence, even while assuring its continued relevance in the Roman economy. The supply of this stone for the economy of urban construction thus played an important role in the history of both Gabii and Rome.

---

<sup>499</sup> Davies 1875, 138-39.

## **Appendix: Discussion of Sampling and Trace Element Analysis of**

### ***Lapis Gabinus***

A central goal of this project was to accurately determine the distribution of ashlar *lapis Gabinus*; to this end, samples were acquired from monuments attested to include the stone, as well as from the quarries at Gabii (both those above ground as well as that excavated by the Gabii Project). I also sampled many of the structures exposed in the Gabii Project excavations which appeared, macroscopically, to consist of *lapis Gabinus*. Fabrizio Marra, of the Istituto Nazionale assisted me with the collection of the samples from the visible quarry faces at Gabii and from the excavated quarry face; I alone collected those from the other excavated structures at Gabii and from the other Roman monuments. At the quarries, we sampled a number of different outcrops in order to assess any vertical or horizontal variation within the deposit; the map in figure 24 indicates sampling locations. For monuments in Rome, of those which were said to include *lapis Gabinus* permission could be obtained to sample only three: the Forum of Caesar, the Forum of Augustus, and the area of Sant'Omobono.

All of these samples were then sent to Activation Laboratories, Ltd., of Ancaster, Ontario (Canada), where they were subjected to inductively coupled plasma mass spectrometry (ICP/MS), a technique that measures minute amounts of many trace elements. As recent research has shown, ratios between certain immobile trace elements, including Zr/Y, Nb/Y, Nb/Zr, SiO<sub>2</sub>/MgO, and SiO<sub>2</sub>/Na<sub>2</sub>O+K<sub>2</sub>O, can be used as geochemical signatures unique to particular

volcanic deposits within central Italy.<sup>500</sup> Fabrizio Marra interpreted the results and produced the tables and graphs used in this dissertation, though any error in their presentation here is my own. The results are summarized here in the appendix; the most significant results have also been discussed in the text of the dissertation.

Results for the samples from the quarries at Gabii are summarized in figure 25. As the top figure demonstrates, when ratios of  $\text{SiO}_2$  and  $\text{Na}_2\text{O}+\text{K}_2\text{O}$  are plotted on the graph the *lapis Gabinus* samples fall into a distinct field, separated from the samples of *lapis Albanus*, which are denoted on the figure as PA-B and PA-C. In the lower figure, ratios of  $\text{SiO}_2$  and  $\text{MgO}$  are plotted for the same samples, and again those for *lapis Gabinus* fall into a distinct field. This figure also demonstrates that samples of tufo del Palatino (“cappellaccio”) can be distinguished from *lapis Gabinus* and *lapis Albanus* in this manner, as the sample labelled CH-1 was taken from the outcrops of this tufo on the Capitoline hill. These analyses confirm the validity of this method of tufo identification when distinguishing between these three types of tufo. In addition, the top figure displays some potential variation within the *lapis Gabinus* deposit at Gabii. In particular, those samples taken from the quarry face exposed by the Gabii Project excavations appear distinct from those taken from the other visible quarry faces. Further analyses are needed to confirm the possibility of locating the point of stone extraction more specifically within the quarries, though I have noted potential implications in the text above.

The samples from archaeological contexts at Rome and Gabii were also analyzed, and the results are presented in figure 39. Examples of *lapis Gabinus* are labelled in red (sample #2 and #3, from the Forum of Augustus; #4, from the Forum of Caesar; #5, from the quarry debris excavated at Gabii; #6, from the sixth century structure in area D; and #9, from the staircase at S. Omobono). Examples of tufo del Palatino (cappellaccio) are labelled in blue, and those for *lapis*

---

<sup>500</sup> E.g., Marra et al. 2011; Lancaster et al. 2011.

*Albanus* appear as stars. We were able to confirm the presence of *lapis Gabinus* in the forum of Caesar, the Forum of Augustus, and the archaeological area of S. Omobono, in addition to a number of features excavated in the course of the Gabii Project excavations, as discussed in the text above.

Several of these results are particularly interesting. Samples #8 and SO-1 were taken from a wall at S. Omobono which was visually identical to *lapis Albanus* but which our analysis has identified as Tufo del Palatino (cappellaccio, labelled in blue on the graphs). Sample #6, on the other hand, was taken from a sixth century structure at Gabii which appeared to consist of blocks of cappellaccio. However, we compared this with a sample of the bedrock near the archaeological remains, which similarly appeared to be cappellaccio, and determined that both were, in fact, *lapis Gabinus*. Finally, in light of our results suggesting that it may be possible to source samples of *lapis Gabinus* to more specific areas within the quarries, it is worth noting that the data for samples from the Forum of Augustus most closely match that for the excavated quarry debris in the Gabii Project excavations. This is further discussed above, in chapters 4 and 6.

## Figures

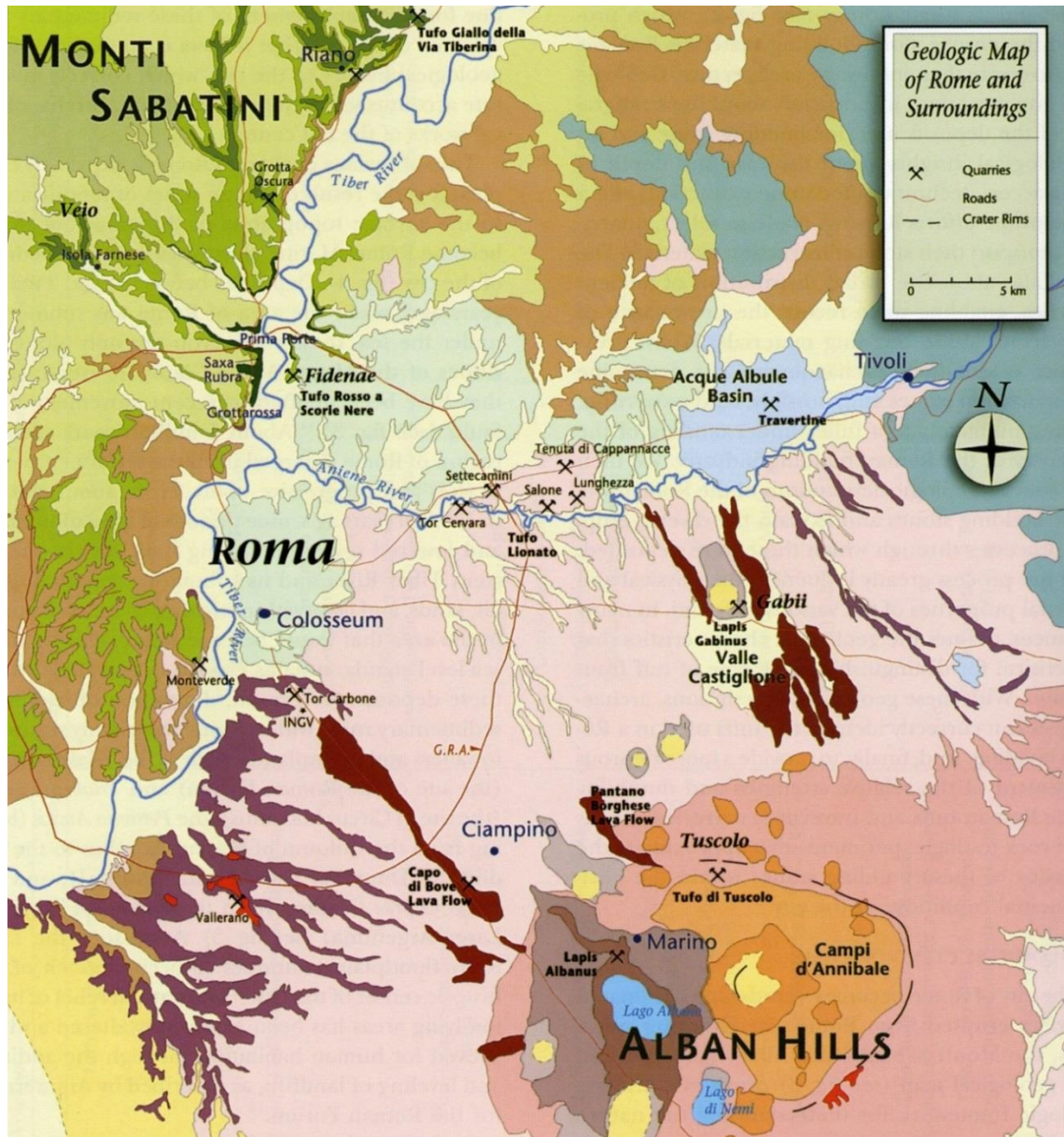


Figure 1: The location of Gabbii and other tufo quarries in relation to Rome (Jackson and Marra 2006).



**Figure 2: Aerial view of Gabii from the south. The area of the Gabii Project excavations is visible in the lower right, indicated by the arrow.**





411



Figure 3: Denarii of C. Antistius Reginus, 13 BCE (left) and C. Antistius Vetus, 16 BCE (right).

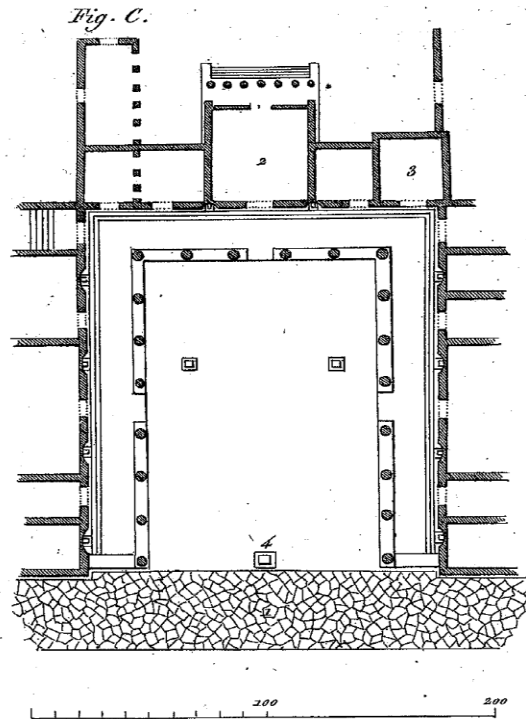


Figure 4: The "forum" discovered by Hamilton in 1790's (Visconti 1797).



Figure 5: Temple of Juno Gabina, Gabii

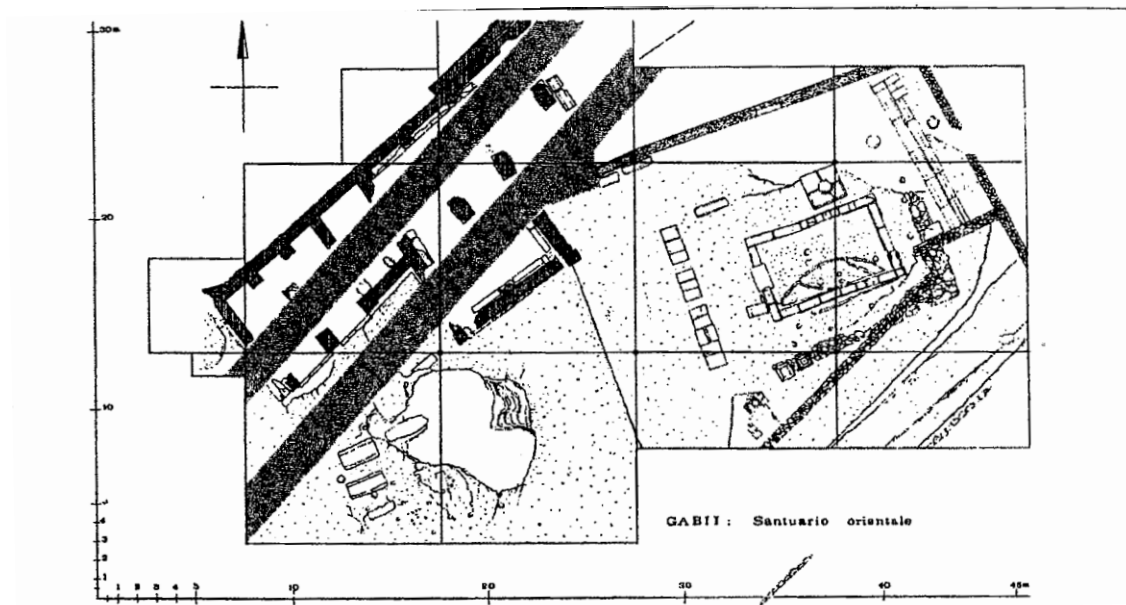


Figure 6: Santuario Orientale, Gabii (Guaitoli 1981a)

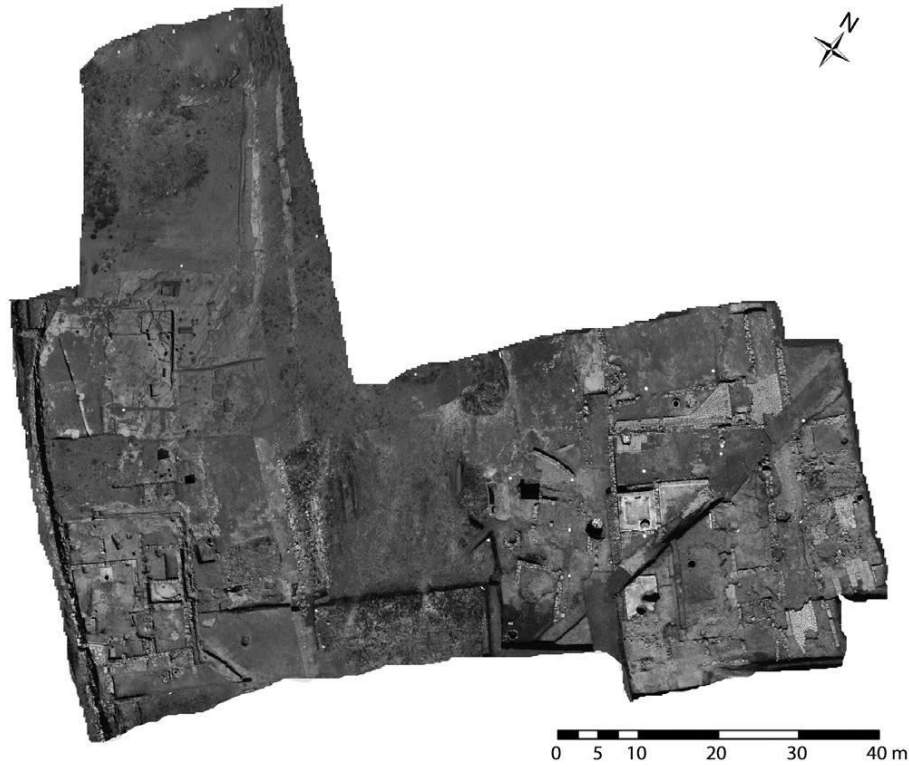


Figure 7: Photomosaic of Gabii Project Excavations (Mogetta and Becker 2014)

