

Dennis Mario Beck

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Roman Imperial Quarries.
The Chaîne Opératoire as a Method
for Identifying Dependencies**

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1. Introduction and Methodology

In the last twenty years, ancient quarries have become an interdisciplinary research topic for scholars who are particularly interested in technical and structural organization, trading networks and infrastructure, as well as the individual workforces, work processes and resource exploitation. Due to the influence of New Institutional Economics (NIE) theories on the study of ancient networks and supply chains in particular, and the ancient economy in general, the study of individual actors and of production and organizational processes has become an important research focus and it also introduced new methods into research, such as network analysis or the chaîne opératoire.¹ Research into ancient quarries, their

¹ See, Alfred M. Hirt, “Chresimus, procurator a marmoribus und der Strassenbau. Überlegungen zu Logistik und Transportwesen kaiserlicher Steinbrüche,” in *Siedlungen und Verkehr im Römischen Reich: Römerstrassen zwischen Herrschaftssicherung und Landschaftsprägung: Akten des Kolloquiums zu Ehren von Prof. H. E. Herzig vom 28. und 29. Juni 2001 in Bern*, ed. Regula Frei-Stolba (Bern: Fritz Lang, 2010): 115–34; Henrik Mouritsen, *The Freedman in the Roman World* (Cambridge: Cambridge University Press, 2011); Wim Broekaert, *Navicularii et Negotiantes. A Prosopographical Study of Roman Merchants and Shippers*, Pharos 28 (Rahden: Verlag Marie Leidorf, 2013); Paul Erdkamp, Koenraad Verboven and Arjan Zuiderhoek, eds., *Ownership and Exploitation of Land and Natural Resources in the Roman World* (Oxford: Oxford University Press, 2015); Wim Broekaert, “Freedmen and Agency in Roman Business,” in *Urban Craftsmen and Traders in the Roman World: Oxford Studies on the Roman Economy*, ed. Andrew Wilson and Miko Flohr (Oxford: Oxford University Press, 2016): 222–53; Cameron Hawkins, *Roman Artisans and the Urban Economy* (Cambridge: Cambridge University Press, 2016); Seth G. Bernard, “Workers in the Roman Imperial Building Industry,” in *Work, Labour, and Professions in the Roman World*, ed. Koenraad Verboven and Christian Laes, *Impact of Empire* 23 (Leiden: Brill, 2017); Elio Lo Cascio, *Die neue Wirtschaftsgeschichte des Römischen Reiches. Paradigmen und Ansätze*, Beiträge zur Wirtschaftsarchäologie 1 (Bonn: Habelt, 2017). For the use of the term chaîne opératoire, see Nathan Schlanger, “‘Suivre les gestes, éclat par éclat’. La chaîne opératoire d’André Leroi-Gourhan,” in *Autour de l’homme: Contexte et actualité d’André Leroi-Gourhan*, ed. Françoise Audouze and Nathan Schlanger (Antibes: Editions APDCA, 2004): 127–47; Joanna E. Fairlie and Lawrence S. Barham, “From Chaîne Opératoire to Observational Analysis: A Pilot Study of a New Methodology for Analysing Changes in Cognitive Task-Structuring Strategies Across Different Hominin Tool-Making Events,” *Cambridge Archaeological Journal* 26, no. 4 (2016): 643–64; Ben Russell, “Roman Stone Carvers and Their Chaîne Opératoire,” in *The Value of Making: Theory and Practice in Ancient Craft Production*, ed. Helle Højscheid and Ben Russell, *Studies in Classical Archaeology* 13 (Turnhout: Brepols, 2021): 71–88. For network analysis in history and archaeology, see, e.g., Ulrich Müller, “Netzwerkanalysen in der Historischen Archäologie: Begriffe und Beispiele,” in *Historia archaeologica. Festschrift für Heiko Steuer zum 70. Geburtstag*,

exploitation and in particular the trade of stones and marbles were, from the very beginning, closely linked to the study of imperial slaves and freedmen in these economic systems. Already in the nineteenth century, Luigi Bruzza studied the offices and individuals mentioned in inscriptions with regard to their participation, organisation and tasks in the Roman marble trade, using mostly marble blocks and columns that came to light during the excavations directed by Pietro Ercole Visconti at the Emporium in Rome.² In the course of the twentieth century, the material base for this research was continually expanded by the discovery of additional marble depots, for example, the marble yards in Ostia and Portus as well as in the city of Rome, and by the investigation of several quarry sites throughout the entire Mediterranean region.³ Current research draws on a quite small number of individually and comprehensively investigated quarry sites throughout the Mediterranean, in particular concentrated in modern Egypt, Tunisia, Italy, Greece and Turkey – all former parts of the Roman Empire.⁴ The investigation of quarries as

Ergänzungsbände zum Reallexikon der Germanischen Altertumskunde 70 (Berlin: De Gruyter, 2009): 735–54.

- ² Luigi Bruzza, “Iscrizioni dei marmi grezzi,” *Annali dell’Istituto di corrispondenza archeologica* 42 (1870): 106–204; Luigi Bruzza, “Gli scavi dell’Emporio,” in *Triplce Omaggio alla Santità di Papa Pio IX nel suo giubileo episcopio* (Rome: Tipografia della Pace, 1877): 39–46. Further investigations were conducted by Otto Hirschfeld and Charles Dubois with the then-known stock of inscriptions from some quarries; see Otto Hirschfeld, *Die kaiserlichen Verwaltungsbeamten bis auf Diocletian* (Berlin: Weidmann, 1905); Charles Dubois, *Etude sur l’administration et l’exploitation des carrières (marbres, porphyre, granit, etc.) dans le monde romain* (Paris: Fontemoing, 1908). The quarries were thus one of the first areas of the ancient economy to be investigated with regard to the roles of slaves and freedmen in dependencies, and their personal relationships to the emperor. On this issue, see J. Clayton Fant, “The Roman Emperors in the Marble Business: Capitalists, Middle-men or Philanthropists?” in *Classical Marble: Geochemistry, Technology and Trade*, ed. Norman Herz and Mark M. Waelkens, NATO ASI series E: Applied Sciences 153 (Dordrecht: Springer Science + Business Media, 1988): 147–58, with an influential and, until today, often quoted contribution on the emperor and his role in the marble trade, which also contains an almost complete list of the early investigations and studies from the nineteenth and twentieth centuries.
- ³ For an overview of the scholarship, see Martin Maischberger, *Marmor in Rom: Anlieferung, Lager- und Werkplätze in der Kaiserzeit* (Wiesbaden: Reichert-Verlag, 1997): 13–31; for this early period of research, see Alfred M. Hirt, *Imperial Mines and Quarries in the Roman World* (Oxford: Oxford University Press, 2010).
- ⁴ Maischberger, *Marmor in Rom*; Hirt, *Imperial Mines*; Patrizio Pensabene, *I Marmi nella Roma antica* (Rome: Carocci Ed., 2013); for the localisation of the quarries, see Ben Rus-

archaeological sites emerged predominantly from a first wave of interest and studies, mainly during the second half of the twentieth century, in the origin and distribution of stones used in antiquity, especially in the Roman imperial period, and from an interest in the technical and organizational aspects of quarrying processes, transports and logistics.⁵ In addition to these basically well-studied quarries from the Roman

sell, “Gazetteer of Stone Quarries in the Roman World,” Version 1.0 (2013), https://oxrep.web.ox.ac.uk/sites/default/files/oxrep/documents/media/russell_2013_gazetteer_of_roman_stone_quarries.pdf [accessed 07.02.2023]; Lorenzo Lazzarini, “Ancient Mediterranean Polychrome Stone,” in *The Contribution of Mineralogy to Cultural Heritage*, ed. Gilberto Artioli and Roberta Oberti, EMU Notes in Mineralogy 20 (London: European Mineralogical Union and the Mineralogical Society of Great Britain & Ireland, 2019): 367–92.