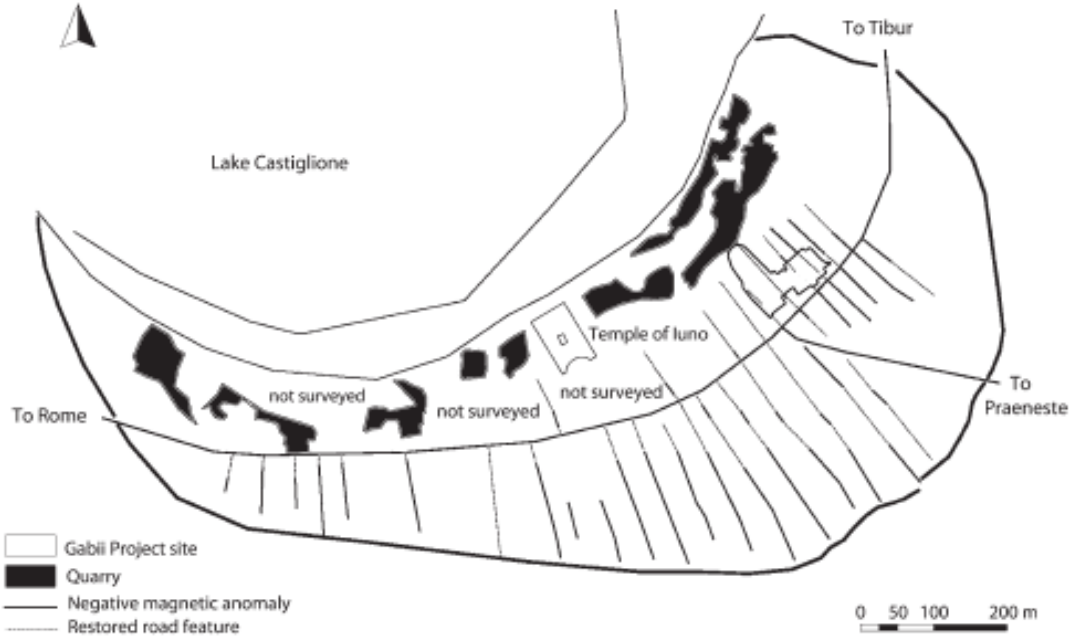
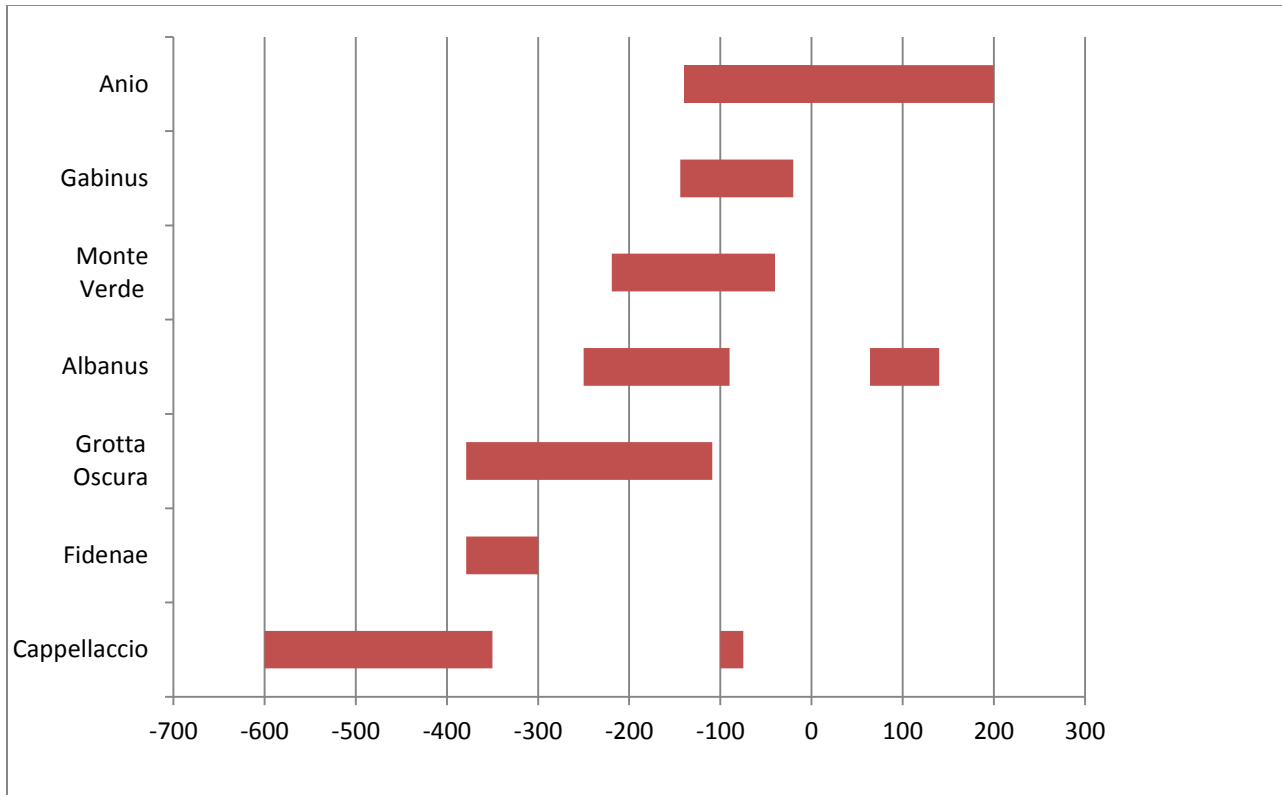


Figure 8: Results of the magnetometry survey of Gabii, showing the road network within the city (Mogetta and Becker 2014)



**Figure 9: Chronological tufo use according to Frank 1924.**

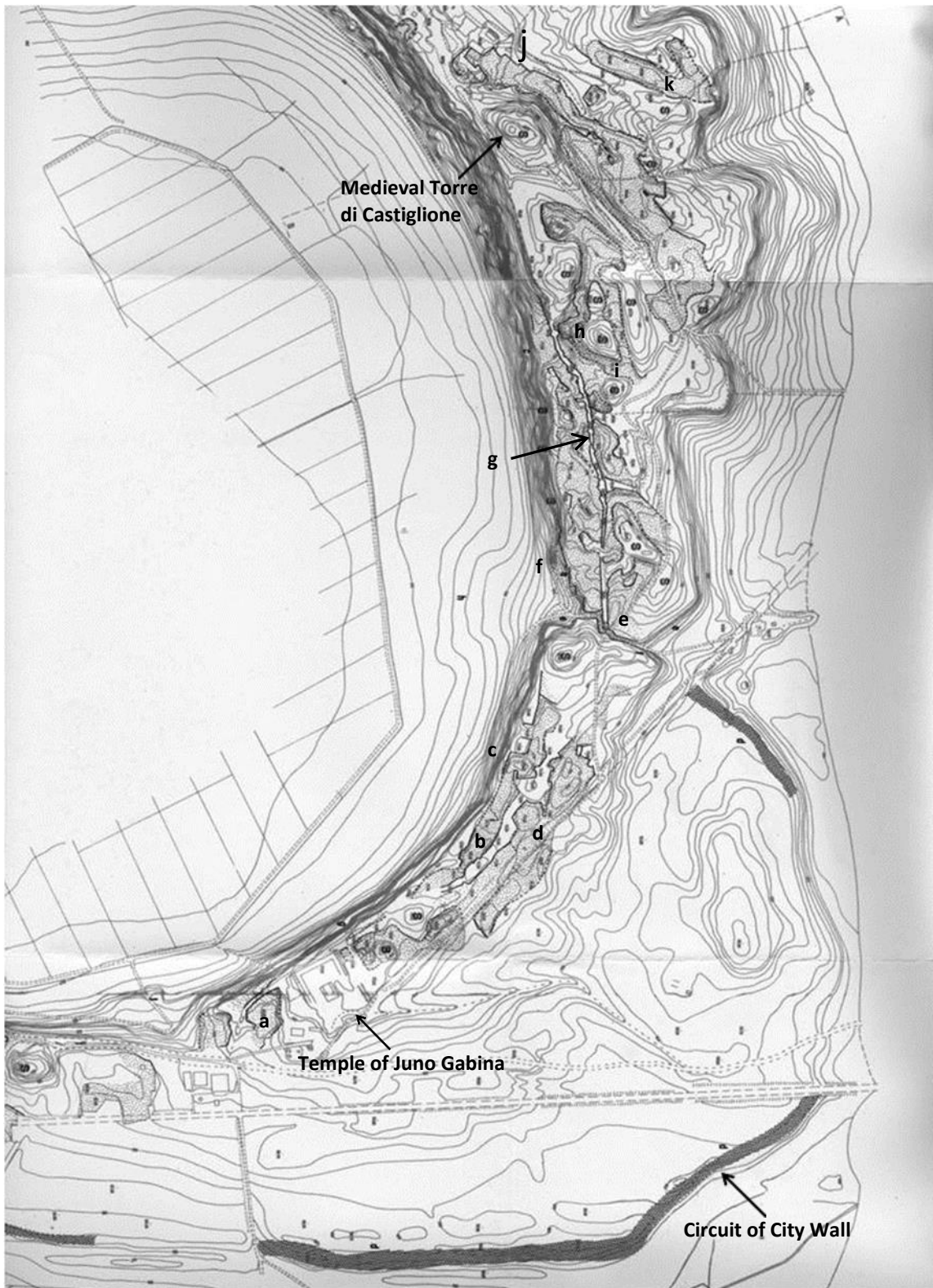


Figure 10: Map of the lapis Gabinus quarries created by F. Piccarreta (1981). Bold black lines represent vertical quarry faces, dotted lines are reconstructed faces based on interpretation of aerial photos. Quarried areas have been shaded.



**Figure 11: “Corner” quarry along the edge of the crater**



**Figure 12: Indications of large block removal at the quarry in figure 11.**



**Figure 13: Quarry faces within the crater, though quite large, are mostly inaccessible due to vegetation.**



**Figure 14: Road cut into the bedrock north of the city; to the left, the interior of the Castiglione crater.**





**Figure 15: Small outcrop in northern quarry zone, with visible pick marks.**



**Figure 16: A typical quarry face.**



**Figure 17: Steps cut into quarry faces reveal the manner of extraction.**



**Figure 18: Trenches outline emerging blocks.**



**Figure 19: Extraction of blocks on an angle, to preserve more of the remaining stone.**



**Figure 20: Quarry faces east and north of the medieval tower. While quite large, they are completely hidden under present flora. However, the ground level can be observed near the buildings at left, giving some sense of the height of the faces.**



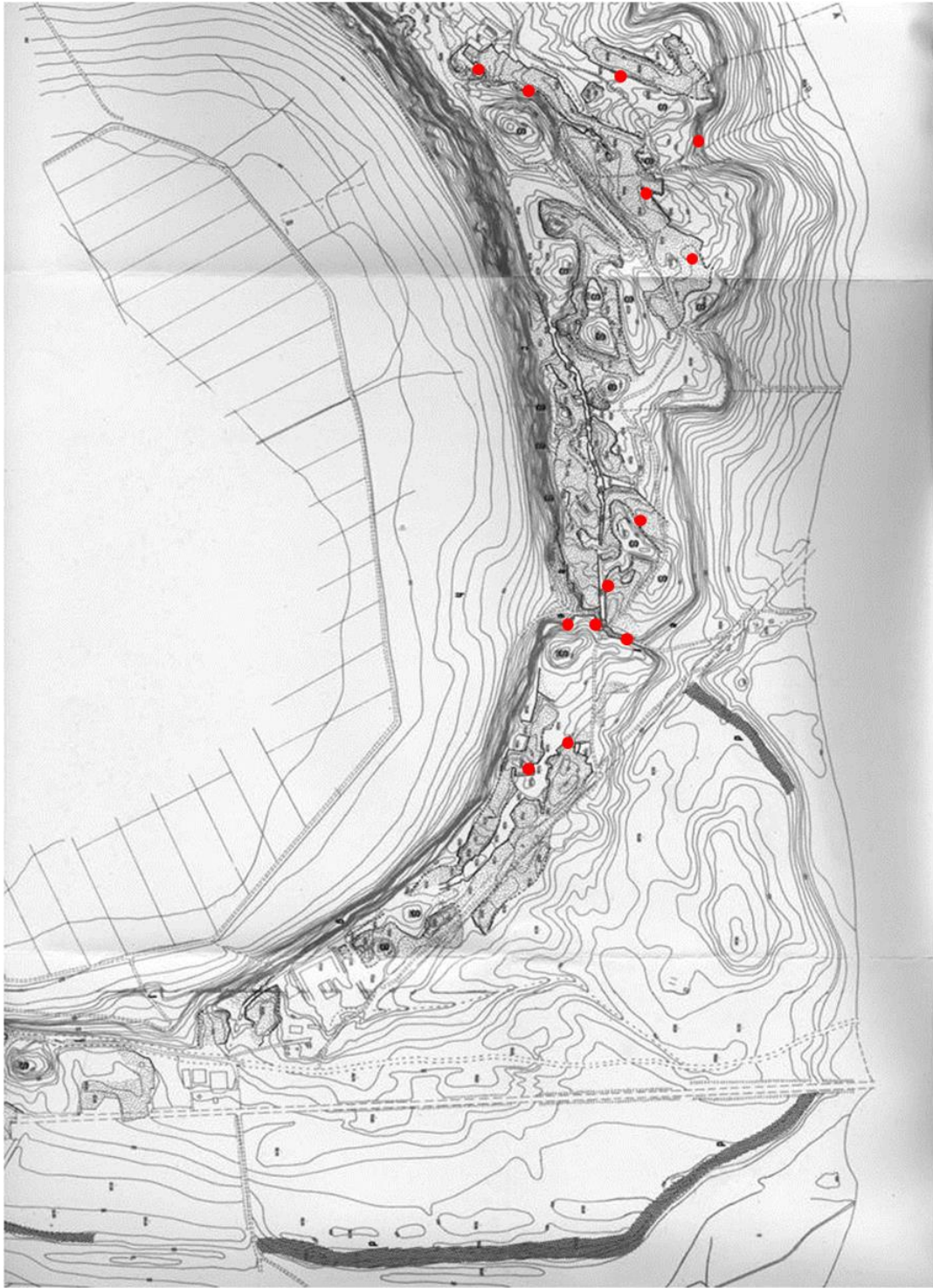
**Figure 21: Quarry face along the eastern edge of the extraction zone.**



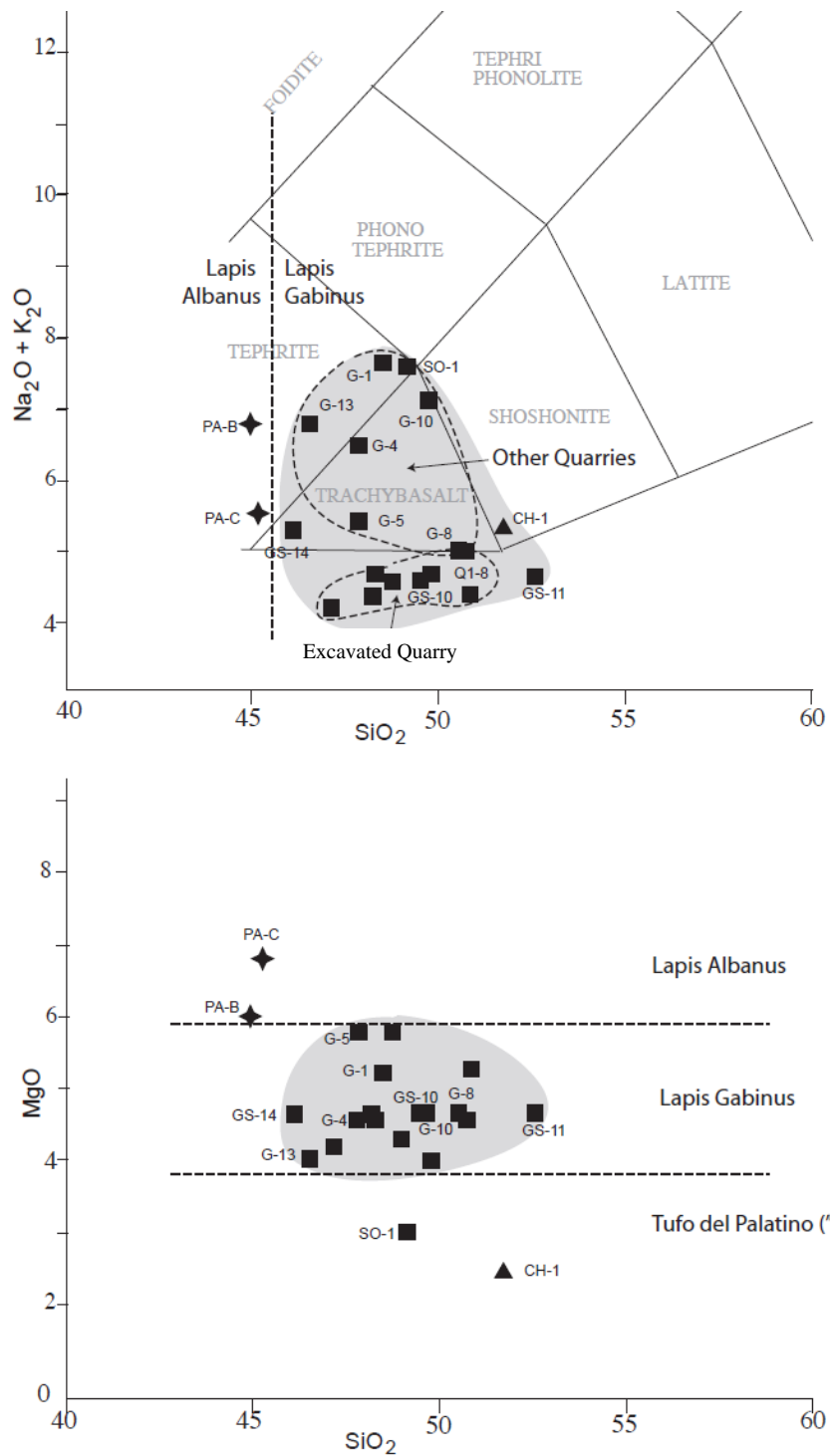
**Figure 22: Quarry face along the eastern edge of the extraction zone.**



**Figure 23: Outcrop within large extraction zone.**



**Figure 24:** Map of the quarries at Gabii, indicating the locations from which samples of stone were acquired for analysis.