- ⁵ In general: Maischberger, *Marmor in Rom*: 13–31; Hirt, *Imperial Mines*; Ben Russell, *The Economics of the Roman Stone Trade* (Oxford: Oxford University Press, 2013); Russell, “Gazetteer”; Hirt, “Centurions, Quarries, and the Emperor,” in *Ownership and Exploitation of Land and Natural Resources in the Roman World* (Oxford: Oxford University Press, 2015): 289–314, which includes a summary on Egypt; Lorenzo Lazzarini, “The Distribution and Reuse of the Most Important Coloured Marbles in the Provinces of the Roman Empire,” in *ASMOSIA 7. Actes du VIIe colloque international de l’ASMOSIA. Thasos 15–20 septembre 2003*, ed. Yannis Maniatis, Bulletin de correspondance hellénique, Suppl. 51 (Athens: École française d’Athènes, De Boccard Édition, 2009): 459–81; Lazzarini, “Ancient Mediterranean.” For Simitthus/Chimtu, see Josef Röder, “Die Steinbrüche des Numidischen Marmors von Chemtu,” in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 17–53; Mustapha Khanoussi, “Les officiales marmorum Numidicorum,” in *L’Africa Romana. Atti del XII convegno di studio. Olbia, 12–15 dicembre 1996*, vol. 2, ed. Mustapha Khanoussi, Paolo Ruggeri and Cinzia Vismara (Sassari: Editrice Democratica Sarda, 1998): 997–1016; Stefan Ardeleanu, “Giallo Antico in Context. Distribution, Use and Commercial Actors according to New Stratigraphic Data from the Western Mediterranean (2nd c. BC–1st c. AD),” in *ASMOSIA 11. Proceedings of the Eleventh International Conference of ASMOSIA, Split, 18–22 May 2015*, ed. Daniela Matetić Poljak and Katja Marasović (Split: University of Split, 2018): 155–65; Dennis Mario Beck, *Simitthus 6. Marmor Numidicum. Gewinnung, Verarbeitung und Distribution eines antiken Buntmarmors* (Wiesbaden: Reichert-Verlag, 2024, in press). For Dokimeion, see John Clayton Fant, *Cavum Antrum Phrygiae. The Organization and Operations of the Roman Imperial Marble Quarries in Phrygia* (Oxford: BAR Publishing, 1989); Patrizio Pensabene, “Cave di marmo bianco e pavonazzetto in Frigia. Sulla produzione e sui dati epigrafici,” *Marmora: International Journal for Archaeology History and Archaeometry of Marbles and Stone* 6 (2010): 71–134. For Luni, see Patrizio Pensabene, “The Quarries at Luni in the 1st Century AD: Final Considerations on Some Aspects of Production, Diffusion and Costs,” in *Interdisciplinary Studies on Ancient Stone. Proceedings of the IX ASMOSIA Conference (Tarragona 2009)*, ed. Anna Gutiérrez García-Moreno, Pilar Lapuente Mercadal and Isabel Rodà de Llanza (Tarragona: Indústries Gràfiques Gabriel Gibert, 2012): 731–43.

imperial period, during which the distribution of stone throughout the Mediterranean was a well-organized business for the first time in history, much smaller and often only locally and regionally used quarries began to be studied in the last two decades – to both complement and differentiate the overall picture.⁶ Apart from a few recent studies, however, the quarry sites have mostly been studied on their own and independently from each other.⁷ This data situation was examined from several perspectives through models and theories from the New Institutional Economics. The influence of the NIE on ancient studies has constantly led to systematic, overarching and interdisciplinary approaches and studies of quarrying processes, the organization of labour and the actors involved that employed new models, an approach that has expanded and deepened our general knowledge considerably over the last couple of years.⁸ This area of research is particularly important for the overall picture as it pays much closer attention than before to questions about the every-

⁶ Ameur Younès, Mohamed Essghaier Gaied and Wissem Gallala, “Quarries in Tunisia,” in *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, ed. Helaine Selin (Dordrecht: Springer Science + Business Media, 2014): 1–9; Matthias Bruno and Fulvia Bianchi, *Marmi di Leptis Magna* (Rome: L’Erma di Bretschneider, 2015); Matthias Bruno and Fulvia Bianchi, “The Limestone Quarries of Wadi Gadatz in the territory of Leptis Magna,” in *Interdisciplinary Studies on Ancient Stone. ASMOSIA 10. Proceedings of the Tenth International Conference of ASMOSIA. Association for the Study of Marble & Other Stones in Antiquity. Rome, 12–26 May 2012*, ed. Patrizio Pensabene and Eleonora Gasparini (Rome: L’Erma di Bretschneider, 2015): 35–42; Stefan Ardeleanu, *Numidia Romana? Die Auswirkungen der römischen Präsenz in Numidien (2. Jh. v. Chr.–1. Jh. n. Chr.)* (Wiesbaden: Reichert-Verlag, 2021); Dennis Beck, “The Quarries,” in *Studies on the Urban History of Meninx (Djerba): The Meninx Archaeological Project 2015–2019*, ed. Stefan Ritter and Sami Ben Tahar, *Archäologische Forschungen* 43 (Wiesbaden: Reichert-Verlag, 2022): 197–202.

⁷ Fant, *Cavum*; Röder, “Die Steinbrüche”; Valeria A. Maxfield and David Peacock, “The Roman Imperial Porphyry Quarries: Gebel Dokhan, Egypt,” *Journal of Egyptian Archaeology* 82 (1996): 15–19; Hélène Cuvigny, *Mons Claudianus. Ostraca Graeca et Latina III. O. Claudii. 417 à 613* (Cairo: Boustany’s Publishing House, 2000); Pensabene, “Cave”; Pensabene, “The Quarries at Luni”; Adam Bülow-Jacobsen, *Mons for Mons Claudianus: Ostraca Graeca et Latina IV—The Quarry Texts: O. Claud.* (Cairo: Boustany’s Publishing House, 2009): 632–896; Bernard, “Workers”; Ardeleanu, “Giallo Antico.”

⁸ See Hirt, *Imperial Mines*; Russell, *The Economics*; Hirt, “Centurions”; Bernard, “Workers”; Russell, “Roman Stone”; Hélène Cuvigny, “The Organization Chart of the Personell of an Imperial Quarry According to an Ostrakon of Mons Claudianus,” in *Rome in Egypt’s Eastern Desert*, ed. Roger S. Bagnall, *ISAW Monographs* (New York: New York University Press, 2021): 181–212; Beck, *Simithus*.

day operation of the quarries and the different labour and status groups required for the numerous different processes. Due to this interest and these different approaches, both epigraphic and archaeological finds came into sharper focus, allowing us to draw conclusions about specialized workforces and craftsmen, organizational structures, workplaces and thus dependencies in systems and networks, especially regarding the interconnectedness of people in different legal status groups. Numerous Latin and Greek inscriptions both at quarry sites and on quarried objects in marble depots – such as semi-finished or finished and stored columns or blocks as well as other ancient media like tablets, ostraca, papyri, and ingots – can provide concrete insights into these structures and individuals, for instance, during production based on a division of labour or specialization in crafts. These new insights have recently been summarised in some overviews, mainly for the roman imperial period.⁹

At the current state of research, we have some information about the archaeological and socio-historical contexts of different organizational structures of labour in quarries, and about the various actors and institutions involved. However, there are now more comprehensive observations, interpretations based on them and models of the imperial marble trade or its structures than there are individual observations on specific quarry sites that take into account new questions and methodological approaches.¹⁰ If we take, for example, the question of the emperor's influence on marble extraction, the evidence from individual quarry sites was mainly used selectively to generate overarching models of the imperial marble trade.¹¹ Although, as mentioned, theories from the New

⁹ For a summary of the scholarship, see Bülow-Jacobsen, *Mons*; Hirt, *Imperial Mines*: 10–47; Russell, *The Economics*: 2–5; Pensabene, *I Marmi*; Patrizio Pensabene, “Marmi pubblici e marmi privati. Note in margine ad un recente volume di Ben Russell,” *Archeologica Classica* 66 (2015): 575–94; Bruno and Bianchi, *Marmi di Leptis*; Lazzarini, “Mediterranean”; Beck, *Simitthus*.

¹⁰ On this issue, see Beck, *Simitthus*.

¹¹ Special mention should be made of the influential publication by Ward-Perkins and Fant. See, in brief, Russell, *The Economics*; Hirt, *Imperial Mines*; Dennis Mario Beck, “Use, Aesthetics and Semantics of Coloured Marble Columns in the Western Mediterranean during the Late Republic and Early Roman Empire,” in *Materiality in Roman Art and Architecture. Aesthetics, Semantics and Function*, ed. Annette Haug, Adrian Hielscher and M. Taylor Lauritsen (Berlin: De Gruyter, 2021): 95–112.

Institutional Economics offered new approaches and broadened the view substantially. Comparable approaches were very rarely used before in the quarries themselves. Connected with this is an essential aspect of the problem of identifying dependency in these organizational structures in quarries, the question of whether the influence of the Roman emperor made itself felt – and if so, to what extent, and as a result, what individual developments and changes were due to imperial control over the quarries and their operation. This paper will examine these questions both in terms of how they contrast with divergent or earlier organizational structures and from a long-term perspective in the Roman Empire.¹² Based on the work done on the topic in the last twenty years and the sources now available, some quarries are particularly well-suited as objects of comprehensive study of the ancient economy, since both imperial as well as private and municipal officials interacted there in several perspectives, and different legal status groups were involved in the system.¹³ In addition to the Roman imperial organizational structures, there was the mass of non-imperially operated or influenced quarries, which were often managed by private entrepreneurs or municipal officials. Here, too, questions can be asked about dependencies, personal relationships and the actors involved in these processes – they cannot, however, be considered in detail in this contribution.¹⁴ Several questions arise from the results and observations in research: Who was affected by personal dependencies? Which sources can we use to infer the various dependencies, and also to compare them? What levels of depend-

¹² See the different approaches by Fant, “The Roman Emperors”; Fant, *Cavum*; John Clayton Fant, “Ideology, Gift, and Trade: A Distribution Model for the Roman Imperial Marbles,” in *The Inscribed Economy: Production and Distribution in the Roman Empire in the Light of Instrumentum Domesticum*, ed. William V. Harris (Ann Arbor: University of Michigan, 1993): 145–70; and Röder, “Die Steinbrüche.” For recent debates, see Hirt, *Imperial Mines*; Russell, *The Economics*, and Pensabene, *I Marmi*. A similar approach can be found in Bryan Pfaffenberger, “Mining communities, chaînes opératoires and sociotechnical systems,” in *Social Approaches to an Industrial Past: The Archaeology and Anthropology of Mining*, ed. Eugenia W. Herbert, A. Bernard Knapp and Vincent C. Pigott (London: Routledge, 2013): 291–300.

¹³ This was first postulated in a particularly insightful and convincing manner by Hirt, *Imperial Mines* and Russell, *The Economics*, in the general discussion on the study of the marble trade and the people involved.

¹⁴ On this topic, see Hirt, *Imperial Mines*, chapter 7; Russell, *The Economics*: 53–60.

ency existed between the individual actors? To what extent was the organization of work based on personal and structural dependencies and relationships, and what structures of dependency can we identify with the approach proposed? Which actors were needed mandatorily in the networks to establish a stable and continuous system?

The methodological approach to answering these questions has so far been based on the objects found in both the quarries and marble depots; therefore, the evidence not only varies quantitatively but is also only comparable to a limited extent and under certain circumstances. In order to arrive at a systematic basis for comparison, I propose to use the chaîne opératoire method and to apply it in the second part of this paper to one of the quarries – namely the marble quarries at Simitthus/Chimtou in present-day Tunisia. This method will make it possible to analyse the quarrying process of one case in detail in its individual steps and, in addition, to answer specific questions on the basis of the primary sources originating at this quarry. The results are therefore compared as far as possible with those of other quarries and industries in order to gain further insights and make more general statements.

2. Types of Sites and Differences in Spatiality

In both Greek and Roman antiquity, the majority of large stone objects were always further processed on site after quarrying to prepare them for transport both within and especially outside of the quarry¹⁵. Quarries were numerous and therefore need to be further defined as objects of study.¹⁶ As mentioned above, my focus is on the Roman imperial period, during which there were, broadly speaking, three different administrative structures for the quarries. These will also guide the selection of my examples in what follows: 1. Imperial quarries, where actors dependent

¹⁵ “Large stone objects” are defined as larger than hand size and heavier than can be carried by one person alone. Stone pieces were usually not completed until at the construction site, a process that happened in several steps. On this issue, see Russell, *The Economics*: 95–140; Bernard, “Workers.”

¹⁶ For the most widely used marbles in antiquity, see Russell, “Gazetteer”; Lazzarini, “Mediterranean.”

on the emperor were predominantly responsible for both the organisation and operation of the quarries; 2. Municipal quarries, where mainly municipal officials and private entrepreneurs (individuals and groups are testified) were responsible for the operation and infrastructure; and, lastly, 3. Private quarries, where exclusively private individuals or groups oversaw the entire operation.¹⁷ In categories 2) and 3), usually there were no interactions with imperial officials; or to be more precise, no indications of such interactions have been preserved in the archaeological and epigraphic evidence. Due to my focus on dependency on the emperor, both by individuals and in the structural organisation and operation, the focus of the present paper will be on the first type, the quarries with imperial officials.

2.1 The Imperial Quarries in the Roman Empire

Since the beginning of the study of ancient stones and marbles, the imperial quarries in the Roman Empire have received by far the most attention among all quarry sites. One reason for this is the large number of quarried materials and remains that have been preserved from them in archaeological contexts, another is scholars' interest in the use to which the emperors put these prestigious and expensive stones, especially in Rome, but also in other cities in the empire. At this point, I can only mention in passing the long history of this research, which has been summarized in recent studies by Martin Maischberger, Ben Russell, Alfred M. Hirt and other scholars.¹⁸ As a starting point, let me briefly mention results from recent research in order to provide the basis for further deliberations: One characteristic of the imperial quarries above all was the fact that over a period of approximately 200–250 years, in a few quarries in the Mediterranean region, officials in personal dependence

¹⁷ For details on these categorisations, see Hirt, *Imperial Mines*; Russell, *The Economics*; Russell, "Gazetteer."

¹⁸ Hirt, *Imperial Mines*; Russell, *The Economics*. For a complete list of earlier scholarship, especially for the marble depots in Rome, Ostia and Portus, see Maischberger, *Marmor in Rom*: 14–15; for the late republican and early imperial marble economy, see Pensabene, *I Marmi*; Beck, "Use, Aesthetics and Semantics."

on the emperor or the wider imperial family, often imperial slaves and freedmen, were involved in the procurement, or the quarrying and distribution, of marble. These quarries included, among others, those at Mons Claudianus and Mons Porphyrites in Egypt; Chios, Paros, Penteli and Karystos in Greece; Teos and Dokimeion in Turkey; Simitthus in Tunisia, and Luni in Italy.¹⁹ Imperial officials are mainly attested by inscriptions on workpieces that have been found either in the quarries, at urban collection points and port depots, or in archaeological contexts.²⁰ A central result of recent studies is that these actors were active in several networks at the same time, but that only individual sites can ever be inferred from the combination of sources. Interestingly, while the administrative structures in each quarry were slightly different, they also shared certain similarities, especially from the second century AD onwards. This is quite likely closely related to the inconsistent development of and allowance for local conditions in the administrative structures and the actors involved in the first century AD.²¹ It is therefore

¹⁹ Peacock and Maxfield, “The Roman Imperial Porphyry Quarries”; Maischberger, *Marmor in Rom*: 20 note 55; Hirt, “Chresimus”; Bülow-Jacobsen, *Mons*; Hirt, *Imperial Mines*: 295–96 and 307–9; Pensabene, “Cave”; Pensabene, “The Quarries at Luni”; Pensabene, *I Marmi*; Russell, “Gazetteer”; Lazzarini, “Mediterranean”; Mustafa Adak and Musa Kadioğlu, “Die Steinbrüche von Teos und ‘Marmor Luculleum’,” *Philia* 3 (2017): 1–43; Ardeleanu, “Giallo Antico”; Cuvigny, “The Organization Chart”; Beck, “Use, Aesthetics and Semantics”; Beck, *Simitthus*.

²⁰ See Patrizio Pensabene and Matthias Bruno, “Aggiornamenti, nuove acquisizioni e riordino dei marmi di cava dal canale di Fiumicino,” in *Marmi Antichi II. Cave e tecnica di lavorazione provenienze e distribuzione*, ed. Patrizio Pensabene (Roma: L’Erma di Bretschneider, 1998): 1–22; Röder, “Die Steinbrüche”; Matthias Bruno, “Blocchi, marchi e sigle di cava di Leptis Magna,” *Marmora: International Journal for Archaeology History and Archaeometry of Marbles and Stone* 5 (2009): 71–94; Hirt, *Imperial Mines*; Russell, *The Economics*; Bernard, “Workers”; Lo Cascio, *Wirtschaftsgeschichte*; Beck, *Simitthus* for the inscriptions and their interpretation. In a few cases, additional offices and actors are known from honorary and funerary inscriptions that can be linked to the marble trade and the emperor.

²¹ Based on the archaeological and epigraphic evidence at the quarry sites and on the basis of the empire-wide distribution of only a few types of marble in the Mediterranean region, scholars no longer uniformly assume that the emperors took complete control of quarrying in the early imperial period, but rather that there was a multiplicity of local administrations by urban elites and entrepreneurs in the late republic and early imperial period, which would differ from place to place. If necessary, in the early imperial period, the emperor used middlemen to procure materials. Those middlemen appear in the inscriptions as *rationarii*. They were not based at the quarries,

key to consider the history of each quarry individually, and only then to formulate overarching questions.

An important change, which, however, only occurred in a few quarries in Trajanic and Hadrianic times, was the creation of specific, high-level offices for marble procurators (named in the inscriptions as *procuratores marmorum* or *procuratores montis/metallorum*) with an arguably narrowly defined area of responsibility, which is indicated by the designation added to their title (e. g., *procurator marmorum Numidicorum*). This led to a standardisation and targeted change in the different organizational structures in the quarries (fig. 1).²² The office of procurator was predominantly held by imperial freedmen, more rarely by slaves. We know from some cases in other quarries that officials and intimates of the imperial family were drawn from the ranks of the military, although this has so far been proven only for Egypt.²³ In fact, the offices were clearly based on personal dependencies on the emperor, for example, in Simitthus, which can be seen from the fact that imperial freedmen held the office of *procurator marmorum*, and imperial slaves were part of the staff.²⁴ The procurators were certainly at the top of the hierarchy in the individual quarries, although in local interactions with some officials of cities or estates, the responsibilities cannot be clarified for all quarries, and competences and responsibilities certainly varied from quarry to quarry²⁵. With the institution of the office of procurator in the quarrying industry, a separate organisational structure was created for the first time in the second century AD, independent of other administrations, for example, the provincial administration. The trigger for this process of specialisation may have been material needs and shortages due to the expansion of cities throughout the empire, especially at Rome in the late

but in Rome, and probably at ports and transshipment hubs. The emperor's influence on the local administration and processing of workpieces in the quarries was therefore small, and the emperor was merely one of many interested parties. On the late republican and early imperial history of quarry organisation, see Hirt, *Imperial Mines*, 2010: 80–82; Hirt, “Centurions”: 306–14; Beck, “Use, Aesthetics and Semantics.”