**Figure 25: Results of trace element analysis, produced by F. Marra. Lapis Gabinus samples fall into a narrow field distinct from samples of lapis Albanus and Tufo del Palatino (cappellaccio). For more information see appendix.**





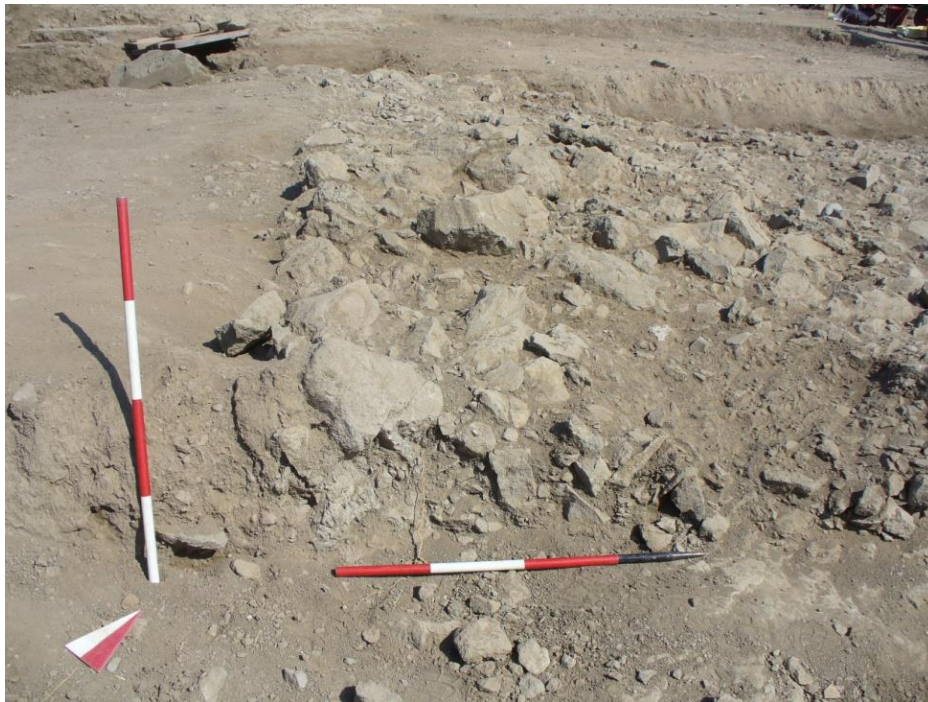
**Figure 26: Excavated quarry face. At the base, a narrow trench for block removal. At right, quarry debris in the fill.**



**Figure 27: Trial quarry pit.**



**Figure 28: Quarry debris field within Gabii Project Excavations. The road can be seen across the background.**



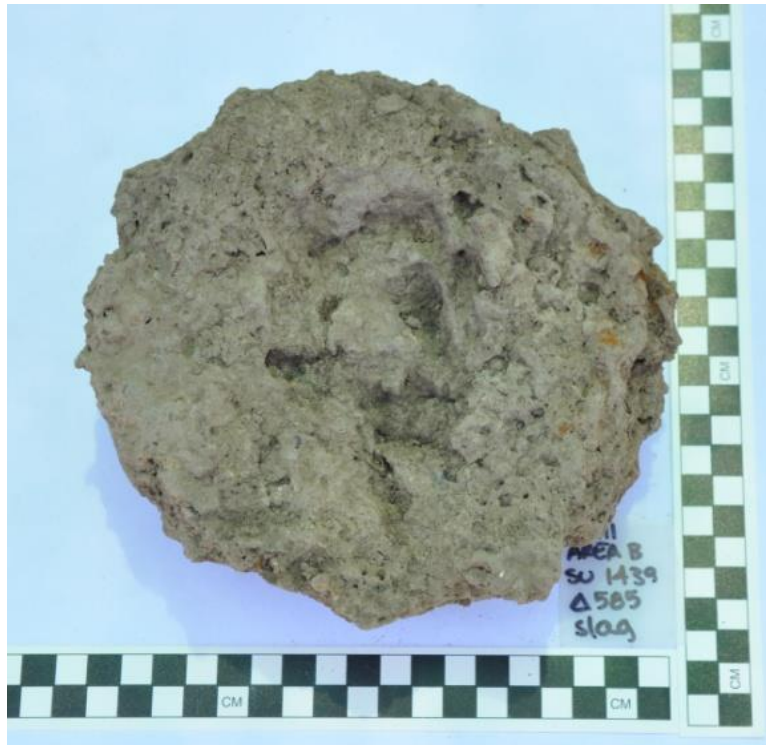
**Figure 29: Quarry Debris field.**



**Figure 30: Extraction of blocks on an angle, to preserve the road (now buried at upper left).**



**Figure 31: Iron wedge found in excavation of Area E, southeast of the excavated quarry face.**



**Figure 32: Crucible slag excavated from Area B, directly south of excavated quarry face.**



**Figure 33: Tabularium façade facing the Roman Forum**



**Figure 34: Lapis Gabinus in the foundations on the north side of the Tabularium**



**Figure 35: Pons Fabricius. Both gray lapis Gabinus and reddish tufo lionato are visible in the facing. The arch is travertine.**



**Figure 36: The Porta Viminalis (in the foreground). In the background, remains of the Servian wall near Stazione Termini.**

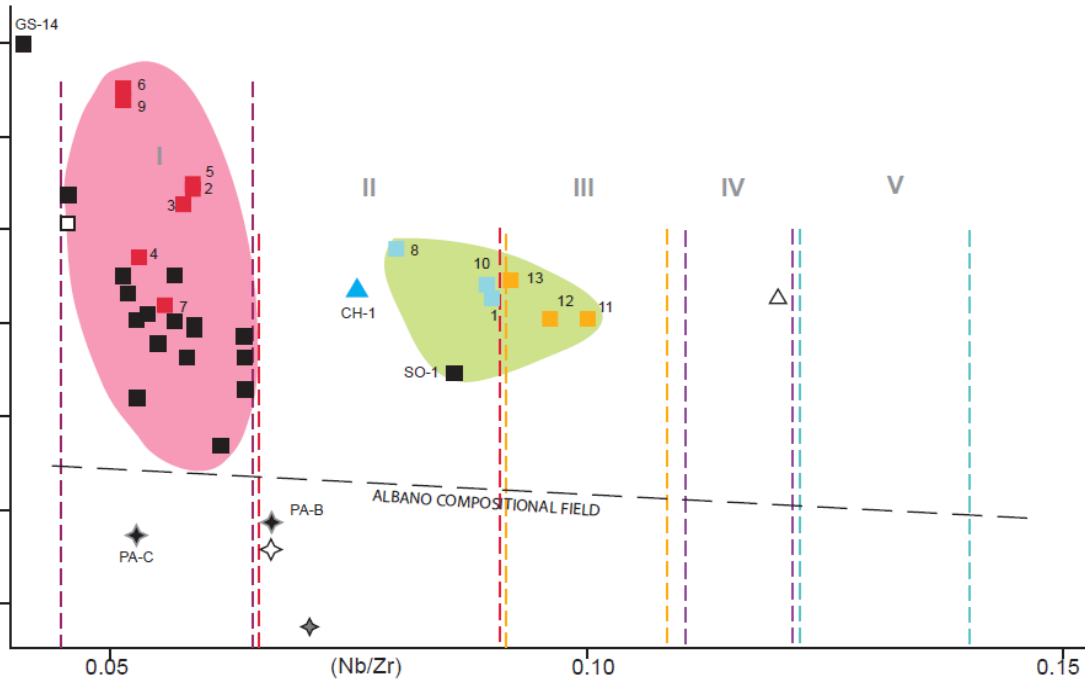
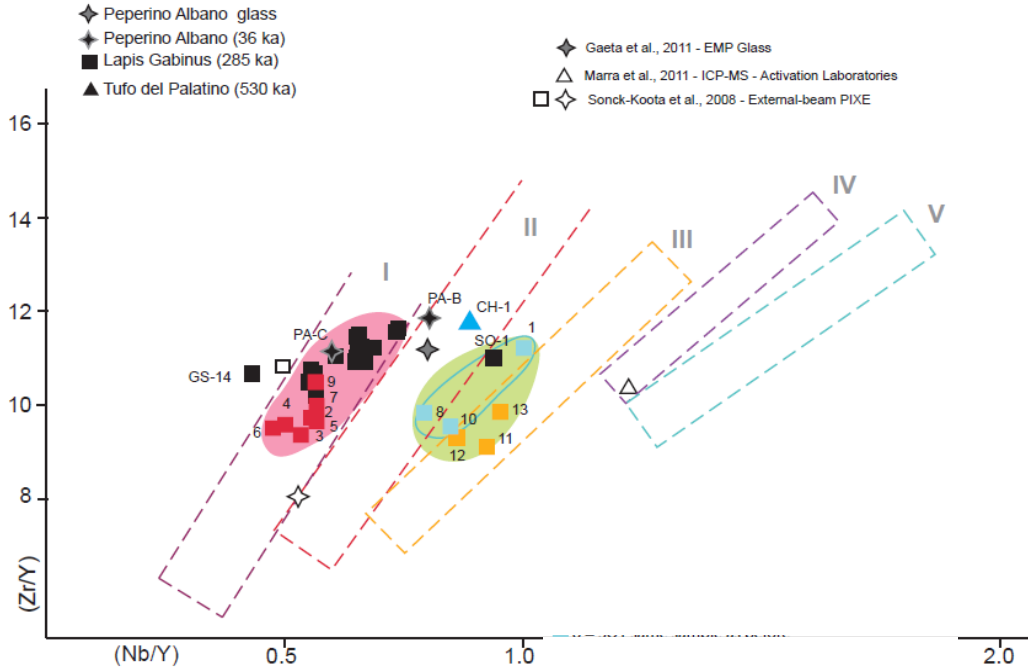


**Figure 37: The Porta Viminalis, with a stretch of Servian wall which includes lapis Gabinus in the background.**

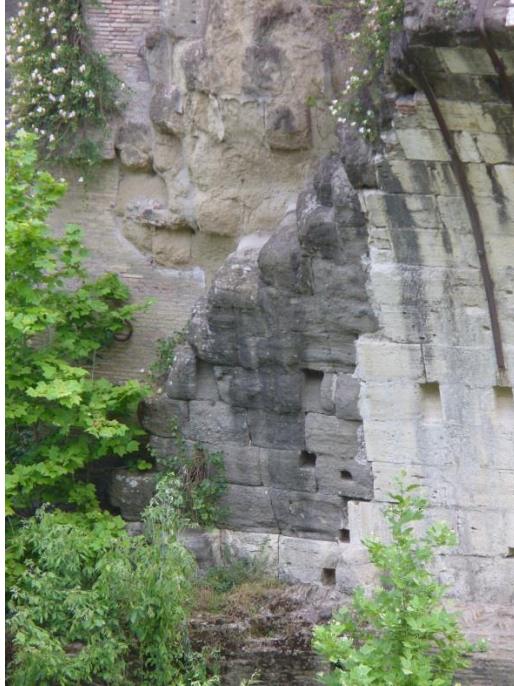


**Figure 38: The tabernae in the Forum of Caesar, with lapis Gabinus piers and flat arches.**





**Figure 39: Results of trace element analysis of stone samples from Roman monuments. Graphs produced by Fabrizio Marra. Black squares represent samples from the quarries at Gabii, and red squares represent samples from archaeological remains. (2=Forum of Augustus, hemicycle wall; 3=Forum of Augustus, podium; 4=Forum of Caesar, taberna pier; 5=Quarry debris from Gabii excavations; 6-7=archaeological remains at Gabii; 8=S. Omobono, cappellaccio which appears at *lapis Gabinus*; 9=S. Omobono, *lapis Gabinus* staircase). Comparative samples of *lapis Albanus* (peperino) and Tufo del Palatino (“cappellaccio”) are also shown.**



**Figure 40: Pons Aemilius: Detail of eastern surviving arch with lapis Gabinus intrado.**



**Figure 41: The Forum of Augustus and the Temple of Mars Ultor.**



**Figure 42: At left, lapis Gabinus blocks in the apses of the Forum of Augustus. At right, lapis Albanus in a later abutting wall.**



**Figure 43: Lapis Gabinus staircase at Sant'Omobono. The church is at upper right.**

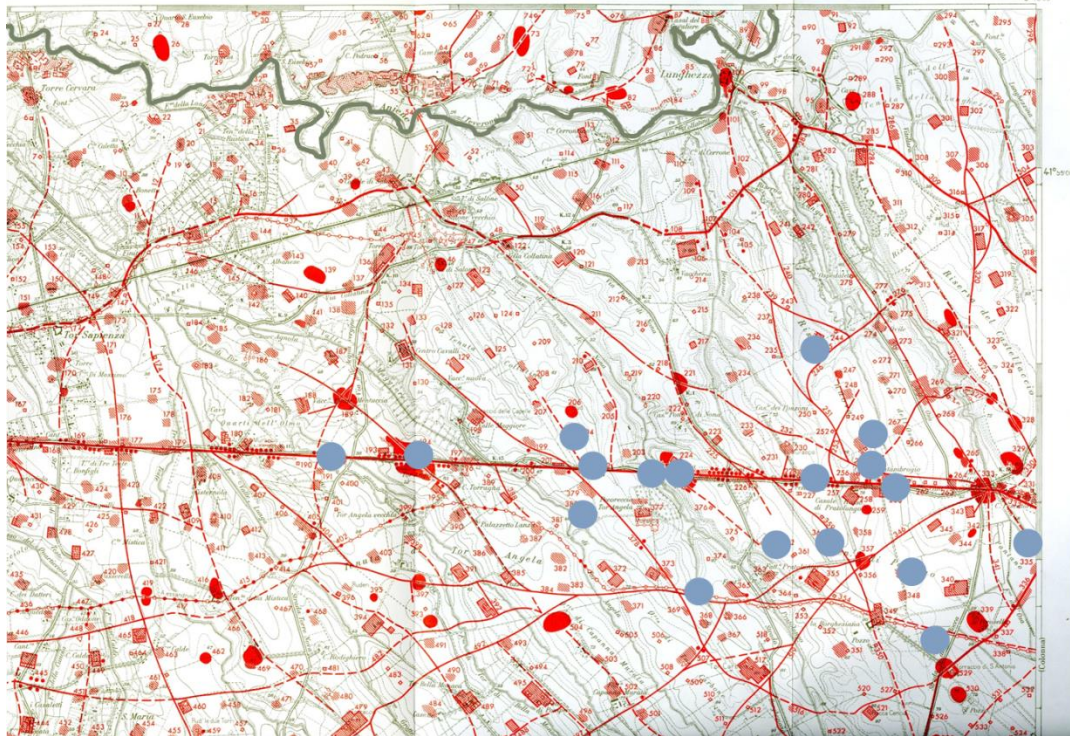


Figure 44: Distribution of sites with lapis Gabinus along the via Praenestina. Gabii is off the map just to the east; at the north the Aniene River can be seen. After Quilici 1974.