²² Hirt, *Imperial Mines*; Pensabene, “Marmi pubblici.”

²³ See the appendix in Hirt, *Imperial Mines* for a nearly complete list of all *procuratores marmorum*.

²⁴ Röder, “Die Steinbrüche”; Hirt, *Imperial Mines*; Hirt, “Centurions”; Beck, *Simitthus*.

²⁵ Hirt, *Imperial Mines*: 202–60.

first and early second centuries AD.²⁶ The testimonies of these *procuratores* provide valuable insights into local administrative structures and hierarchies, enabling us to infer interactions between different actors, which will be the objects of the reflections in the following section, using the example of Simitthus.

2.2. Case Study: Imperial Administrative Structure in the Quarries of Simitthus/Chimtou

Both the urban development and the quarries have been studied by the German Archaeological Institute and the Institut National du Patrimoine, Tunis, since the 1960s.²⁷ Recent excavations and research have revealed some new evidence about the early inhabitants of Simitthus in the first millennium BC. The earliest traces of settlement found so far at the site date to the fifth century BC, although some archaeobotanical evidence has been carbon-dated to the eighth century BC.²⁸ It is thought that marble quarrying started in a later, still pre-Roman settlement period from the late second century BC onward.²⁹ The first building entirely constructed of *marmor Numidicum* was a large Hellenistic monument on the top of Chimtou's 'temple hill', which was probably built by the Numidian king Micipsa.³⁰ Large funerary monuments document the increasing

²⁶ Russell, *The Economics*: 232–38.

²⁷ For an overview of the scholarship, see Philipp von Rummel, Stefan Ardeleanu, Dennis Mario Beck, Heike Möller and Moheddine Chaouali, "Simitthus/Chimtou, Tunesien. Die Arbeiten der Jahre 2016 bis 2018," *e-Forschungsberichte des DAI* 2019, no. 1 (2019): 197–205; see also Ardeleanu, *Numidia*; Beck, *Simitthus*.

²⁸ For the topographic and chronological development of the city, see Friedrich Rakob, "Zur Siedlungstopographie von Chemtou/Simitthus," in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 1–16; von Rummel et al., "Simitthus."

²⁹ Röder, "Die Steinbrüche"; Ardeleanu, "Giallo Antico"; Beck, "Use, Aesthetics and Semantics"; Beck, *Simitthus*.

³⁰ Friedrich Rakob, "Numidische Königsarchitektur in Nordafrika," in *Die Numider. Reiter und Könige nördlich der Sahara*, ed. Christoph B. Rüger and Heinz Günther Horn (Bonn: Rheinland-Verlag; Habelt, 1979): 119–71; Friedrich Rakob, "Der Tempelberg und seine Heiligtümer," in *Simitthus II. Der Tempelberg und das Römische Lager*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1994): 1–38; Josephine Crawley Quinn, "Monumental Power: Numidian Royal Architecture in Context," in *The Hellenistic*

wealth of the population by at least the end of the Iron Age and the beginning of the Hellenistic period. In 46 BC, after the defeat of Pompey and Juba I, Chimtou and its surrounding area probably became part of the Roman province of *Africa*. It acquired the status of a roman *colonia* under Augustus, named *Colonia Iulia Augusta Numidica Simitthensium*, in 27–25 BC.³¹ Marble from Chimtou was in high demand as a luxury good in the Roman Empire from the first century BC onward³², causing an increase in marble quarrying activities. While the running of the quarry was very probably in municipal hands before and also after the founding of the roman colony, from the Augustan period and into the reign of Trajan, there is occasional evidence of a few imperial slaves acting as *rationarii*³³, who were involved in marble quarrying and probably also trading in cooperation with local workshops within the framework of *locatio-conductio*-contracts – the standard form of Roman contracts in economic systems.³⁴

West. Rethinking the Ancient Mediterranean, ed. Josephine Crawley Quinn and Jonathan Prag (Cambridge: Cambridge University Press, 2013): 179–215.

³¹ Rakob, “Zur Siedlungstopographie”:1; Hirt, *Imperial Mines*: 25–27.

³² For a complete list of the ancient literary sources, see Rolf-Michael Schneider, *Bunte Barbaren. Orientalenstatuen aus farbigem Marmor in der römischen Repräsentationskunst von Augustus bis Trajan* (Worms: Wernersche Verlagsgesellschaft Worms, 1986): 142–60; Röder, “Die Steinbrüche”; Lazzarini, “Mediterranean”; Beck, “Use, Aesthetics and Semantics”; Ardeleanu, “Giallo Antico”; Beck, *Simitthus*.

³³ The *rationarii* are controversial in their interpretation. They bore responsibility for quarried material, since they are named exclusively in the inscriptions on quarried marble. Possibly they are individual and independent entrepreneurs who have an area of responsibility in their own or rented unit of account (ratio)/ account-holders. Probably the accounting in a ratio is connected with a contractually fixed quarrying quantity, which would give rise to the logic of counting the workpieces and found comparisons in other economic systems based on contracts. On the *rationarii*, see Hirt, *Imperial Mines*: 305 and 312; Russell, *The Economics*: 46.

³⁴ Within the *locatio conductio*-contracts, a distinction is made between *locatio conductio operis* and *locatio conductio rei* on the basis of the old laws that have been handed down. This means that the quarry administration as *conductor* could lease the rights to the quarry to private entrepreneurs as *coloni*, under the terms of a *locatio conductio rei* contract, for a general fee or a share of the production. The *locatio conductio operis* contracts, on the other hand, give the quarry administration the possibility to hire contractors to carry out a certain type of work, e.g., quarrying a certain amount of marble blocks, pillars or generally working in a quarry area. In research, it is generally assumed that these contracts were concluded with terms of five years, although this was probably also more flexibly manageable. On the *locatio-conductio*-system, see Hirt, *Imperial Mines*: 117–19; Sophie Schmall, “Patrimonium und Fiscus. Studien zur kaiser-

However, in addition to the imperial *rationarii*, private entrepreneurs and municipal magistrates were also involved in the quarrying and trading of marble, resulting in its wide distribution during the early imperial period.³⁵ In parallel with the intensification of quarrying and trading activities, the city of Simitthus expanded and gained political importance on a regional level and prospered during the height of the Roman imperial period, especially under the reign of the Antonine and Severan emperors, as did most other towns in North Africa. The city's prosperity is so far evidenced by several monumental entertainment buildings, such as a theatre, an amphitheatre, several baths, and huge administrative and political buildings around the forum, as well as many temples in the urban area and a major cult centre on the so-called 'temple mount' in the second to fourth centuries AD.³⁶

However, with the creation and establishment of the office of the *procuratores marmorum Numidicorum* during the reign of Hadrian, the previously regularly mentioned *rationarii* disappeared completely from the inscriptions in Simitthus. The leasing and operating systems must have changed along with the whole procurement structure. This is reflected in the facts that from 137 AD onwards, the emperor is mentioned as the owner of the quarried material on almost all workpieces, and that his *procurator marmorum* was responsible for the contracts and overseeing the quality of materials, as the formula *sub cura* in the inscriptions very probably indicates.³⁷ Moreover, the marble procurators were on site, as is evidenced by several dedications in sanctuaries, repairs and donations of buildings, and sometimes also funerary monuments for citizens.³⁸ The archaeological and epigraphical evidence in Simit-

lichen Domänen- und Finanzverwaltung von Augustus bis Mitte des 3. Jahrhunderts n. Chr." (PhD-diss., Rheinische Friedrich-Wilhelms-Universität Bonn, 2011): 161–65; Russell, *The Economics*: 45; Hirt, "Centurions": 300, with examples. For the evidence from the quarries, see Ardeleanu, "Giallo Antico": 158–59; Beck, *Simitthus*.

³⁵ Röder, "Die Steinbrüche"; Lazzarini, "Mediterranean"; Ardeleanu, "Giallo Antico"; Lazzarini, "The Distribution"; Beck, "Use, Aesthetics and Semantics"; Beck, *Simitthus*.

³⁶ Rakob, "Zur Siedlungstopographie"; Rakob, "Tempelberg"; von Rummel et al., *Simitthus*.

³⁷ For summaries on this issue, see Hirt, *Imperial Mines*: 421–24; Hirt, "Centurions": 305; Beck, *Simitthus*.

³⁸ Röder, "Die Steinbrüche"; Hirt, *Imperial Mines*: 117–19 and 421–24.

thus from the Roman imperial period therefore offers the opportunity to investigate the interactions and the underlying dependency structures both within the organizational system and in their connection to the imperial family. Moreover, it is possible to examine the personal dependencies of imperial slaves and freedmen as well as of private individuals and other office holders in the quarry administration, too. To approach this systematically, chapter 3 will present a scenario using the chaîne opératoire method, applied to the production of a column during the high imperial period.

3. Chaîne Opératoire: The Logic of Procedure

In essence, the method of the chaîne opératoire makes it possible to illuminate the production chain of an object in temporal and spatial reflection and with a detailed focus on the actors involved. The method has been widely used in archaeological research, and various new approaches have been added in recent years, adapting and developing the original concept of André Leroi-Gourhan.³⁹ In the present paper, the method provides the observational framework and thus pursues a new aspect that has so far never been explored for the issues of ancient quarries and their operation.⁴⁰

The initial question concerns the different actors in the quarry at Simitthus, their legal statuses and personal dependencies, especially those on the emperor, but also on each other. I will briefly list the actors concerned below (see 3.1 and fig. 1). There is a broad consensus among scholars that a *procurator marmorum* was responsible for a single quarry

³⁹ For the chaîne opératoire, see André Leroi-Gourhan, *Le Geste et la Parole. I, Technique et langage* (Paris: Albin Michel edition, 1964); Schlanger, “Suivre les gestes”: 127–47; Fairlie and Barham, “From Chaîne Opératoire”: 643–64; Russell, “Roman Stone.”; Pfaffenberger, “Mining communities, chaînes opératoires and sociotechnical systems”: 291–300 for mines.

⁴⁰ Apart from Ben Russell, who recently mentioned a similar idea; see Russell, “Roman Stone.”

or a region with several quarries.⁴¹ He would have stood at the head of the quarry's administration. In the Roman senatorial provinces, this office most likely evolved from that of the regional procurator, who was in charge of all imperial property in a given region, including its resources (imperial domains).⁴² At Simitthus as well as in some other quarries, it is likely that this office was predominantly, if not exclusively, filled by imperial freedmen who were replaced in a regular cycle of not more than three years.⁴³ The emperor therefore acted as owner of the quarries and could appoint direct administrators, with a local representative for the resources, especially if they were located in senatorial provinces like Africa Proconsularis or Asia (figs. 1 and 4).⁴⁴ These *procuratores marmorum* therefore headed the respective workshops and work units, by virtue of their imperial prestige and the authority conferred on them by both their office and the relation to the emperor (fig. 4). The sources do not allow us to infer who worked in the quarry workshops, but we can assume that slaves, freedmen and *coloni*, i.e., partially free citizens, worked side by side, or were at least connected on a contractual level (fig. 1).⁴⁵ Moreover, we can identify less than a handful imperial slaves in the inscriptions who probably worked on the procurator's staff.⁴⁶ They would have been placed in the hierarchy at a level below the procurators, but in an area that is difficult to classify in relation to the respective work units due to their responsibilities and skills (fig. 4). These actors also had a personal relationship with and

⁴¹ Hirt, *Imperial Mines*: 107–49, with details; Russell, *The Economics*: 43–45; Beck, *Simitthus*.

⁴² See Hirt, “Chresimus”; Schmall, *Patrimonium*: 472, on the development and status of procuratorial offices.

⁴³ Cf. Hirt, *Imperial Mines*; Beck, *Simitthus*.

⁴⁴ For several comparisons, see Schmall, *Patrimonium*; Hirt, *Imperial Mines*.

⁴⁵ See Russell, *The Economics*: 344–51, on this subject and with an example of the production of sarcophagi. Further examples are mentioned in Miriam J. Groen-Vallinga and Laurens E. Tacoma, “Contextualising Condemnation to Hard Labour in the Roman Empire,” in *Global Convict Labor*, ed. Christian G. de Vito and Alex Lichtenstein, *Studies in Global Social History* 19 (Leiden: Brill 2015): 49–78.

⁴⁶ For an overview, see Theodor Kraus, “Steinbruch- und Blockinschriften,” in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 55–64; Hirt, *Imperial Mines*: 155–67, on the “subaltern staff”; Ardeleanu, “Giallo Antico”; Beck, *Simitthus*.

dependence on the emperor, but the authority to issue instructions was the responsibility of the procurators. There is controversy among scholars as to whether military units and prisoners, the so-called *damnati ad metalla*, were present in the quarries both in general and in Simitthus and involved directly in the quarrying work.⁴⁷ The findings of archaeological investigations in a large building complex north of the quarries and the town tell us that slaves and prisoners may have been housed in a building briefly used as an *ergastulum* (dormitory for slaves and small workshops) and guarded by military units.⁴⁸ As Alfred M. Hirt pointed out, the *damnati ad metalla* had even fewer rights than other slaves, so that they were probably assigned the heaviest and most dangerous work in the quarries.⁴⁹ However, the number of prisoners and working slaves housed in the *ergastulum* remains indeterminable⁵⁰.

The method of the chaîne opératoire is particularly revealing in showing the individual connections between these actors, as I will show in the following section.

⁴⁷ Khanoussi, “Les officielles”; Michael Mackensen, *Simitthus III. Militärlager oder Marmorwerkstätten. Neue Untersuchungen im Ostbereich des Arbeits- und Steinbruchlagers von Simitthus-Chemtou*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 2005); Hirt, *Imperial Mines*; Beck, *Simitthus*. Groen-Vallinga and Tacoma, “Hard Labour”: 49–53, summarize on the basis of Roman law for forced labour. Moreover, for the evidence in ancient sources see D. Lassandro, “I ‘damnati in metalla’ in alcune testimonianze antiche,” in *Coercizione e mobilità umana nel mondo antico*, ed. Marta Sordi (Milan: Vita e pensiero, 1995): 271–77. See also the discussion regarding controversial evidence for the presence of a small military detachment at Mons Claudianus to supervise convicted criminal labourers: Adam Bülow-Jacobsen, ed., *Mons Claudianus, ostraca Graeca et Latina. IV: The quarry-texts: O. Claud. 632–896* (Cairo: Institut français d’archéologie orientale, 2009): 2; Groen-Vallinga and Tacoma, “Hard Labour”: 75–76; summarized by Hirt, *Imperial Mines*: 93–98.

⁴⁸ See below, chapter 3.3; Khanoussi, “Les officielles”; Mackensen, *Simitthus III*: 100; Beck, *Simitthus*.

⁴⁹ Hirt, *Imperial Mines*: 97 and 223. This fact was also addressed by Groen-Vallinga and Tacoma, “Hard Labour”: 53. 60–63. with some examples from Egyptian quarries in the imperial period.

⁵⁰ Groen-Vallinga and Tacoma, “Hard Labour”: 53 argue that the number of working slaves and prisoners was probably always larger than is generally assumed; so also Manuel Fernández-Götz, Dominik Maschek and Nico Roymans, “The Dark Side of the Empire. Roman Expansionism Between Object Agency and Predatory Regime,” *Antiquity* 94 (2020): 1635–38.

3.1. Case Study of the Production of a Marble Column in the Quarries

Actors: The abbreviations listed in the legend indicate the social and legal status of the actors where this information can be gleaned from the sources or plausibly inferred through comparisons to other economic sectors:

(S) = slave(s)

(IS) = imperial slave(s)

(F) = free citizen(s)

(FM) = freedman/men

(IFM) = imperial freedman/men

(IPM) = imperial *procurator marmorum*

Other abbreviations:

ind. = indeterminable

< 8h = this information refers to less than one working day

> 8h = this information refers to more than one working day

| No | work step | space | duration | actor(s) | source(s) |
|------------------|--|-----------|----------|--|---|
| 1 | Ordering/ acceptance by imperial <i>procurator marmorum</i> (IPM), <i>locatio-conductio-operis</i> -contract | Simitthus | ind. | Several options; emperors to traders (F; FM) | Epigraphic sources: cf. Hirt, <i>Imperial Mines</i> |
| Quarrying | | | | | |
| 2 | Sighting + selection of quarry area | quarry | ind. | Experts (FM, S), possibly <i>procurator marmorum</i> (IPM) | Test drillings in several quarries in the Mediterranean |
| 3 | Preparation of quarrying | quarry | ind. | S, ind. | Röder, “Die Steinbrüche”: 36 f. fig. 19, 3, Tav 53 b, c |

| No | work step | space | duration | actor(s) | source(s) |
|---|---------------------------------|-----------------------------------|-----------------------------------|--|---|
| 4 | Scraping of the column blank | quarry | 20h per worker and sqm, cf. Röder | Experts (F, S, FM), unskilled workers (F, S) | Archaeological evidence; traces of wedge-shaped grist Röder, “Die Steinbrüche”: 32 fig. 18. 47 f. |
| 5 | Wedging and scraping the column | quarry | several days | Experts (F, S, FM), unskilled workers (F, S) | Archaeological evidence; traces of wedge-shaped grist; Röder, “Die Steinbrüche”: 47 |
| Processing and finishing of the prefabricated column (workpiece) | | | | | |
| 6 | Rough finishing | quarry workstation | several days | Experts (F, S, FM) | Archaeological evidence for workplaces, cf. Röder, “Die Steinbrüche”: 42–4 |
| 7 | Fine work | quarry workstation | several days | Experts (F, S, FM) | Archaeological evidence |
| 8 | Inscription | quarry workstation | ind. < 8h | Experts (F, S, FM) | Archaeological and epigraphic evidence |
| Röder calculated that the production of a semi-processed column of l: 8 m and diam: 1 m in Simitthus took approximately 864 man-hours or 108 days, assuming a working day of eight hours. It would have taken four skilled workers approx. 27 days. | | | | | |
| Quality inspection by the <i>Procurator marmorum</i> (IPM) | | | | | |
| Transports within the quarry | | | | | |
| 9 | Transport with logs and sledges | quarry workstation to loading bay | ind. | Experts (F, S, FM), unskilled (F, S, FM) | Archaeological evidence; cf. Korres, <i>Penteli</i> : 26-31; Rakob, “Zur Siedlungstopographie”: 50; Russell, <i>The Economics</i> : 101 |
| 10 | Loading onto a wagon | loading bay in quarry zone | ind. < 8h | Experts (F, S, FM) | Archaeological evidence; plausible assumption |

| No | work step | space | duration | actor(s) | source(s) |
|---|---|--------------------|--|--|---|
| Transport from Simitthus to Carthage | | | | | |
| 11 | On transport wagons or sledges to the river | streets | ind. strongly depending on quarry area | Experts (F, S, FM), unskilled (F, S, FM) IFM; IS military? | Röder, “Die Steinbrüche”: 49 |
| 12 | Loading by crane | harbour, Simitthus | < 8h | Experts (F, S), unskilled (F, S); military? | Archaeological evidence |
| 13 | Transport by River Medjerda | river | Wilson, “Rivers,” 1–2 days | Freight forwarder/trader (F, FG, S), military? | Cic. Att. 1, 8, 2. 1, 9; Wilson, “Rivers”: 111–14 and 118 |
| 14 | Loading by crane and transport to Carthage | harbour, Carthage | usually < 8h | Experts (F, S, FM) | Plausible assumption |