Figure 45: The Ponte di Nona, constructed largely with lapis Gabinus.



Figure 46: The Ponte Amato, about 8 kilometers east of Gabii.

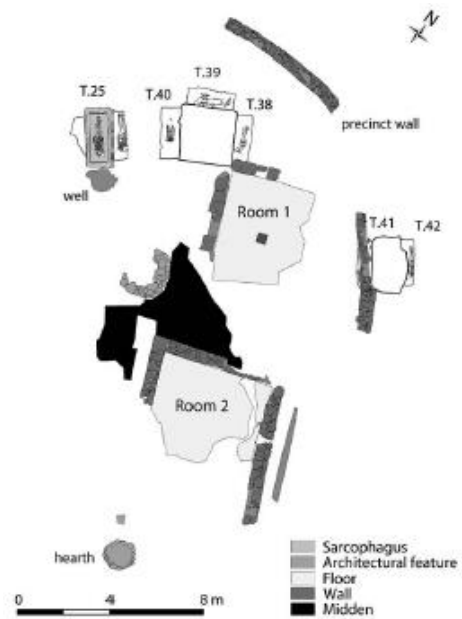


Figure 47: Early structures in Area D, composed of local stone.



**Figure 48: Mid-Republican retaining wall at Gabii composed of lapis Gabinus.**



**Figure 49: Mid-Republican retaining wall (right) with monumental staircase at left. The concrete walls at far left is from a much later phase.**

## Tables

Monument	Date of <i>lapis Gabinus</i> use	Location	Position of Stone
<i>Tomb of the Scipios*</i>	175-150 BCE	Via Appia, just south of Rome	Sarcophagi and inscriptions within tomb
Bridge over Fosso di Tor Angela	Uncertain.	East of Rome; no longer extant	Arch, of either the <i>aqua Alexandriana</i> or the <i>via Gabina</i>
Temple of Juno Gabina	150-100 BCE	Gabii	Used extensively
Aqua Marcia	144 BCE/Augustan restorations	Rome to near Agosta (ca. 91 km east of Rome)	Top and bottom of <i>specus</i> (location along course of aqueduct unspecified)
Pons Milvius	109 BCE	Via Cassia/Clodia, just north of Rome	Facing of piers; vaulting
Tabularium	78 BCE	Rome, Forum Romanum at base of Capitoline	Foundation; second story pillared arcade
Pons Fabricius	62 BCE/21 BCE restoration	Rome, Campus Martius-Tiber Island	Facing of piers; vaulting
Theater of Pompey	55 BCE/32 BCE restoration	Rome, Campus Martius	Unspecified
Cloaca Maxima	1st c. BCE	Rome, Tiber River	Reconstruction of outlet into Tiber
Ponte di Nona	1st c. BCE	Via Praenestina, 12 km east of Rome	Arches
Ponte Amato	1st c. BCE	Via Praenestina, 18th milestone	Arches
Porta Viminalis	50 BCE	Rome, northeastern Servian wall	All surviving blocks. Also said to be in restorations of wall itself.
Forum Iulium	46 BCE	Rome, Imperial Fora	Support pillars and flat arches of tabernae; corner of podium of temple to Venus Genetrix
Tomb of Caecilia Metella	30-20 BCE	Via Appia, just south of Rome	Single course atop concrete foundations
Pons Aemilius	After 12 BCE	Rome, Forum Boarium-Trastevere	15 courses of the arch
Forum Augustum	2 CE	Rome, Imperial Fora	Boundary wall; statuary niches; corners of podium of temple to Mars Ultor
<i>Pons Aelius*</i>	134 CE	Rome, Tiber River	Intrados of the arches
Quays on the Tiber near the Forum Boarium	Uncertain.	Rome, Tiber River	Uncertain

Table 1: Alleged *lapis Gabinus* use in and around Rome. The table is organized roughly chronologically, though many of the dates are uncertain.\* Italicized names indicate monuments where the presence of *lapis Gabinus* is doubtful.



	Dates of Construction	Possible Quarrying
Temple of Juno	160-150	175-150
Pons Milvius	109	112-109
Tabularium	78	83-78
Pons Fabricius	62 or 21	65-62 or 25-21
Forum Iulium	46	54-44
Pons Aemilius	after 12	12 BCE-14CE
Forum Augustum	2 CE	25-15

Table 2: Large-scale projects using *lapis Gabinus* and the probable dates of associated stone quarrying. These dates are estimates only.

## Bibliography

- Abad Casal, L., S. Keay and S. Ramallo Asensio, eds. 2006. *Early Roman Towns in Hispania Tarraconensis*. JRA Suppl. 62.
- Adam, J.P. 1994. *Roman Building: Materials and Techniques*. Bloomington: University of Indiana Press.
- Adams, C.E.P. 2001. "Who Bore the Burden? The Organization of Stone Transport in Roman Egypt." In *Economies beyond Agriculture in the Classical World*, edited by D.J. Mattingly and J. Salmon, 171-92. London: Routledge.
- Alarcão, J. and A. Tavares. 1988. "A Roman Marble Quarry in Portugal." In *Studia Pompeiana & Classica: In Honor of Wilhemina F. Jashemski*, edited by R. Curtis, 1-13. A.D. Caratzas.
- Allen, J.R.L. 2005. "Roman and Medieval-Early Modern building stones in South East Wales: the Sudbrook Sandstone and Dolomitic Conglomerate (Triassic)." *The Monmouthshire Antiquary* 21: 21-44.
- Àlvarez, A., A. Gutiérrez, P. Lapuente, A. Pitarch and I. Rodá. 2009. "The Marmor of Tarraco or Santa Tecla Stone (Tarragona, Spain)." In *Marbres et autres roches de la Méditerranée antique: études interdisciplinaires*, edited by P. Jockey, 129-40. Proceedings of the 8th International Conference of the Association for the Study of Marbles and Other Stones in Antiquity (ASMOSIA). Paris: Maisonneuve & Larose-MMSH.
- Alvarez, W. 1972. "The Trei Valley north of Rome: Volcanic stratigraphy, topographic evolution and geological influences on human settlement." *Geologica Romana* 11: 153-176.
- Alvarez, W. 1973. "Ancient course of the Tiber River near Rome: An Introduction to the Middle Pleistocene volcanic stratigraphy of central Italy." *Geol. Soc. America Bull.* 84: 749-758.
- Alvarez, W. 1975. "The Pleistocene volcanoes north of Rome." In *Geology of Italy*, edited by C.H. Squyres. Tripoli: Earth Sciences Society.
- Alvarez, W., A.J. Ammerman, P.R. Renne, D.B. Karner, N. Terrenato, and A. Montanari. 1996. "Quaternary fluvial-volcanic stratigraphy and geochronology of the Capitoline Hill, Rome." *Geology* 24: 751-54.

- Alvarez, W., A. Gordon, and E.P. Rashak. 1975. "Eruptive Source of the "tufo rosso a scories nere," a Pleistocene Ignimbrite north of Rome." *Geologica Romana* 14: 141-154.
- Alvarez, W., M. Nicoletti, and C. Petrucciani. 1976. "Potassium-argon Ages on Pyroclastic Rocks from the Pleistocene Sabatini Volcanic District, North of Rome." *Rendiconti della Società Italiana di Mineralogia e Petrologia* 32: 147-152.
- Alföldy, G. 1998. "Drei Bauinschriften aus Gabii." *Arctos* 32: 27-44.
- Aldrete, G.S. 2006. *Floods of the Tiber in Ancient Rome*. Baltimore: The Johns Hopkins University Press.
- Almagia, R. 1929. "The Repopulation of the Roman Campagna." *Geographical Review* 19, 529-555.
- Almagro Basch, M. 1958. "Las excavaciones españolas en Gabii." *Cuadernos de Trabajos de la Escuela Española de Historia y Arqueología en Roma* 10:7-27.
- Almagro Gorbea, M., ed. 1982. *El Santuario de Juno en Gabii*. Biblioteca Itálica 17. Rome: Escuela Española de Historia y Arqueología en Roma.
- . 1982. "L'area del tempio di Giunone Gabina nel VI - V secolo a.C." *Archeologia laziale* 4: 297-304.
- Amici, C. 1991. *Il Foro di Cesare*. Florence: Leo S. Olschki.
- Amiri, B. 2012. "Negotiator sericarius: sur la route de la promotion sociale." *L'Antiquité Classique* 81: 125-143.
- Ammerman, A. 1990. "On the Origins of the Forum Romanum" *AJA* 94: 627-645.
- Anderson, J.C. 1984. *Historical Topography of the Imperial Fora*. Brussels: Latomus, Revue d'Etudes latines.
- Anderson, J.C. 1997. *Roman Architecture and Society*. Baltimore: The Johns Hopkins University Press.
- Ashby, T. 1902. "Classical Topography of the Roman Campagna – I." *PBSR* 1: 125-281.
- Ashby, T. 1935. *The Aqueducts of Ancient Rome*. Oxford: The Clarendon Press.
- Badian, E. 1969. "Two Roman Non-Entities." *The Classical Quarterly* 19: 198-204.
- Balance, M.H. 1951 "The Roman Bridges of the Via Flaminia." *PBSR* 19: 78-117.

- Becker, J.A. and J. Knowlin. 2011. "Orientalizing Infant Burials from Gabii, Italy." *BABesch* 86:27–39.
- Becker, J.A., M. Mogetta, and N. Terrenato. 2009. "A new plan for an ancient Italian city: Gabii Revealed." *AJA* 113: 629-42.
- Bedon, R. 1984. *Les Carrières et les Carriers de la Gaule Romaine*. Paris: Picard.
- Beeston, R.F. and H. Becker. 2013. "Investigation of Ancient Roman Pigments by Portable X-ray Fluorescence Spectroscopy and Polarized Light Microscopy." *Archaeological Chemistry* 8: 19-41.
- Bernard, S. 2012. "Continuing the Debate on Rome's Earliest Circuit Walls." *PBSR* 80: 1-44.
- Bessac, J.-C. 1988. "Influences de la conquête romaine sur le travail de la pierre en Gaule méditerranéenne." *JRA* 1: 57-72.
- Bessac, J.-C. 1993. "Traces d'outils sur la pierre : méthodes d'étude et interpretation." In *Archeologia delle attività estrattive e metallurgiche. V ciclo di lezioni sulla ricerca applicata in archeologia. Certosa di Pontignano (SI) – Campiglia Marittima (LI), 9-21 settembre 1991*, edited by R. Francovich, 143-76. Florence, Al Insegna del Giglio.
- Bessac, J.-C. 1996. *La Pierre en Gaule Narbonnaise et les Carrières du Bois des Lens (Nîmes): Histoire, Archéologie, Ethnographie, et Techniques*. *JRA Suppl.* 16.
- Bianchetti, P.L. G. Lombardi, and C. Meucci. 1982. "Study of the Degredation of "tuff" blocks used in the Roman Temple of Cibeles (Rome, Italy)." In *Proceedings of the Fourth International Congress on the Deterioration and Preservation of Stone Objects, Louisville, Kentucky, July 7-9, 1982*, edited by K.L. Gauri and J.A. Gwin, 29-38. University of Louisville.
- Bianchetti, P.L., G. Lombardi, S. Marini and C. Meucci. 1994. "The Volcanic Rocks of the Monuments of the Forum and Palatine (Rome)." In *Lavas and Volcanic Tuffs, Proceedings of the International Meeting, Easter Island, Chile, 25-31 October, 1990*, edited by A. Charola, R.J. Koestier and G. Lombardi, 83-106. Rome: ICCROM.
- Bietti Sestieri, A.M. 1979. *Ricerca su una comunità del Lazio protostorico: il sepolcreto dell'Osteria dell'Osa sulla Via Prenestina*. Rome: De Luca.
- Bietti Sestieri, A. M. 1992a. *La necropoli laziale di Osteria dell'Osa*. Three Volumes. Rome: Edizioni Quasar.
- Bietti Sestieri, A.M. 1992b. *The iron age community of Osteria dell'Osa: a study of socio-political development in central Tyrrhenian Italy*. Cambridge, Cambridge University Press.

- Bietti Sestieri, A. M., A. De Santis, and A. La Regina. 1990. "Elementi di tipo culturale e doni personali nella necropoli laziale di Osteria dell'Osa." *Scienza dell'Antichità* 3-4, 65-88.
- Black, S., J. Browning and R. Laurence. 2008. "From Quarry to Road: The Supply of Basalt for Road Paving in the Tiber Valley." In *Mercator Placidissimus: The Tiber Valley in Antiquity*, edited by F. Coarelli and H. Patterson, 705-30. Rome: Quasar.
- Blagg, T.F.C. 1990. "Building Stone in Roman Britain." In *Stone Quarrying and Building in England, AD 43-1525*, edited by D. Parsons, 33-51. Chichester: Phillimore in association with the Royal Archaeological Institute.
- Blake, M.E. 1947. *Ancient Roman Construction in Italy from the Prehistoric Period to Augustus. A chronological study based in part upon the material accumulated by the late Dr. Esther Boise Van Deman*. Washington D.C.: Carnegie Institution of Washington.
- Blake, M.E. 1959. *Roman construction in Italy from Tiberius through the Flavians*. Washington D.C.: Carnegie Institution of Washington.
- Blake, M.E., and D.T. Bishop. 1973. *Roman construction in Italy from Nerva through the Antonines*. Philadelphia: American Philosophical Society.
- Blázquez, J.M. 1958. "Terracotas del templo de Gabii." *Cuadernos de trabajos de la Escuela española de historia y arqueología en Roma* 10:83-136.
- Boari, E., Avanzinelli, R., Melluso, L., Giordano, G., Mattei, M., De Benedetti, A., Morra, V., Conticelli, S., 2009. "Isotope geochemistry (Sr–Nd–Pb) and petrogenesis of leucitebearing volcanic rocks from "Colli Albani" volcano, Roman Magmatic Province, Central Italy: inferences on volcano evolution and magma genesis." *Bulletin of Volcanology* 71: 977–1005.
- Boatwright, M.T. 1989. "Hadrian and Italian cities." *Chiron* 19: 235-71.
- Boatwright, M.T. 2000. *Hadrian and the Cities of the Roman Empire*. Princeton: Princeton University Press.
- Borsari, L. 1888. "Le Mura e Porte di Servio." *BullCom*: 12-22.
- Borsari, L. 1892. "Delle recenti scoperte relative al ponte Elio ed al sepolcro di Adriano." *NSc*: 412-428.
- Bravo, B., and M. Griffin. 1988. "Un frammento del libro XI di Tito Livio?" *Athenaeum* 66: 447–521.
- Brunt, P.A. 1980. "Free Labour and Public Works at Rome." *JRS* 70: 81-100.
- Bruun, P. 1967. "The Foedus Gabinum." *Arctos* 5:51–66.