Detailed description and interpretation of the single steps

In the passages below, I will describe the individual steps for the production of an assumed column up to its delivery in Carthage on the basis of a chain of operations during the high imperial period. The diagram above can be referenced for the description below. (1) I have assumed that the production of a column of approximately 8 m in length was governed by a fixed-lease contract based on *locatio-conductio-operis*, which was concluded between the *procurator marmorum* by mandate of the emperor and a workshop owner after a request by a third party.⁵¹ We do not know from the ancient sources whether a particular quarry area was selected in connection with a specific order. The fact that the marble variants of certain quarry areas were definitely preferred and appropriate for

⁵¹ On the fragmentary nature of the evidence regarding the initial stages of such treaty negotiations, see Hirt, *Imperial Mines*: 205; Russell, *The Economics*: 24 and 45–53.

certain objects makes this very likely, but the selection process cannot be deduced from the sources so far. In Simitthus, there are both deep fractures for column quarrying and near-surface quarrying (fig. 2).⁵² The selection of the quarry areas was certainly done by specialists, as numerous test drillings in the quarries show. In Simitthus, it was possible to quarry marble in all areas due to the technical capabilities of the craftsmen using the wedge-slot technique in quarrying.⁵³ (2) After selecting the quarry area, the surface was cleared of vegetation and debris, mainly by unskilled workers, mostly slaves and probably convicts, too.

Quarrying⁵⁴

Because of numerous traces of the extraction of columns using the wedge-shot technique in the quarries in Simitthus, which are still partly visible today, we are able to reconstruct the individual steps exactly and with important details of the process⁵⁵. (3) After the surface had been prepared, the process of cutting free the whole length of the column body began, with a surplus for protection. Skilled and unskilled craftsmen cut deep furrows into the rock with pointed chisels and mallets to first isolate a rectangular block on all sides (fig. 3). (4) For orientation, the circle line served as the centre point on both sides of the column head. From here, the diameter of the column was calculated and worked out.⁵⁶ Individual shafts were driven deep into the rock, with depths of up to one metre being not uncommon in Simitthus for quarrying large columns.⁵⁷ Röder calculated that approximately 20 man-hours were needed

⁵² See Röder, “Die Steinbrüche”: Suppl. 4.

⁵³ Röder, “Die Steinbrüche”: 37–41 on the wedge shot technique, “Keilschrottechnik.” In this technique, iron and wooden wedges are inserted at regular intervals into previously knocked-out holes in the rock. Once the wedges are put into the rock, the wedges are rhythmically struck with hammers until the rock dislodges from the bedrock.

⁵⁴ For illustrations of individual processes, see Pensabene and Bruno, “Aggiornamenti”: 1–22; Manolis Korres, *Vom Penteli zum Parthenon: Werdegang eines Kapitells zwischen Steinbruch und Tempel* (München: Glyptothek, 1992); Röder, “Die Steinbrüche.”

⁵⁵ Röder, “Die Steinbrüche”: 32, fig. 18; 47–48 has a detailed description.

⁵⁶ Röder, “Die Steinbrüche”: 45–47.

⁵⁷ Röder, “Die Steinbrüche”: 45.

for quarrying one square metre of marble.⁵⁸ This required experienced craftsmen who could monitor the breaking process and react in case of mistakes. (5) After the column had been broken free on both sides, the column was worked on at each end. This could be done either in a semi-circular form or in a full curve.⁵⁹ The next step was the shaping of the semi-circular column, which was done with pointed chisels, hammers and mallets. The surface of the column was worked on piece by piece between the rounded corners along the entire length of the column. For this, the deeply hewn shot from the first step was relevant, as the workers had to climb into the shot and sometimes work in uncomfortable positions. As soon as the rounding was created, the decisive event of detaching the workpiece was executed. We can deduce from the blanks lying in the quarry zones that it was during this part of the process that most errors happened. The semi-cleared column was wedged off the rock or partially cleared by deeper cuts.⁶⁰ These steps were carried out by several trained workers who kept the rock under tension or wedged it directly with wooden slats.

Preparing the column

After the column shape had been detached from the rock, it was moved from the quarry site to the work site with ropes, hoists and beams and then suspended so that it could be worked on all around. For the transport of a column of about 8 metres in length and a weight of about 20 tonnes, draught animals were probably necessary. (6) At the work site, any projecting material was removed with different tools, mostly with iron or wooden chisels. This was followed by a rough trimming, during which the broken material was checked. (7) At this point at the latest, the mason's marks would be put on one end of the workpiece, if this had not already been done beforehand when the compass point was applied. For the production of a semi-processed column of 8 metres in length

⁵⁸ Röder, "Die Steinbrüche": 49.

⁵⁹ Röder, "Die Steinbrüche": 47.

⁶⁰ Röder, "Die Steinbrüche": 47 and tav. 47c. 57c with some examples.

and one metre in diameter in Simitthus, Röder calculated an average of 860 man-hours, which, if we assume an eight-hour working day, corresponds to approximately 108 days. If at least four workers were permanently assigned to the stonemasonry work, it would have taken them 27 days until a column with these dimensions was ready for transport.⁶¹ Whether an inspection and examination of the column was carried out by the *procurator marmorum* or his staff cannot be proven, but it is plausible, since the responsibility for the workpiece included the delivery of defect-free material. An inscription or other markings may also have been added during this process (8).

Transport within the quarry

(9) We can assume that during transport, our column was securely fixed and that experts did the work. The preserved post holes in the quarries (fig. 2) make it likely that the column had been lowered onto a sledge or wooden rollers for transport.⁶² Depending on the specific point of origin of the column, it may have been possible to roll it down the southern slope so that it would have reached the north-south road that ran there. The length of the road, its course and its proximity to the quarry areas cannot be determined in the north, but in the south, it probably led to a loading station on the Medjerda River. Our column would most likely have been transported to this station on wooden sledges with logs.⁶³ (10) Transport experts would have been responsible for this, as the column had to pass through the city and many draught animals were needed.⁶⁴

⁶¹ Compare Röder, “Die Steinbrüche”: 47–49 to these calculations.

⁶² Korres, *Penteli*: 26–31; Röder, “Die Steinbrüche”: 1993, 50.

⁶³ See Colin E. P. Adams, *Land Transport in Roman Egypt* (Oxford: Oxford University Press, 2007): 67–68, with comparisons from Egypt; Hirt, “Chresimus”; Hirt, *Imperial Mines*: 332–342; Russell, *The Economics*: 98.

⁶⁴ See Russell, *The Economics*: 99–100, with comments on the draught animals in such transports.

To what extent experienced military personnel were involved in these transport operations cannot be inferred for Simitthus.⁶⁵

Transport to the export port in Carthage

(11-12) For lifting and loading of columns of this size, there must have been permanently installed cranes at a river site in Simitthus, most likely slewable cranes, which could have been used for these purposes.⁶⁶ For a column weighing 20 tonnes, it needed a balancing ballast as cargo on a small river ship.⁶⁷ For river transport across the Medjerda, vessels with a loading capacity of up to 100 tonnes were probably common.⁶⁸ In general, flat-bottomed boats (e.g., prahms) would have been used for river transport.⁶⁹ The transport was most likely organised by private skippers who acted in cooperation with the *procurator marmorum* or other middlemen and were financially remunerated for these activities.⁷⁰ Depending on the vessel's loading capacity and ballast, they could load additional goods and sell them along the route and at the destination.⁷¹ To ensure a continuous supply, transport needed to be well-organised. This was possibly one of the reasons why a *procurator marmorum* was appointed in Simitthus in the second century AD. We can assume that the shipping network on the Medjerda was as stable as that on the Tiber in the imperial period.

⁶⁵ Hirt, *Imperial Mines*: 179–85, doubts the involvement of soldiers in Simitthus in the transports as they were much more likely to guard the prisoners in the camp; contra Russell, *The Economics*: 41, 100–103.

⁶⁶ Maischberger, *Marmor in Rom*: 31.

⁶⁷ Röder, “Die Steinbrüche”: 51.

⁶⁸ Maischberger, *Marmor in Rom*: 29–30; on cargoes and river ships, see Ronald Bockius, “Antike Prahme. Monumentale Zeugnisse keltisch-römischer Binnenschifffahrt aus dem 2. Jh. v. Chr. bis ins 3. Jh. n. Chr.,” *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 47, no. 2 (2000): 439–93.

⁶⁹ Maischberger, *Marmor in Rom*: 29–30; for a detailed discussion of this issue and the relevant ancient sources, see Bockius, “Antike Prahme”: 439–93.

⁷⁰ Pascal Warnking, *Der römische Seehandel in seiner Blütezeit. Rahmenbedingungen, Seerouten, Wirtschaftlichkeit* (Rahden: Verlag Marie Leidorf, 2015).

⁷¹ See Warnking, *Der römische Seehandel*: 154, on the division of labour between *gubernatores* and *magistri naves* on the ships.

After several days, the skippers and forwarders would bring the column to the mouth of the Medjerda in Utica. (13) There, they would transfer their goods for Carthage either to some form of land transport or to another ship; or they would have continued to the port of Carthage by sailing along the coast. In the latter case, they would have had the advantage that after unloading their cargo, they could load new trade goods for interested parties and trading partners and return to the hinterland (14).⁷² Whether marble products were temporarily stored in Carthage or not depended on the onward transport. In any case, cranes would again have been necessary to transfer our column to a larger ship due to its great weight. These operations were probably organised by several middlemen in the harbour.⁷³

3.2. Relations and Dependencies among the Workers within each Worksite

The examination of this chaîne opératoire exemplifies what was probably the most common method of procuring workpieces from Simitthus in the mid and late second century AD. The majority of the quarried columns were the results of *locatio-conductio*-contracts with leases and subleases, which ensured both the continuous work of the quarries and the constant procurement of material, and so met the demand of both the emperor and the interested parties in the market. Guided by the supervision of the *procurator marmorum*, the workshops worked out the contracted quantities of blocks and columns according to the defined orders, and very probably for a quarry-to-stock system, so that this material was available for delivery to its destinations and the flexible use afterwards⁷⁴ (fig. 4).

⁷² See Simon Keay, “The Port System of Imperial Rome,” in *Rome, Portus and the Mediterranean*, ed. Simon Keay, Archaeological Monographs of the British School at Rome 21 (London: The British School at Rome, 2012): 46, on similar procedures with the boatmen on the Tiber and the *naves caudiciae*.

⁷³ For references, see Bockius, “Antike Prahme”; Warnking, *Der römische Seehandel*.

⁷⁴ Russell, *The Economics*: 314–16 for make-to-stock in the imperial period.

There were several dependencies within this marble procurement system in the quarries, which I have divided into systemic-structural and personal dependencies. The operation of the quarries, or the areas of the quarry that were part of an imperial possession, depended heavily on this system (fig. 4). Without the *procurator marmorum* as the highest official of the administration on site – the local workshops which carried out the quarrying and processing, and the interested parties – the operation of the quarries would not have been possible and successful over this long period. The various dependencies are taken into account in the respective contracts, whereby profit margins are calculated, and these dependencies kept the system in continuous operation and in a certain balance. This means that not only was the *procurator marmorum* dependent on the emperor – as owner and at the same time as the highest awarding authority of the quarry concessions – but that the emperor was also dependent to a certain extent on the procurator and his staff, who were able to generate profits for him and profits for themselves, too. The emperor and the procurator, as well as the imperial slaves, were also tied together by their individual personal dependencies.⁷⁵ Here, almost every individual was dependent on the other in order for the whole chain to function. In fact, everyone was forced to work together in this system. An inscription from Simitthus, which commemorated a local resident woman, was commissioned by a man named Galata, who described himself as the emperor's *verna* (a house-born slave). This not only shows Galata's close personal connection to the emperor, but also demonstrates that a slave could erect and finance a large tomb for a deceased female citizen of the city.⁷⁶ His personal connection to the imperial house as well as his work within an imperial economic system therefore allowed

⁷⁵ For examples, see Paul Richard Carey Weaver, *Familia Caesaris. A Social Study of the Emperor's Freedmen and Slaves* (Cambridge: Cambridge University Press, 1972), with some details on the *familia Caesaris*; Koenraad Verboven, *The Economy of Friends. Economic Aspects of Amicitia and Patronage in the Late Republic*, Collection Latomus 269 (Brussels: Latomus, 2002); Hirt, *Imperial Mines*; Mouritsen, *The Freedman*.

⁷⁶ Khanoussi, "Les Officiales"; AE 1991, 1681; Mustapha Khanoussi, "L'armée romaine et les carrières impériales de marbre numidique," in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 65–68; AE 1994, 1883.

the slave to raise the funds and endow the building. Moreover, and similarly, as a member of the *familia Caesaris* (and part of the imperial slaves and freedmen), the procurator worked for his patron, while imperial prestige could elevate him to a higher legal status level. His office made him a colleague to other procurators in the province, some of whom held the rank of knights and enabled him to do business with senators and knights to whom he was otherwise subordinate in his status as a freedman.⁷⁷ Buildings donated by the *procurator marmorum* at Simitthus carry dedications both to the emperor and to the governor of the province and they also show the close connection between the procurator and both the emperor and the governors as well as the participation in official representational activities of cities as benefactor⁷⁸.

Contracts created further dependencies, both structural and personal, between the workshops as well as the other contractual partners and the *procurator marmorum*. The workshops supplied the material according to the orders and contracts, and were highly dependent on orders and profit margins. High demand and many orders, above all, enabled increasing profits. This in turn allowed the workshop owners to increase their influence and in the long run also to rise socially, at least in their local surroundings.⁷⁹ The workshop owners acted as contractors (*conductores*); they got their concession from the emperor, or through his procurator, and with this, the right to quarry. The workshop owners also used their own capital and staff in this way, but the emperor, as owner of the quarries, was especially dependent on the workshops, which guaranteed the provision of the material to him and could negotiate conditions.⁸⁰ The extant archaeological and written evidence allows us to answer the question of individual relationships or dependencies between the workers in a given workshop only to a very limited extent, because almost nothing is known about the personal composition of the workshops in the quar-

⁷⁷ For detailed examples, see Weaver, *Familia Caesaris*; Schmall, *Patrimonium*.

⁷⁸ On the *procuratores marmorum Numidicorum* as benefactors see Beck, *procuratores*.

⁷⁹ For some examples, see Hirt, *Imperial Mines*: chapter 7; Mouritsen, *The Freedman*.

⁸⁰ Russell, *The Economics*: 54.

ries⁸¹. It is also unclear whether the workshops employed convicts, who were certainly considered cheaper labour. Although the labour force in the quarries is well documented overall, virtually no self-testimonies of convicts and slaves have been preserved. We can only deduce some individual tales from inscriptions in the quarries at Simitthus. One of the rare examples is a dedicatory inscription by the slave Dorus. He worked in the workshop named Junonis and donated a votive to the god Saturn to fulfil a vow he had made.⁸² In the inscription, Dorus reports that he is being sexually abused (*pedicatur*, sodomised), although he does not say by whom. This shows his lack of freedom and his inability to decide about his own body. This testimony may not represent a general picture of the people in the workshops, but it provides concrete insights into everyday life. The majority of the workers will have been men, although this cannot be proven from the sources; it is, however, generally assumed and widely accepted, as well as very plausible, due to the physically demanding nature of the work.⁸³

The personal relationship between imperial slaves and slaves of private entrepreneurs is an interesting factor, but this information cannot be obtained from the sources in the quarries. Very likely, the slaves of interested parties would have carried out the ordering and procurement of marble for their masters, so that there must have been interactions, although these probably did not take place with fellow slaves, but rather with imperial administrative personnell, due to the authority of their patron.⁸⁴ Sometimes the slaves of city dignitaries interacted with imperial slaves, but this can only be assumed because of logical processes,

⁸¹ For Simitthus, the only names known are those of the workshops listed by Hirt. We do now know enough to be able to say how the workshops were staffed, Hirt, *Imperial Mines*: 420–28. In general, see Groen-Vallinga and Tacoma, “Hard Labour”: 67.

⁸² AE 1994, 1876; Theodor Kraus, “Steinbruch- und Blockinschriften,” in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 59 Neu 29, Tav. 61 b.

⁸³ Some women are testified as workshop owners (*officinatrices*), and they were probably active in several sectors of the economy; see Päivi Setälä, “Women and Brick Production – Some New Aspects,” in *Women, Wealth and Power in the Roman Empire*, ed. Päivi Setälä et al. (Rome: Institutum Romanum Finlandiae, 2002): 181–201.