- Bruzza, L. 1870. "Inscrizione dei marmi grezzi." *Annali dell'Istituto di Corrispondenza Archeologia* 42: 106-204.
- Buckler, W.H. 1923. "Labor Disputes in the Province of Asia." In *Anatolian Studies Presented to W. M. Ramsay*, edited by W.H. Buckler and W.M. Calder, 27-50. Manchester.
- Bülrow-Jacobsen, A. 2009. *Mons Claudianus. Ostraca graeca et latina IV. The Quarry Texts. O. Claud. 632–896*. Documents de Fouilles 47. Cairo: Institut Français d'Archéologie Orientale.
- Burford, A. 1960. "Heavy Transport in Classical Antiquity." *Econ. Hist. Rev.* 13: 1-18.
- Burford, A. 1969. *The Greek Temple Builders at Epidauros: A Social and Economic Study of Building in the Asklepien Sanctuary, during the Fourth and Early Third Centuries BC*. Liverpool: University Press.
- Camodeca, G. 2002. "I console del 43 e gli Antistii Veteres d'età Claudia dalla riedizione delle Tabula Herculenses." *ZPE* 140: 227-236.
- Campbell, J.B. 2013. *Rivers and the Power of Ancient Rome*. Chapel Hill: University of North Carolina Press.
- Camporeale, S., E. Papi and L. Passalacqua. 2008. "L'organizzazione dei cantieri edili a Volubilis (Mauretania Tingitana): iscrizione e opera pubbliche, la Maison aux deux pressoirs e l'arco di Caracalla." In *Arqueología de la Construcción I: Los Procesos Constructivos en el Mundo Romano: Italia y Provincias Occidentales (Merida, Instituto de Arqueología, 25-26 de Octubre de 2007)*, edited by Camporeale et al., 285-308. Mérida: Instituto de Arqueología.
- Canina, L. 1856. *Gli Edifizi Antichi dei Contorni di Roma Cogniti per Alcune Reliquie*. Rome.
- Canter, H.V. 1932. "Conflagrations in Ancient Rome." *The Classical Journal* 27: 270-288.
- Capannesi, G., C. Seccaroni, A.F. Sedda, V. Majerini and S. Musco. 1991. "Classification of Fifteenth- to Nineteenth-Century Mortars from Gabii Using Instrumental Neutron Activation Analysis." *Archaeometry* 33: 255-256.
- Carboni, F. 1997. *Via Prenestina: Antiche strade Lazio*. Rome: Istituto Poligrafico e Zecca dello Stato.
- Carnabuci, E. 2013. *Regia. Nuovi dati archeologici dagli appunti inediti di Giacomo Boni*. Rome: Quasar.
- Casson, L. 1965. "Harbour and River Boats of Ancient Rome." *JRS* 55: 31-39.

- Castagnoli, F. 1980. "Installazione portuali a Roma." *MAAR* 36, *The Seaborne Commerce of Ancient Rome: Studies in Archaeology and History*, 35-42.
- Casson, L. 1971. *Ships and Seamanship in the Ancient World*. Princeton: Princeton University Press.
- Charola, A.E., R.J. Koestler and G. Lombardi, eds. 1994. *Lavas and Volcanic Tuffs, Proceedings of the International Meeting, Easter Island, Chile, Oct. 25-31*. Rome: ICCROM.
- Champlin, E. 1982. "The *Suburbium* of Ancient Rome." *AJAH* 7: 97-117.
- Ciccioli, P., C. Cattuto, P. Plescia, V. Valentini and R. Negrotti. 2010. "Geochemical and Engineering Geological Properties of the Volcanic Tuffs used in the Etruscan Tombs of Norchia (Northern Latium, Italy) and a Study of the Factors Responsible for their Rapid Surface and Structural Decay." *Archaeometry* 52: 229-251.
- Cifani, G. 2008. *Architettura romana arcaica: edilizia e società tra monarchia e repubblica*. Roma: Bretschneider.
- Cifani, G. 2010. "I Grandi Cantieri della Roma Arcaica: Aspetti Tecnici ed Organizzativi." In *Arqueología de la Construcción II. Los Procesos Constructivos en el Mundo Romano: Italia y Provincias Orientales (Merida, Instituto de Arqueología, 25-26 de Octubre de 2007)*, edited by Camporeale et al., 35-50. Mérida: Instituto de Arqueología.
- Cisneros, M. 1988. *Mármoles hispanos: su empleo en la España romana*. Monografías Arqueológicas 29. Zaragoza: Departamento de Ciencias de la Antigüedad, Universidad de Zaragoza.
- Coarelli, F. 1972. "Il sepolcro degli Scipioni." *DialArch* 6: 36-106.
- Coarelli, F. 1982. "L'altare del tempio e la sua isrizione." In *El Santuario de Juno en Gabii*, edited by Almagro-Gorbea, 125-130. Biblioteca Itálica 17. Rome: Escuela Española de Historia y Arqueología en Roma.
- Coarelli, F. 2007. *Rome and Environs: An Archaeological Guide*. Berkeley: University of California Press.
- Coarelli, F. 2009. "Rilievo del Sepolcro degli Haterii con monumenti romani." In *Divus Vespasianus: Il bimillenario dei Flavi*, edited by F. Coarelli, 429. Milan: Electa.
- Coarelli, F. 2010. "Substructio et tabularium." *PBSR* 78: 107-32.
- Coarelli, F. and H. Patterson. 2008. *Mercator Placidissimus: The Tiber Valley in Antiquity. New Research in the Upper and Middle River Valley*. Rome: Quasar.

- Coelho, C. 2009. "Colaride: A Roman Quarry at the Municipium Olisponensis." In *Marmora Hispana: Explotación y Uso de los Materiales Pétreos en la Hispania Romana*, edited by T. Nogales and J. Beltrán. *Hispania Antigua, Serie Arqueológica* 2: 523-543.
- Colonna, G. 1980. "Graeco more bibere: L'iscrizione della tomba 115 dell'Osteria dell'Osa." *Archeologia Laziale* 3: 51-55.
- Colini, A.M. 1937. "Parere del Dott. Antonio M. Colini." In "Il problema archeologico del Teatro di Pompeo e il Corso del Rinascimento," by C. Galassi Paluzzi, G. Giglioli, A. Bartoli, G. Lugli, G. Marchetti Longhi, and A. Colini. *Capitolium* 12: 118-22.
- Colini, A.M. 1939. "Campidoglio." *BullGov* 200.
- Colini, A.M. 1980. "Il porto fluviale del foro boario a Roma." *MAAR* 36, *The Seaborne Commerce of Ancient Rome: Studies in Archaeology and History*, 43-53.
- Cozzi, A. and A. Pasqui. 1885. "Gabii (Agro Romano)." *NSc*: 424-28.
- Craig, C.P. 1990. "Cicero's Strategy of Embarrassment in the Speech for Plancius." *AJP* 111: 75-81.
- Cuomo, S. 2007. *Technology and Culture in Greek and Roman Antiquity*. Cambridge: Cambridge University Press.
- Cuvigny, H. 1996. "The Amount of Wages Paid to the Quarry-Workers at Mons Claudianus." *JRS* 86: 139-145.
- Davies, W. 1875. *The Pilgrimage of the Tiber*. London: Sampson Low, Marston, Low and Searle.
- Davies, J.G. 1958. "Condemnation to the Mines: A Neglected Chapter in the History of the Persecutions." *University of Birmingham Historical Journal* 6: 99-107.
- De Angelis D'Ossat, G. 1948. "Osservazioni di geologia applicata sugli scavi alla Stazione Termini di Roma." *Ingegneria Ferroviaria* 8: 443-450.
- De Casa, G., G. Giglio, G. Lombardi and M. Mariottini. 1994. "Characterization and State of Decay of the Volcanic Tuff of the Tabularium in the Roman Forum, Italy." In *Lavas and Volcanic Tuffs, Proceedings of the International Meeting, Easter Island, Chile, 25-31 October, 1990*, edited by A. Charola, R.J. Koestier and G. Lombardi, 107-128. Rome: ICCROM.
- De Casa, G., G. Lombardi, C. Meucci, R. Galloni, and P. Vitali. 1999. "Il Tufo Lionato deo Monumenti Romani: Caratteri Petrografici, Geomeccanici, e Trattamenti Conservativi." *Geologia Romana* 35: 1-25.



- Delaine, J. 1995. "The Supply of Building Materials to the City of Rome." In *Settlement and Economy in Italy 1500 BC to AD 1500*, edited by N. Christie, 555-62. Papers of the Fifth Conference in Italian Archaeology. Oxford: Oxford Monograph 41.
- Delaine, J. 1997. *The Baths of Caracalla: A Study in the Design, Construction, and Economics of Large-Scale Building Projects in Imperial Rome*. JRA Suppl. 25.
- Delaine, J. 2001. "Bricks and Mortar: Exploring the Economics of Building Techniques at Rome and Ostia." In *Economies beyond Agriculture in the Classical World*, edited by D. Mattingly and J. Salmon, 230-68. London: Routledge.
- Delaine, J. 2003. "The Builders of Roman Ostia: Organisation, Status and Society." In *Proceedings of the First International Congress on Construction History, Madrid, 20th-24th January 2003*, edited by S. Huerta, 723-32. Madrid: Juan de Herrera.
- Delbrück, R. 1907-1912. *Hellenistische Bauten im Latium*. Two volumes. Strassburg: Karl J. Trübner.
- Dennison, W. 1909. "An Incription of the Labicani Quintanenses." *AJA* 13: 125-29.
- De Rita, D., and R. Funicello.
- De Rita, D. and C. Giampaolo. 2005. "Local Volcanic Building Stones used in the Construction of Ancient Rome." In *Cultural Responses to the Volcanic Landscape: The Mediterranean and Beyond*, edited by M.S. Balmuth, D.K. Chester and P.A. Johnston, 165-84. Archaeological Institute of America, Colloquia and Conference Papers 8.
- De Rita, D. and C. Giampaolo. 2006. "A Case Study: Ancient Rome was Built with Volcanic Stone from the Roman Land." In *Tuffs – Their Properties, Uses, Hydrology, and Resources*, edited by G. Heiken, 119-26. Boulder: Geological Society of America.
- De Santis, A. 1995. "Contatti fra Etruria e Lazio antico alla fine dell'VIII secolo a.C. La tomba di guerriero di Osteria dell'Osa." In *Settlement and Economy in Italy, 15000 B.C.-A.D. 1500*, edited by N. Christie, 365-75. Papers of the Fifth Conference of Italian Archaeology. Oxford: Oxbow Books.
- Dubois, C. 1908. *Études sur l'administration et l'exploitation des carrières marbres, porphyre, granit, etc. dans le monde romain*. Thèse pour le Doctorat présentée à la Faculté des Lettres de Paris. Paris: Ancienne Librairie Thorien et Fils.
- Dubourdieu, A. 1986. "Cinctus Gabinus." *Latomus* 45: 3-20.
- Dumasy, F. 2008. "Les Pratiques Constructives du theater d'Argentomagus (Saint-Marcel, Indre)." In *Arqueología de la Construcción I: Los Procesos Constructivos en el Mundo Romano: Italia y Provincias Occidentales (Merida, Instituto de Arqueología, 25-26 de Octubre de 2007)*, edited by Camporeale et al., 141-54. Mérida: Instituto de Arqueología.

- Duncan-Jones, . 1982. *The Economy of the Roman Empire: Quantitative Studies*. Cambridge: Cambridge University Press.
- Dworakowska, A. 1983. *Quarries in Roman Provinces*. Bibliotheca Antiqua XVI.
- Erdkamp, P. 1999. "Agriculture, Underemployment, and the Cost of Rural Labour in the Roman World." *The Classical Quarterly* 49: 556-572.
- Evans, H.B. 1982. "Agrippa's Water Plan." *AJA* 86: 401-411.
- Evans, H.B. 2002. *Aqueduct Hunting in the Seventeenth Century: Raffaele Fabretti's De aquis et aquaeductibus veteris Romae*. Ann Arbor: The University of Michigan Press.
- Eubanks, J.E. 1930 "Navigation on the Tiber." *The Classical Journal* 25: 683-695.
- Fabbri, M., S. Musco, and M. Osanna. 2010. "Sur les traces des Tarquins à Gabies. Une découverte exceptionnelle." *Les Dossiers d'Archéologie* 339: 62-65.
- Fabbri, M., S. Musco, and M. Osanna. 2012. "Nouve indagini al santuario orientale di Gabii." In *Sacra Nominis Latini. I Santuari del Lazio arcaico e repubblicano. Atti del Convegno Internazionale, Roma, Palazzo Massimo, 19-21 febbraio 2009*, edited by E. Marroni, 229-242. Napoli: Loffredo Editore Napoli.
- Fabretti, R. 1680. *De aquis et aquaeductibus veteris Romae dissertationes tres*.
- Fant, J. 1988. *Ancient Marble Quarrying and Trade*. London: British Archaeological Reports International Series 453. Oxford: BAR.
- Fant, J.C. 1988. "The Roman Emperors in the Marble Business: Capitalists, Middlemen or Philanthropists?" In *Classical Marble: Geochemistry, Technology, Trade*, edited by N. Herz and M. Waelkens, 147-58. Dordrecht: Kluwer.
- Fant, J.C. 1989a. *Cavum Antrum Phrygiae: The Organization and Operations of the Roman Imperial Marble Quarries in Phrygia*. British Archaeological Reports 482. Oxford: BAR.
- Fant, J.C. 1989b. "Poikiloi lithoi: the anomalous economics of the Roman imperial marble quarry at Teos." In *The Greek Renaissance in the Roman Empire: Papers from the Tenth British Museum Colloquium*, edited by S. Walker and A. Cameron, 206–17. BICS, Supplement 55. London: University of London Institute of Classical Studies.
- Fant, J.C. 1993. "The Roman Imperial Marble Trade: A Distributional Model." In *Archeologia delle Attività Estrattive e Metallurgiche, V Ciclo di Lezioni sulla Ricerca Applicata in Archeologia, Certosa di Pontigliano (SI) – Campiglia Marittima (LI), 9-21 Settembre 1991*, edited by R. Francovich, 71-96. Florence: All'Insegna del Giglio.

- Fant, J.C. 1993. "Ideology, Gift and Trade: A Distributional Model for the Roman Imperial Marbles." In *The Inscribed Economy: production and distribution in the Roman Empire in the light of instrumentum domesticum. The proceedings of a conference held at The American Academy in Rome on 10-11 January, 1992*, edited by W. V. Harris, 145-70. JRA Suppl. 6. Ann Arbor: University of Michigan.
- Fant, J.C. 2001. "Rome's Marble Yards." *JRA* 14: 167-198.
- Fant, J.C. 2008. "Quarrying and Stoneworking." In *The Oxford Handbook of Engineering and Technology in the Ancient World*, edited by J.P. Oleson, 121-135. Oxford: Oxford University Press.
- Farney, G. 2007. *Ethnic Identity and Aristocratic Competition in Republican Rome*. Cambridge: Cambridge University Press.
- Fiorani, G. 1968. "Problemi architettonici del Foro di Cesare." *Studi topografia Romana* 5: 91-104.
- Fischer, M.L. 1998. *Marble Studies: Roman Palestine and the Marble Trade*. Konstanz: UVK Universitätsverlag Konstanz.
- Flower, H. 2006. *The Art of Forgetting: Disgrace and Oblivion in Roman Political Culture*. University of North Carolina Press.
- Forbis, E.P. 1990. "Women's Public Image in Italian Honorary Inscriptions." *AJP* 111: 493-512.
- Fortson, B.W. and D.S. Potter. 2011. "A Fragmentary Early Republican Public Inscription from Gabii." *ZPE* 178: 255-260.
- Fornaseri, M., Scherillo, A., Ventriglia, U. 1963. *La regione vulcanica dei Colli Albani: il Vulcano Laziale*. Rome: Consiglio Nazionale delle Ricerche.
- Frank, T. 1918. "Notes on the Servian Wall." *AJA* 22: 175-188.
- Frank, T. 1924. *Roman Buildings of the Republic: An Attempt to Date them from their Materials*. Papers and Monographs of the American Academy in Rome, v. 3. Rome: American Academy in Rome.
- Freda, C., M. Gaeta, D.B. Karner, F. Marra, P.R. Renne, J. Taddeucci, P. Scarlato, J. Christensen, and L. Dallai. 2006. "Eruptive history and petrologic evolution of the Albano multiple maar (Alban Hills, Central Italy)." *Bulletin of Volcanology* 68: 567-591.
- Funiciello, R. 1995. *La Geologia di Roma: Il Centro Storico*. Memorie descrittive della Carta Geologica d'Italia 50. Rome: Istituto Poligraphico e Zecco della Stato.

- Funiciello, R. and G. Giordano. 2010. *The Colli Albano Volcano*. Bath: Geological Society.
- Funiciello, R., G. Heiken, R. Levich, J. Obenholzner and V. Petrov. 2006. "Construction in Regions with Tuff Deposits." In *Tuffs – Their Properties, Uses, Hydrology, and Resources*, edited by G. Heiken, 119-26. Boulder: Geological Society of America.
- Funiciello, R., A. Praturlon, and G. Giordano. 2008. *La Geologia di Roma: dal Centro Storico alla Periferia*. Memorie descrittive della Carta Geologica d'Italia 80. Rome: Istituto Poligrafico e Zecco dello Stato.
- Gabrielli, C. 2003. "Lucius Postumius Megellus at Gabii: a new fragment of Livy." *Classical Quarterly* 53: 247-59.
- Gabrielli, C. 2012. "Moral Reflections and Sacred Constraints: About a *lucus* at Gabii." *Archiv für Religionsgeschichte* 13: 253-62.
- Gagliardo, M.C. and J.E. Packer. 2006. "A New Look at Pompey's Theater: History, Documentation, and Recent Excavations." *AJA* 110: 93-122.
- Gallone, A. 2012. "The Use of Lead in Central Italian Funerary Contexts: The New Evidence from Gabii." Paper read at the 2012 Annual Meeting of the Archaeological Institute of America, 5–8 January, Philadelphia.
- Gallone, A. and M. Mogetta. 2011. "Gabii: Indagini archeologiche nel settore meridionale della città." In *Lazio e sabina 7: Atti del Convegno Settimo Incontro di Studi sul Lazio e la Sabina, Roma, 9–11 marzo 2010*, edited by G. Ghini, 211–15. Rome: Quasar.
- Gallone, A. and M. Mogetta. 2013. "Gabii in età Repubblicana: I rivestimenti pavimentali di alcune unità abitative." In *Atti del XVIII Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico, Cremona, 14–17 marzo 2012*, edited by C. Angelelli, 717–25. Tivoli: Scripta Manent.
- Garcia-Moreno, A.G., P. Mercadal, and I. Rodà de Llanza, eds. 2012. *Interdisciplinary studies on ancient stone : proceedings of the IX Association for the Study of Marbles and Other Stones in Antiquity (ASMOSIA) Conference (Tarragona 2009)*. Tarragona: Institut Català d'Arqueologia Clàssica.
- Gazda, E. 2001. "Cosa's Contribution to the Study of Roman Hydraulic Concrete: An Historiographic Commentary." In *New Light from Ancient Cosa: Classical Mediterranean Studies in Honor of Cleo Rickman Fitch*, edited by N.W. Goldman, 145-177. New York: Lang.
- Gazda, E. 2008. "Cosa's Hydraulic Concrete: Towards a Revised Chronology." In *The Maritime World of Ancient Rome*, edited by R.L. Hohlfelder, 265-290.
- Gazzola, P. 1963. *Ponti Romani*. Two volumes. Florence: Leo S. Olschki.

- Giaccio, B., F. Marra, I. Hajdas, D.B. Karner, P.R. Renne, and A Sposato. 2009. “ $^{40}\text{Ar}/^{39}\text{Ar}$  and  $^{14}\text{C}$  geochronology of the Albano maar deposits: implications for defining the age and eruptive style of the most recent explosive activity at the Alban Hills Volcanic District, Italy.” *Journal of Volcanology and Geothermal Research* 185: 203–213.
- Gerding, H. 2002. *The Tomb of Caecilia Metella: Tumulus, Tropaeum and Thymele*. Dissertaion, Lund University.
- Gnoli, R. (1988). *Marmora Romana*. Rome: Edizioni dell'Elefante.
- Graham, S. 2005. “Of lumberjacks and brick stamps: working with the Tiber as infrastructure.” In *Roman Working Lives and Urban Living*, edited by A. Mac Mahon and J. Price, 106-124. Oxford: Oxbow Books.
- Graham, S. 2006. *Ex Figlinis: The Network Dynamics of the Tiber Valley Brick Industry in the Hinterland of Rome*. British Archaeological Reports International Series 1486. Oxford: BAR.
- Granino Cecere, M.G. 1986. “Apollo in due iscrizioni di Gabii.” In *Decima miscellanea greca e romana*, edited by U. Spigo, 265-88. Rome: Istituto Italiano per la Storia Antica.
- Grissom, C.A. 1994. “The deterioration and treatment of volcanic stone: A review of the literature.” In *Lavas and Volcanic Tuffs, Proceedings of the International Meeting, Easter Island, Chile, 25-31 October, 1990*, edited by A. Charola, R.J. Koestier and G. Lombardi, 3-29. Rome: ICCROM.
- Guaitoli, M. 1981a. “Gabii.” *PP* 36: 152-73.
- Guaitoli, M. 1981b. “Gabii. Osservazioni sulle fasi di sviluppo dell’abitato,” in *Ricognizione archeologica. Nuove ricerche nel Lazio*, 23-57. QuadIstTopA 9. Florence: Leo S. Olschki.
- Gustafson, M. 1994. “Condemnation to the Mines in the Later Roman Empire.” *Harvard Theological Review* 87: 421-433.
- Hamilton, S., M.S. Thomas, and R. Whitehouse. 2011. “Say it with stone: constructing with stones on Easter Island.” *World Archaeology* 43: 167-190.
- Harris, W.V. 2013. “Defining and Detecting Mediterranean Deforestation, 800 BCE to 700 CE.” In *The Ancient Mediterranean Environment between Science and History*, edited by W.V. Harris, 173-194. Boston: Brill.
- Hayward, K.M.J. 2009. *Roman Quarrying and Stone Supply on the Periphery – Southern England: A Geological Study of First-Century Funerary Monuments and Monumental Architecture*. British Archaeological Reports 500. Oxford: BAR.

- Heiken, G., ed. 2006. *Tuffs – Their Properties, Uses, Hydrology, and Resources*. Geological Society of America Special Paper no. 408. Boulder: Geological Society of America.
- Heiken, G., R. Funicello and D. de Rita. 2005. *The Seven Hills of Rome: A Geological Tour of the Eternal City*. Princeton: Princeton University Press.
- Herz, N. and M. Waelkens, eds. 1988. *Classical Marble: Geochemistry, Technology, Trade*. Dordrecht: Kluwer.
- Hirt, A.M. 2010. *Imperial Mines and Quarries in the Roman World*. Oxford: Oxford University Press.
- Holland, L. 1949. “Forerunners and Rivals of The Primitive Roman Bridge.” *TAPA* 80: 281-319.
- Holland, L. 1955. Review of *Le Tibre, fleuve de Rome, dans l'antiquité* and *Recherches sur le culte du tibre*, by Joel Le Gall. *American Journal of Archaeology* 59: 85-86.
- Holland, L.A. and L.B. Holland. 1950. “Down the Tiber on a Raft.” *Archaeology* 3: 87-94.
- Holloway, R.R. 1994. *The Archeology of Early Rome and Latium*. London: Routledge.
- Hopkins 2007 “The Cloaca Maxima and the Monumental Manipulation of Water in Archaic Rome.” In *The Waters of Rome No. 4*, edited by K. W. Rinne, 1-15. Charlottesville: Institute for Advanced Technology in the Humanities, University of Virginia.
- Hughes, J.D. 1983. “How the Ancients Viewed Deforestation.” *Journal of Field Archaeology* 10: 435-45.
- Hughes, J.D. 2011. “Ancient Deforestation Revisited.” *Journal of the History of Biology* 44: 43-57.
- Hughes, J.D., and J.V. Thirgood. 1982. “Deforestation, Erosion, and Forest Management in Ancient Greece and Rome.” *Journal of Forest History* 26: 60-75.
- Isager, J. 1991. *Pliny on Art and Society*. New York: Routledge.
- Jackson, M.C., and C. Kosso. 2013. “Scientia in Republican Era Stone and Concrete Masonry.” In *A Companion to the Archaeology of the Roman Republic*, edited by J. D. Evans, 268-84. Oxford: Blackwell.
- Jackson, M., C. Kosso, F. Marra and R. Hay. 2006. “Geological Basis of Vitruvius’ Empirical Observations of Material Characteristics of Rock Utilized in Roman Masonry.” In *Proceedings of the Second International Congress of Construction History*, edited by M. Dunkeld, J. Campbell, F. Louw, M. Tutton, B. Addis and R. Thorne, 1685-702. London: The Construction History Society.

- Jackson, M.D., F. Marra, R.L. Hay, C. Cawood and E.M. Winkler. 2005. "The Judicious Selection and Preservation of Tuff and Travertine Building Stone in Ancient Rome." *Archaeometry* 47: 485-510.
- Jackson, M. and F. Marra. 2006. "Roman Stone Masonry: Volcanic Foundations of the Ancient City." *AJA* 110: 403-36.
- Kahane, A.M., and J. Ward-Perkins. 1972. "The Via Gabina." *PBSR* 40: 91-126.
- Kahane, A.M. 1973. "The paved Roman road east from Gabii." *PBSR* 41:18-44.
- Karner, D.B., L. Lombardi, F. Marra, P. Fortini and P.R. Renne. 2001a. "Age of Ancient Monuments by Means of Building Stone Provenance: a Case Study of the Tullianum, Rome, Italy." *Journal of Archaeological Science* 28: 387-393.
- Karner, D.B., F. Marra, and P. Renne. 2001b. "The history of the Monti Sabatini and Alban Hills volcanoes: groundwork for assessing volcanic-tectonic hazards for Rome." *Journal of Volcanology and Geothermal Research* 107: 185-219.
- Karner, D. B., and P.R. Renne. 1998. "40Ar/39Ar geochronology of Roman volcanic province Tephra in the Tiber River Valley: Age calibration of Middle Pleistocene sea-level changes." *Geological Society of America Bulletin* 110: 740-747.
- Kay, S. 2013. "Geophysical Survey of the City of Gabii, Italy." In *Archaeological Survey and the City, University of Cambridge Museum of Classical Archaeology Monograph no.2*, edited by P.Johnson and M.Millett, 283-302. Oxford: Oxbow.
- Keay, S. 1998. "The Development of Towns in Early Roman Baetica." In *The Archaeology of Early Roman Baetica*, JRA Suppl. 29.
- Kendal, R. 1996. "Transport Logistics Associated with the Building of Hadrian's Wall." *Britannia* 27: 129-152.
- Kolaiti, E. and L.G. Mendoni. 1992. "The Relationship between a Quarrying Site and a City-Center: The Case of the Ancient City of Karthaia, Keos Island, Greece." In *Ancient Stones: Quarrying, Trade and Provenance*, edited by M. Waelkens, N. Herz and L. Moens, 29-36. Leuven: Leuven University Press.
- Kolb 1995. *Rom: Die Geschichte der Stadt in der Antike*. Munich: Beck.
- Kozelj, T. 1988. "Extraction of Blocks in Antiquity: Special Methods of Analysis." In *Classical Marble: Geochemistry, Technology, Trade*, edited by N. Herz and M. Waelkens, 31-40. Dordrecht: Kluwer.

- Kozelj, T., and M.W. Kozelj. 1993. "Les Transports dans l'Antiquité." In *Archeologia delle Attività Estrattive e Metallurgiche, V Ciclo di Lezioni sulla Ricerca Applicata in Archeologia, Certosa di Pontigliano (SI) – Campiglia Marittima (LI), 9-21 Settembre 1991*, edited by R. Francovich, 97-142. Florence: All'Insegna del Giglio.
- Lambraki, A. 1978. "Les roches vertes. Étude sur les marbres de la Grèce exploités aux époques romaine et paléochrétienne." Unpublished Thèse de Troisième Cycle, Université de Paris I - Pantheon-Sorbonne.
- Lancaster, L. 1999. "Building Trajan's Column." *AJA* 103: 419-439.
- Lancaster, L. 2005a. *Concrete Vaulted Construction in Rome: Innovations in Context*. Cambridge: Cambridge University Press.
- Lancaster, L. 2005b. "The Process of Building the Colosseum." *JRA* 18: 57-82.
- Lancaster, L., G. Sottili, F. Marra, and G. Ventura. "Provenancing of Light Weight Volcanic Stones Used in Ancient Roman Concrete Vaulting: Evidence from Turkey and Tunisia." *Archaeometry* 52: 949-61.
- Lancaster, L.C., Sottili, G., Marra, F., Ventura G., 2011. "Provenancing of Light Weight Volcanic Stones Used in Ancient Roman Concrete Vaulting: Evidence from Rome." *Archaeometry* 53: 707-727.
- Lanciani, R. 1874. "Delle principali scoperte avvenute nella prima zona del nuova quartiere Esquilino (con due incisioni nel testo)." *BullCom* 2: 195-223.
- Lanciani, R. 1880. *Topografia di Roma antica. I comentarii de Frontino intorno le acque e gli aquedotti. Silloge epigrafica aquaria memoria*. Rome: Coi tipi del Salviuci.
- Lanciani, R. 1890. *NSc*: 11.
- Lanciani, R. 1897. *The Ruins and Excavations of Ancient Rome*. Boston, Houghton Mifflin.
- Lanciani, R. 1901. *New Tales of Old Rome*. London: Macmillan.
- Lanciani, R. 1918. "Delle scoperte di antichità avvenute nelle fondazioni degli edifici per le Ferrovie di Stato nella già Villa Patrizi in Via Nomentana." *Rivista Tecnica delle Ferrovie Italiane* 14, 118: 3-36.
- Lanciani, R. and Visconti. 1872. "Delle scoperte avvenute nel nuovo quartiere detto del Castro Pretorio nella estate del 1872." *BullCom*: 5-20.
- Landels, J.G. 1978. *Engineering in the Ancient World*. Berkeley: University of California Press.



- Laurence, R. 1998. "Land Transport in Roman Italy: costs, practice and the economy." In *Trade, Traders, and the Ancient City*, edited by H. Parkins and C. Smith, 129-48. London: Routledge.
- Laurene, R. 1999. *The Roads of Roman Italy: Mobility and Cultural Change*. London: Routledge.
- Laurence, R. 2004. "The Economic Exploitation of Geological Resources in the Tiber Valley: Road Building." In *Bridging the Tiber: Approaches to Regional Archaeology in the Middle Tiber Valley*, edited by H. Patterson, 285-95. Archaeological Monograph of the British School at Rome, 13. London: British School at Rome.
- Laurence, R. 2013. "Roads and Bridges." In *A Companion to the Archaeology of the Roman Republic*, edited by J. DeRose Evans, 296-308. Oxford: Wiley-Blackwell.
- Lawrie, H.N. 1914. "Essential to Oregon's Development." *The Mineral Resources of Oregon 1*: 3-46. Oregon Bureau of Mines and Geology.
- Le Gall, M. 1953. *Le Tibre, Fleuve de Rome, dans L'Antiquité*. Paris: L'Institute d'Art et d'Archéologie de l'Université de Paris.
- Le Glay, M. 1985. "Les Oppii de Praeneste à Gabies." *ZPE* 58: 204-6.
- Ling, R. 1985. "The Mechanics of the Building Trade." In *Roman Urban Topography in Britain and the Western Empire*, edited by F. Grew and B. Hobley, 14-27. CBA Research Report 59.
- Lo Cascio, E. 2007. "The Early Roman Empire: The State and the Economy." In *The Cambridge Economic History of the Greco-Roman World*, edited by W. Scheidel, I. Morris, and R. Saller, 619-647. Cambridge: Cambridge University Press.
- Locardi, E., G. Lombardi, R. Funicello, and M. Parotto. 1977. "The main volcanic groups of Latium (Italy): Relations between structural evolution and petrogenesis." *Geologia Romana* 16: 279-300.
- Lombardi, G., and C. Meucci. 2006. "Il Tufo Giallo della Via Tiberina (Roma) utilizzato nei monumenti romani." *Rend Fis. Acc. Lincei* 17: 263-287.
- Long, Leah. *Urbanism, Art, and Economy: The Marble Quarrying Industries of Aphrodisias and Roman Asia Minor*. PhD Dissertation, University of Michigan.
- Lugli, G. 1957. *La tecnica edilizia romana: con particolare riguardo a Roma e Lazio*. Rome: G. Bardi.
- Maischberger, M. 1997. *Marmor in Rom: Anlieferung, Lager- und Werkplaitzien der Kaiserzeit*. Wiesbaden: Reichert.

- Majarini, V. and S. Musco. 2001. "Gabii. Indagini archeologiche: area urbana, area della chiesa di S. Primitivo e area del santuario extraurbano orientale." In *Archeologia e Giubileo: gli interventi a Roma e nel Lazio nel Piano per il Grande Giubileo del 2000*, edited by F. Filippi, 490-99. Naples: Electa Napoli.
- Mancini, G. 1912. "Nuove coperte nella città e nel suburbia." *NSc*: 264-72.
- Mancini, A. and C. Pilo. 2006. "Materiali votivi ed oggetti rituali dal Santuario Orientale di Gabii." *Siris* 7: 85-126.
- Maniatis, Y., N. Herz and Y. Basiakos. 1995. *The Study of Marble and Other Stones used in Antiquity*. ASMOSIA III. London: Archetype.
- Marc, J.-Y. 1995. "Who owned the marble quarries of Thasos in the Imperial Period?" In *The Study of Marble and Other Stones used in Antiquity*, edited by Y. Maniatis, N. Herz and Y. Basiakos, 33-8. ASMOSIA III. London: Archetype.
- Mari, Z. 1986. "Gabii." In *Thomas Ashby: Un archeologo fotografa la campagna romana tra '800 e '900*, 102-06. British School at Rome Archive 1. Rome: DeLuca.
- Marra, F., D. Deocampo, M.D. Jackson, and G. Ventura. 2011. "The Alban Hills and Monti Sabatini volcanic products used in ancient Roman masonry (Italy): An integrated stratigraphic, archaeological, environmental and geochemical approach." *Earth-Science Reviews* 108: 115–136.
- Marra, F., C. Freda, P. Scarlato, J. Taddeucci, D.B. Karner, P.R. Renne, M. Gaeta, D.M. Palladino, R. Trigila, and G. Cavarretta. 2003. "40Ar/39Ar Geochronology of the recent phase of activity of the Alban Hills Volcanic District (Rome, Italy): implications for seismic and volcanic hazards." *Bulletin of Volcanology* 65: 227–247.
- Marra, F., D.B. Karner, C. Freda, M. Gaeta, and P.R. Renne. 2009. "Large mafic eruptions at the Alban Hills Volcanic District (Central Italy): chronostratigraphy, petrography and eruptive behavior." *Journal of Volcanology and Geothermal Research* 179: 217–232.
- Marra, F., C. Freda, P. Scarlato, J. Taddeucci, D.B. Karner, P.R. Renne, M. Gaeta, D.M. Palladino, R. Trigila, and G. Cavarretta. 2003. "The post-caldera phase of activity in the Alban Hills Volcanic District (Italy): 40Ar/39Ar geochronology and insights into magma evolution." *Bulletin of Volcanology* 65: 227–247.
- Marra, F., and Rosa. 1995. "Stratigrafia e assetto geologico dell'area romana." In *La Geologia di Roma. Il Centro Storico: Memorie Descrittive della Carta Geologica d'Italia*, edited by R. Funicello, 49-118. Rome: Ist. Poligrafico e Zecca dello Stato.

- Marzano, A. 2007. *Roman Villas in Central Italy: A Social and Economic History*. New York, Brill.
- Mattingly, D. 2010. *Imperialism, Power and Identity: Experiencing the Roman Empire*. Princeton, Princeton University Press.
- Mattingly, D. and J. Salmon. 2001. "The Productive Past: Economies beyond Agriculture." In *Economies beyond Agriculture in the Classical World*, edited by D.J. Mattingly and J. Salmon, 3-14. London: Routledge.
- Maxfield, V. and D. Peacock. 1997. *Mons Claudianus : survey and excavation, 1987-1993*. Cairo: Institut français d'archéologie orientale.
- Maxfield, V. and D. Peacock. 2001. *The Roman Imperial Quarries: Survey and Excavation at Mons Porphyrites, 1994-1998*. London: Egypt Exploration Society.
- Mayer, M. and I. Rodà. 1998. "The Use of Marble and Decorative Stone in Roman Baetica." In *The Archaeology of Early Roman Baetica*, edited by S. Keay, 217-34. JRA Suppl. 29.
- McCallum, M. 2010. "The Supply of Stone to the City of Rome: A Case Study of the Transport of Anician Building Stone and Millstone from the Santa Trinità Quarry (Orvieto)." In *Trade and Exchange: Archaeological Studies from History and Prehistory*, edited by C.D. Dillian and C.L. White, 75-94. New York: Springer.
- Meiggs, R. 1980. "Sea-Borne Timber Supplies to Rome." *MAAR 36, The Seaborne Commerce of Ancient Rome: Studies in Archaeology and History*, 185-196.
- Meiggs, R. 1983. *Trees and Timber in the Ancient World*. Oxford: Oxford University Press.
- Millar, F. 1984. "Condemnation to Hard Labour in the Roman Empire, From the Julio-Claudians to Constantine." *PBSR 52*: 124-47.
- Minieri, L. 1988. "Una Mancata 'adlectio inter gentes patricias': Il Caso degli Antisti." *Ricerche sulla Organizzaziione Gentilizia Romana 2*: 213-241.
- Mogetta, M. 2014. "From Latin Planned Urbanism to Roman Colonial Layouts: The Town-Planning of Gabii and Its Cultural Implications." In *Papers on Italian Urbanism in the First Millennium B.C.*, edited by E.C. Robinson, 145-74. JRA Suppl. 97. Portsmouth, R.I.: Journal of Roman Archaeology.
- Mogetta, M. and J.A. Becker. 2014. "Archaeological Research at Gabii, Italy: The Gabii Project Excavations, 2009–2011." *AJA 118*: 171-188.
- Moir, K. M. 1986. "The Epitaph of Publius Scipio". *The Classical Quarterly 36*: 264–266.
- Molisani, G. 1971. "Lucius Cornelius Quinti Catuli Architectus." *RendLinc 26*: 1-10.

- Montero Herrero, S. 1981. "Gabii a través del foedus Gabinum." *Cuadernos de trabajos de la Escuela española de historia y arqueología en Roma* 15: 9-16.
- Morley, N. 1996. *Metropolis and Hinterland: The city of Rome and the Italian Economy 200 B.C.-A.D. 200*. Cambridge: Cambridge University Press.
- Murgatroyd, P. 2005. *Mythical and Legendary Narrative in Ovid's Fasti*. Mnemosyne Suppl. 263. Leiden: Brill.
- Musco, S., C. Morelli and M. Brucchiotti. 1997. "Ager Gabinus: note di topografia storica." *Archeologia Laziale* 12: 275-92.
- Narcisi, B., Anselmi, B., Catalano, F., Dai Pra, G. & Magri, G. 1992. "Lithostratigraphy of the 250,000 year record of lacustrine sediments from Valle di Castiglione crater, Rome." *Quaternary Science Reviews* 11: 353–362.
- Narducci, P. 1881. *Bullettino dell' Instituto di Corrispondenza Archeologica*, 209-210.
- Narducci, P. 1889. *Sulla fognatura della città di Roma; descrizione tecnica*. Roma: Forzani.
- Nijland, T.G., S. Brendle, R.P.J. van Hees, and G.-J.L.M. de Haas. 2003. "Decay of Rhenish Tuff in Dutch Monuments. Part 1: Use, Composition, and Weathering." *Heron* 48: 149-66.
- Nogales, T. and J. Beltrán, eds. 2008. *Marmora Hispana: explotación y uso de los materiales pétreos en la Hispania Romana*. Hispania Antigua, Serie Arqueológica 2.
- Nogales, T., J.L. de la Barrera and P. Lapuente. 1995. "Marbles and other Stones used in Augusta Emerita, Hispania." In *Archéomatériaux: Marbres et autres roches, Actes de la IVème Conférence Internationale de l'Association pour l'Etude des Marbres et Autres Roches Utilisés dans le Passé (ASMOSIA IV)*, edited by M. Schvoerer, 339-351. Bordeaux: Centre de Recherche en Physique Appliquée à l'Archéologie, Université Michel de Montaigne.
- O'Connor, C. 1993. *Roman Bridges*. Cambridge: Cambridge University Press.
- Ogilvie, R.M. 1965. *A Commentary on Livy Bks. I-V*. Oxford, Oxford University Press.
- Osborne, R. 1987. *Classical Landscape with Figures: The Ancient Greek City and its Countryside*. London : George Philip.
- Ozkahraman, H.T. and A. Bolatturk. 2006. "The use of tuff stone cladding in buildings for energy conservation." *Construction and Building Materials* 20, 435–440.

- Packer, J., J. Burge and M.C. Gagliardo. 2007. "Looking Again at Pompey's Theater: The 2005 Excavation Season." *AJA* 111 (3), 505-522.
- Palmer, R. E. A. 1990. "A new Fragment of Livy throws Light on the Roman Postumii and Latin Gabii." *Athenaeum* 78: 5-18.
- Pasqui, 1912. "Nuove scoperte nella città e nel suburbia." *NSc*: 195-202.
- Patterson, J.R. 2006. *Landscapes and Cities: Rural Settlement and Civic Transformation in Early Imperial Italy*. Oxford: Oxford University Press.
- Patterson, J.R. 2008. "Modelling the Urban History of the Tiber Valley in the Imperial Period." In F. Coarelli and H. Patterson, eds., *Mercator Placidissimus: The Tiber Valley in Antiquity*. Quaderni di Eutopia 8. Rome: 487-498.
- Paton, S. and R.M. Schneider. 1999. "Imperial Splendour in the Province: Imported Marble on Roman Crete." In A. Chaniotis, ed., *From Minoan Farmers to Roman Traders: Sidelights on the Economy of Ancient Crete*. 279-304.
- Peacock, D.P.S. 1993. "Mons Claudianus and the Problem of the 'Granito del Foro'." In *Archeologia delle Attività Estrattive e Metallurgiche, V Ciclo di Lezioni sulla Ricerca Applicata in Archeologia, Certosa di Pontigliano (SI) – Campiglia Marittima (LI), 9-21 Settembre 1991*, edited by R. Francovich, 49-70. Florence: All'Insegna del Giglio.
- Peacock, D.P.S and V.A. Maxfield. 1997. *Mons Claudianus, Survey and Excavation I: Topography and the Quarries*. Cairo: Institut francais d'archeologie orientale.
- Peacock, D.P.S. and D.F. Williams. 1995. "Ornamental Coloured Marble in Roman Britain: An Interim Report." In *Archéomatériaux: Marbres et autres roches, Actes de la IVème Conférence Internationale de l'Association pour l'Etude des Marbres et Autres Roches Utilisés dans le Passé (ASMOSIA IV)*, edited by M. Schvoerer, 353-357. Bordeaux: Centre de Recherche en Physique Appliquée à l'Archéologie, Université Michel de Montaigne.
- Pearson, A. 2006. *The Work of Giants: Stone and Quarrying in Roman Britain*. Stroud: Tempus.
- Pegoretti, G. 1869. *Manuale pratico per l'estimazione dei Lavori Architettonici, Stradali, Idraulici e di Fortificazione, per uso degli ingegneri ed architetti*. 2nd Revised Edition. Milan: A. Cantalupi.
- Peña, J.T. 1989. "P. Giss. 69: Evidence for the Supplying of Stone Transport Operations in Roman Egypt and the Production of Fifty-foot Monolithic Column Shafts." *JRA* 2: 126-32.
- Pensabene, P., R. Mar and R. Cebrián. 2012. "Funding of public buildings and calculation of the costs of the stone materials. The case of the Forum of Segobriga (Cuenca, Spain)." In

*Interdisciplinary studies on ancient stone : proceedings of the IX Association for the Study of Marbles and Other Stones in Antiquity (ASMOSIA) Conference (Tarragona 2009)*, edited by A.G. Garcia-Moreno et al., 161-175. Tarragona: Institut Català d'Arqueologia Clàssica

Peruzzi, E. 1992. "Cultura Graeca a Gabii nel Secolo VIII." *PP* 47: 459-468.

Peruzzi, E. 1995. "Grecità di Gabii." *PP* 50: 81-90.

Piccarreta, F. 1981. "Saggi di restituzione e interpretazione di fotografie aeree", in *Ricognizione archeologica: nuove ricerche nel Lazio*, 13-21. QuadIstTopA 9. Florence: Leo S Olschki.

Piccarreta, F. 1987. *Manuale di Fotografia Aerea: Uso Archeologico*. Studio Archaeologica 42. Rome: Bretschneider.

Pinza, G. 1903. "Gabii ed i suoi monumenti." *BullCom* 31: 321-50.

Pitzl, G. 2004. *Encyclopedia of Human Geography*. Westport: Greenwood Press.

Pollard, M., C. Batt, B. Stern, and S.M.M. Young. 2007. *Analytical chemistry in archaeology*. Cambridge: Cambridge University Press.

Potter, T.W. 1984. "A Republican Healing Sanctuary at Ponte di Nona near Rome and the Classical Tradition of Votive Medicine." *Journal of the British Archaeological Association* 138: 23-47.

Potter, T.W. 1989. *Una stipe votiva da Ponte di Nona*. Roma: De Luca Edizioni d'Arte.

Porter, M.W. 1907. *What Rome was built with: a description of the stones employed in ancient times for its building and decoration*. London: Henry Frowde.

Prisset, J.L. 2008. "Les besoins en matériaux, les contraintes d'approvisionnement et la durée d'un chantier de construction. Réflexions à partir du Portique Nord de Saint-Romain-en-Gal (France)." In *Arqueología de la Construcción I: Los Procesos Constructivos en el Mundo Romano: Italia y Provincias Occidentales* (Merida, Instituto de Arqueología, 25-26 de Octubre de 2007), edited by Camporeale et al., 125-140. Mérida: Instituto de Arqueología.

Purcell, N. 1993. "Atrium Libertatis." *PBSR* 61: 125-55.

Quilici Gigli, S., ed. 1986. *Il Tevere e le altre vie d'acqua del Lazio antico (Archeologia Laziale VII, 2)*. Rome.

Quilici, L. and S. Quilici Gigli. 1986. *Fidenae. Latium Vetus V*. Rome: Consiglio Nazionale delle Ricerche.

- Quilici, L. and S. Quilici Gigli. 1991. *Tusculum ed il parco archeologico*. Rome: XI Comunità Montana del Lazio "Castelli romani e prenestini".
- Quilici, L. 1969. *Urbanistica* liv-lv; i-xx.
- Quilici, L. 1974. *Collatia*. Forma Italiae Regio 1, 10.
- Quilici, L. 1986. "Il Tevere e l'Aniene come vie d'acqua a monti di Roma in età imperial." In *Il Tevere e le altre vie d'acqua del Lazio antico (Archeologia Laziale VII, 2)*, edited by S. Quilici Gigli. Rome.
- Taylor, R. 2003. *Roman Builders: A Study in Architectural Process*. Cambridge: Cambridge University Press.
- Quilici, L. 1988. "La posa del nuovo acquedotto Marcio attraverso la zona archeologica di Gabii." *Archeologia Laziale* 9:140-60.
- Reynolds, J. 1996. "Honouring Benefactors at Aphrodisias: A New Inscription." In *Aphrodisias Papers 3. The setting and quarries, mythological and other sculptural decoration, architectural development, Portico of Tiberius, and Tetracylon*, edited by C. Roueché and R. R. R. Smith, 121-6. JRA Suppl. Series 20. Ann Arbor: University of Michigan.
- Ricci, C. and M.G. Granino Cecere. 2006. "Dalle sponde del Reno a quelle dell'Aniene: Marinai e navigazione fluviale." *ZPE* 157: 237-246.
- Richards, C., K. Croucher, T. Paoa, T. Parish, E. Tucki, M., and K. Welham. 2011. "Road my body goes: re-creating ancestors from stone at the great moai quarry of Rano Raraku, Rapa Nui (Easter Island)." *World Archaeology* 43: 191-210.
- Ridgeway, D. "Phoenicians and Greeks in the West: a view from Pithekoussai." In *The Archeology of Greek Colonisation. Essays Dedicated to Sir John Boardman*, edited by G. R. Tsetschladze and F. de Angelis, 35-46. Oxford: Oxford University School of Archaeology.
- Rihll, T.E. "Making Money in Classical Athens." In *Economies beyond Agriculture in the Classical World*, edited by D.J. Mattingly and J. Salmon, 115-142. London: Routledge.
- Robinson, O.F. 1992. *Ancient Rome: City Planning and Administration*. London: Routledge.
- Rockwell, P. 1993. *The art of stoneworking : a reference guide*. Cambridge: Cambridge University Press.
- Rockwell, P. 1993. "Tools in Ancient Marble Sculpture." In *Archeologia delle Attività Estrattive e Metallurgiche, V Ciclo di Lezioni sulla Ricerca Applicata in Archeologia, Certosa di*

*Pontigliano (SI) – Campiglia Marittima (LI), 9-21 Settembre 1991*, edited by R. Francovich, 177-194. Florence: All’Insegna del Giglio.

- Rockwell, P. 1990. “Stone-carving tools: a stone-carver's view.” *JRA* 3: 351-357.
- Röder, J. 1993. “Die Steinbrüche des Numidischen Marmors von Chemtou.” In *Simitthus I. Die Steinbrüche und die antike Stadt*, edited by F. Rakob, 17-54. Mainz am Rhein: Philipp von Zabern.
- Rosa, P. 1861. “Dissotteramenti ottenuti pei lavori della via ferrata di Civitavecchil.” *BdI*: 74.
- Russell, B. 2008. “The dynamics of stone transport between the Roman Mediterranean and its hinterland.” *Facta: A Journal of Roman Material Culture Studies* 2: 107-126.
- Russell, B. 2009. *Sculpted stone and the Roman economy: 100 BC – AD 300*. Ph.D. Dissertation, University of Oxford.
- Russell, B. 2013. *The Economics of the Roman Stone Trade*. Oxford: Oxford University Press.
- Säflund, G. 1932. *Le Mura di Roma Republicanana*. Skrifter utgivna av svenska Institutet i Rom, Vol. 1. Oxford University Press.
- Sallares, R. 2002. *Malaria and Rome: A History of Malaria in Ancient Italy*. New York: Oxford University Press.
- Sappa, G., G. Giglio and G. de Casa. 1995. “Mechanical Characteristics of some Volcanic Tuffs Used in the Buildings of Ancient Rome.” *Materials Research Society Symposia Proceedings* 352: 733-743.
- Schaff, H. 2000. “Antike Tuffbergwerke in der Pellenz.” In *Steinbruch und Berwerk: Denkmäler Römischer Technikgeschichte zwischen Eifel und Rhein*, 17-30. Mainz: Verlag des Römisch-Germanischen Zentralmuseums Mainz.
- Schaaff, H. 2011. “Ein Altes Bergwerk und ein Experiment – Zur Antiken und Mittelalterlichen Technik der Tuffsteingewinnung.” *Archäologisches Korrespondenzblatt* 41: 531-542.
- Sidebotham, S.E., H. Barnard, J.A. Harrell and R.S. Tomber. 2001. “The Roman Quarry and Installations in Wadi Umm Wikala and Wadi Semna.” *Journal of Egyptian Archaeology* 87: 135-170.
- Slater, W.J. 2000. “Handouts at Dinner.” *Phoenix* 54: 107-122.
- Smith, A.H. 1901. “Gavin Hamilton’s Letters to Charles Townley.” *JHS* 21: 306-21.
- Smith, G.O. 1914. *Mineral Resources of the United States. Calendar Year 1913. Part II: Non-Metals*. Washington D.C.: Government Printing Office.



- Smith, S. 1877. *The Tiber and its Tributaries*. London: Longmans, Green, and Co.
- Smith, C.J. 2006. *The Roman Clan: The gens from Ancient Ideology to Modern Anthropology*. Cambridge: Cambridge University Press.
- Solimini, A.G., A. Benvenuti, R. D'Olimpio, M. De Cicco, and G. Carchini. 2001. "Size structure of benthic invertebrate assemblages in a Mediterranean river." *Journal of the North American Benthological Society* 20: 421-431.
- Sommella, P. 1968. "Area Sacra di S. Omobono. Contributo per una Datazione della Platea dei Templi Gemelli." *QuadIstTopA* 5: 63-70.
- Sonck-Koota, P.A., Lindroos, J.-O., Lill, J., Rajander, E.-M., Viitanen, F., Marra, M.H., Pehkonen, J., Suksi, Heselius, S.-J., 2008. "External-beam PIXE characterization of volcanic material used in ancient Roman mortars." *Nuclear Instruments and Methods in Physics Research, Section B, Beam Interaction with Materials and Atoms*.
- Sottili, G., D.M. Palladino, F. Marra, B. Jicha, D.B. Karner, P. Renne. 2010. "Geochronology of the most recent activity in the Sabatini Volcanic District, Roman Province, central Italy." *Journal of Volcanology and Geothermal Research* 196: 20–30.
- Sottili, G., Palladino, D.M., Zanon, V. 2004. "Plinian activity during the early eruptive history of the Sabatini Volcanic District, Central Italy." *Journal of Volcanology and Geothermal Research* 135: 361–379.
- Stewart, R. 2012. *Plautus and Roman Slavery*. Malden: Wiley-Blackwell.
- Tatum, J. and K.M. Moir. 1988. "The Epitaph of Publius Scipio Reconsidered." *The Classical Quarterly* 38: 253-259.
- Terrenato, N. P. Brocato, G. Caruso, A.M. Ramieri, H.W. Becker, I. Cangemi, G. Mantiloni, and C. Regoli. 2012. "The S. Omobono Sanctuary in Rome: Assessing eighty years of fieldwork and exploring perspectives for the future." *Internet Archaeology* 31.
- Terrenato, N., A. Gallone, J.A. Becker and S. Kay. 2010. "Urbanistica ortogonale a Gabii: Risultati delle nuove prospezioni geofisiche e prospettive per il future." *Lazio e Sabina* 6: 237-248.
- Thirgood, J.V. 1981. *Man and the Mediterranean Forest: A History of Resource Depletion*. London: Academic Press.
- Thomas, E. and C. Witschel. 1992. "Constructing Reconstruction: Claim and Reality of Roman Rebuilding Inscriptions from the Latin West." *PBSR* 60: 135-177.

- Thomas, R. and A. Wilson. 1994. "Water Supply for Roman Farms in Latium and South Etruria." *PBSR* 62: 139-196.
- Thornton, M.K., and R.L. Thornton. 1989. *Julio-Claudian Building Programs: A Quantitative Study in Political Management*. Bolchazy-Carducci.
- Tomassetti, G. 1897. "Via Frascati – Avanzi di sontuoso suburban scoperti in contrada Prata Porci." *NSc*: 458-59.
- Tomassetti, G. 1899. "Notizie Epigrafiche." *BullCom*: 280-293.
- Treggiari, S. 1980. "Urban Labor in Rome: mercennarii and tabernarii." In *Non-Slave Labour in the Greco-Roman World*, edited by P. Garnsey, 48-64. *CambPhilSoc Suppl.* 6. Cambridge: Cambridge Philological Society.
- Tucci, P.L. 2005. "'Where high Moneta leads her steps sublime'. The 'Tabularium' and the Temple of Iuno Moneta." *JRA* 18: 6-33.
- Türkmenoğlu, A.G., E.H. Göktürk, and E.N. Caner. 1991. "The Deterioration of Tuffs from the Cappadocia Region of Turkey." *Archeometry* 33: 231-238.
- Ulrich, R.B. 1993. "Julius Caesar and the Creation of the Forum Iulium." *AJA* 97: 49-80.
- Van Deman, E. 1934. *The Building of the Roman Aqueducts*. Washington D.C.: Carnegie Institute.
- Várhelyi, Z. 2010. *The Religion of Senators in the Roman Empire: Power and the Beyond*. New York: Cambridge University Press.
- Varner, E.R. 1995. "Domitia Longina and the Politics of Portraiture." *AJA* 99: 187-206.
- Veal, R. 2013. "Fuelling Ancient Mediterranean Cities: A Framework for Charcoal Research." In *The Ancient Mediterranean Environment between Science and History*, edited by W.V. Harris, 37-60. Boston: Brill.
- Vegas, M. 1968. "Römische Keramik von Gabii (Latium)." *Bonner Jahrbücher* 168: 33-165.
- Ventriglia, U. 1971. *La geologia de la città di Roma*. Rome: Bardi.
- Vinchesi, M.A. 1990. "Notizia su un probabile frammento di Tito Livio." *Atene e Roma* 35: 176-82.
- Visconti, E.Q. 1797. *Monumenti Gabini della Villa Pinciana*. Rome: Presso A. Fulgoni.
- Volpe, R. 1996. *Aqua Marcia – lo scavo di un tratto urbano*. Florence: Edizione All'Insegna del Giglio.

- Waelkens, M., N. Herz and L. Moens. 1992. *Ancient Stones: Quarrying, Trade and Provenance: Interdisciplinary Studies on Stones and Stone Technology in Europe and the Near East from the Prehistoric to the Early Christian Period*. Leuven: Leuven University Press.
- Ward-Perkins, J. 1951. "Tripolitania and the Marble Trade." *JRS* 41: 89-104.
- Ward-Perkins, J.B. 1971. *Quarrying in Antiquity: Technology, tradition and social change*. Proceedings of the British Academy. London: Oxford University Press.
- Ward-Perkins, J. 1980. "Nicomedia and the Marble Trade." *PBSR* 48: 23-69.
- Ward-Perkins, J. 1992. *Marble in Antiquity: Collected Papers of J.B. Ward-Perkins*. Archaeological Monographs of the British School at Rome 6.
- Watkins, C. 1995. "Greece in Italy outside Rome." *Harvard Studies in Classical Philology* 97: 35-50.
- Williams-Thorpe, O. 2008. "A Thousand and One Columns: Observations on the Roman Granite Trade in the Mediterranean Area." *Oxford Journal of Archaeology* 27: 73-89.
- Williams, D.F. and D.P.S. Peacock. 2002. "The use of Purbeck marble in Roman and medieval Britain." In L. Lazzarini, ed., *Interdisciplinary studies on Ancient Stone. ASMOSIA VI: Proceedings of the Sixth International Conference of the Association for the Study of Marble and Other Stones in Antiquity, Venice, June 15-18, 2000*, edited by L. Lazzarini, 135-39. Padua: Bottega d'Erasmus Aldo Ausilio Editore.
- Wilson, A.I. 2001. "Timgad and Textile Production." In *Economies beyond Agriculture in the Classical World*, edited by D.J. Mattingly and J. Salmon, 271-296. London: Routledge.
- Wilson, A.I. 2008. "Machines in Greek and Roman Technology." In *The Oxford Handbook of Engineering and Technology in the Ancient World*, edited by J.P. Oleson, 337-66. Oxford: Oxford University Press.
- Wilson and Fulford. 2009. *Quantifying the Roman Economy: Methods and Problems*. Oxford: Oxford University Press.
- Wiseman, T.P. 1974. "The Circus Flaminius." *PBSR* 42: 3-26.
- Wiseman, T.P. 1976. "Two Questions on the Circus Flaminius." *PBSR* 44: 44-47.
- Wiseman, T.P. 2008. *Unwritten Rome*. Exeter: University of Exeter Press.
- Witcher, R. 2005. "The extended metropolis: *Urbs, suburbium*, and population." *JRS* 18: 120-138.

- Wurch-Kozelj, M. 1988. "Methods of Transporting Blocks in Antiquity." In *Classical Marble: Geochemistry, Technology, Trade*, edited by N. Herz and M. Waelkens, 55-64. Dordrecht: Kluwer.
- Wycheley, R.E. 1974. "The Stones of Athens." *Greece and Rome* 21: 54-67.
- Zaccagni, P. 1978. "Gabii: La città antica ed il territorio." *Archeologia Laziale* 1: 42-6.
- Zuchtriegal, G. 2012a. *Gabii: Das Santuario Orientale im Zeitalter der Urbanisierung. Eisenzeitliche und archaische Funde der Ausgrabungen 1976/77*. Venosa: Osanna Edizioni.
- Zuchtriegal, G. 2012b. "Riflessioni a margine dei vecchi scavi al Santuario Orientale di Gabii: nuovi dati sulla fase iniziale del culto." In *In Sacra Nominis Latini. I Santuari del Lazio arcaico e repubblicano. Atti del Convegno Internazionale, Roma, Palazzo Massimo, 19-21 febbraio 2009*, edited by E. Marroni, 243-246. Napoli: Loffredo Editore Napoli.