⁸⁴ On this subject and the agency of slaves see Groen-Vallinga and Tacoma, “Hard Labour”: 63.

and is not mentioned in the sources explicitly. Alfred M. Hirt has comprehensively discussed these questions of interdependencies on the basis of the available sources in his volume about imperial mines and quarries.⁸⁵

Inside the workshops, there were probably hierarchically structured work units at least due to the division of labour in several steps of production (see 3.1; fig. 1). With regard to the workshops, however, it is important to consider the individual legal statuses of the workers and the significance of these statuses within the system in a differentiated way. It was quite possible for slaves to be specialists in the manual processing of workpieces and to take on important tasks within the process chains. The specialization and division of work within a quarry crew is likely to have led to the temporary disappearance of status significance. Slaves as specialized craftsmen may also have organized the work of free citizens and freedmen who worked in the quarries as day labourers, and may have been mostly unskilled workers. Therefore, it must have been possible, at least for the slaves of workshop owners, to earn money through certain tasks, and even to buy their freedom. These observations have already been made in several fields of work. This permeability in status and rights is particularly important within the entire Roman economy. In some institutionally supported sectors of the economy, an individual's legal status could be less important than their expertise and specialization.⁸⁶ This issue has been defined by Arjun Appadurai with the concept of the 'social landscape'.⁸⁷

The permeability and different statuses definitely did not include the convicts and *damnati ad metalla*, who usually worked in the quarries until they died. Without doubt, they formed the lowest group within the

⁸⁵ Hirt, *Imperial Mines*: chapter 7, "Private Partner to Imperial Operations: *Occupatores/Coloni* and *Conductores*," on the subject of private slaves and entrepreneurs; see also Russell, *The Economics*: 54–56.

⁸⁶ See Mouritsen, *The Freedman*; Broekaert, "Freedmen": 222–53.

⁸⁷ The term and concept of the "social landscape" have been defined in Arjun Appadurai, "Disjuncture and Difference in the Global Cultural Economy," *Theory, Culture and Society* 7 (1990): 295–310, and Martin Albrow, *The Global Age – State and Society beyond Modernity* (Cambridge: Polity Press, 1996). According to this concept, the social landscape is composed of social networks of individuals who form collective identities and interactions with each other based on their life circumstances or common undertakings and occupations.

hierarchy of the quarry. It is commonly held in scholarship on the imperial quarries that criminals and convicts were sent to the quarries for punitive labour in the Roman imperial period. However, these so-called *damnati ad metalla* are far from being well-studied.⁸⁸ During the peak period of quarrying in the second century AD, this group would have made up only a small percentage of the enormous amounts of labour required.⁸⁹ The bulk of the work must have been carried out by slaves who were either hired out or bought by private individuals or interest groups, especially since labour had to be constantly available.⁹⁰ The convicts were dependent to the highest degree on the *procurator marmorum* and workshop owners, as their lives lay in the hands of the local administration and workers: the *damnati* had already been sentenced to death, as it is evidenced for instance by a rescript under Hadrian⁹¹. They were subject to the harshest punishments if they did not do the work, so that they not only worked under coercion, but were also forced to work without respite.

3.3. Interagency and Spatial Relations as Indicators for Dependencies

In the study of personal dependencies, a particular focus lies on the sites of interaction. This was where the different status groups came together and acted in terms of their (institutional or personal) tasks. The guiding concept of interagency can therefore be combined with the method of

⁸⁸ Gaius, Dig. 28.1.8.4; see Hirt, *Imperial Mines*: 97, on the issue of the *damnati ad metalla*; while Russell, *The Economics*: 41, disputes the archaeological and epigraphical evidence on the *damnati ad metalla* in the quarries.

⁸⁹ See Groen-Vallinga and Tacoma, “Hard Labour”: 53; 60 on the problem of quantifying the number of *damnati*. See Beck, *Simitthus*, for references and a discussion of a possible parallel structure by exclusively imperial quarry teams in the quarries that were run by military officials and where convicts very probably worked.

⁹⁰ Hirt, *Imperial Mines*: chapter 7; Russell, *The Economics*: 41.

⁹¹ Gaius, Dig. 28.13–14: *qui in tempus damnati erant, in perpetuum damnarentur, qui in perpetuum damnati erant, in metallum damnarentur, qui in metallum damnati id admiserint, summo supplicio adficerentur*; Gaius Dig. 48.19.8,7 for a similar description of penalties; see also Groen-Vallinga and Tacoma, “Hard Labour”: 53.; 63–65 on the Roman penal system.

the chaîne opératoire, thus allowing for renewed individual observations at places.⁹² All actors are reflected in their interactions with other actors, and therefore their activities are linked to spaces and times as methodological frames. This results in a detailed view of the actors themselves, distinct from or in combination with the others, including their fields of action.⁹³ One characteristic is the study of individuals who interact according to their professional tasks and are only visible in the sources in those specific terms. The name of a workshop, of a contractor or even the responsibility for a quarry area belonging to the emperor become visible within the interlinked actions.

Let us take as an example the *procurator marmorum* and his dependence on several people and groups (fig. 4). To separate the local from the distant and superordinate, the interdependencies according to networks can be divided into global and local.⁹⁴ Starting with a global perspective, the procurator and the emperor were personally and structurally interdependent within the marble business. In addition, there were certainly several other imperial freedmen, slaves and contractors who were dependent on the procurator in a global perspective, in particular in the marble business. In local terms, the procurator was in interaction with nearly all possible status groups by the authority of the emperor: senators and members of the provincial and city elites could have dealt with him and signed contracts. Interaction with the local administration of the city of Simitthus and the surrounding area as well as neighbouring cities must have been very important for representa-

⁹² On the term “interagency,” see Julia Winnebeck, Ove Sutter, Adrian Hermann, Christoph Antweiler and Stephan Conermann, “On Asymmetrical Dependency,” *Concept Paper* 1, Bonn Center for Dependency and Slavery Studies (2021): 10–11, <https://www.dependency.uni-bonn.de/en/publications/bcdss-publishing-series/bcdss-concept-papers> [accessed 13.04.2023]; see further Christoph Antweiler, “On Dependence, Dependency, and a Dependency Turn,” *Discussion Paper* 1, Bonn Center for Dependency and Slavery Studies (2022) for additional definitions of the terms dependence and dependency.

⁹³ On this, see Winnebeck et al., “On Asymmetrical Dependency”: 6; for the concept of interagency, see Juliane Schiel, Isabelle Schürch and Aline Steinbrecher, “Von Sklaven, Pferden und Hunden. Dialog über den Nutzen aktueller Agency-Debatten für die Sozialgeschichte,” *Schweizerische Gesellschaft für Wirtschafts- und Sozialgeschichte* 32 (2017): 17–48.

⁹⁴ Müller, “Netzwerkanalysen”: 736 fig. 1.

tion and participation in social life. The procurator's staff might include other freedmen and slaves, so that here, too, similar and lower status groups worked together.⁹⁵ On basis of the inscriptions found at Simitthus, the staff consisted at least of a *dispensator*⁹⁶ and a *vicarius*.⁹⁷ Both inscriptions can be dated to the second century, and both officials were slaves. However, this does not prove that these offices were permanently part of the procurator's staff.⁹⁸ In fulfilling their tasks, the procurators were heavily dependent on their subaltern staff, for which they needed experts and specialized, skilled people⁹⁹. In addition, procurators interacted with free citizens, with Roman or other citizenships, who worked in the workshops and who, strictly speaking, were part of the contracts concluded (fig. 4). However, these organizational structures were far from being solid. Although the hierarchies were certainly clarified in the quarry administration, the procurator acted as local representative of the emperor in dependence on the latter. Urban elites up to senators and representatives of the provincial administration were therefore in contact with both the emperor and the procurator for possible business. Here, the differences in status of the actors existed in principle, but the high position of the emperor probably enabled the procurator to negotiate contracts on equal terms. Furthermore, the procurator very probably had direct contacts to members of the military of different ranks, although no authority to issue directives can have existed due to the competence and status differences. At Simitthus there are no sources for the interaction of the military and the marble procurator, although there

⁹⁵ Hirt, *Imperial Mines*: 165; Russell, *The Economics*.

⁹⁶ AE 1991, 1681; AE 1994, 1883; see Mustapha Khanoussi, "Les officiales marmorum Numidicorum," in *L'Africa Romana. Atti del XII convegno di studio. Olbia, 12–15 dicembre 1996*, vol. 2, ed. Mustapha Khanoussi, Paolo Ruggeri and Cinzia Vismara (Sassari: Editrice Democratica Sarda, 1998): 997–1016; further Beck, *procuratores*; Beck, *Simitthus*.

⁹⁷ AE 1994, 1884; Mustapha Khanoussi, "*Les officiales*": 1009 nos. 25. 26.

⁹⁸ The epigraphic evidence is not suitable for determining the responsibilities and precise functions of these officials within the organisation of the quarries. Only in the case of Mons Claudianus does the internal correspondence between the imperial officials provide enough information to assess their role in the administration of the quarries, see on Mons Claudianus and some other evidence Hirt, *Imperial Mines*: 251–60.

⁹⁹ On the functions of the imperial procurators and the imperial staff see Hirt, *Imperial Mines*: 258–60.

clearly must have been cooperation on the ground due to the division of tasks. Insofar as the commander of the military unit was responsible for the supervision and punishment of prisoners and slaves, there was interaction between procurator and commander.¹⁰⁰

In addition to the theoretical reflections on interdependence, it is above all spatial relations and temporal contexts that provide a more precise picture of individuals and groups in interaction. In the quarries, the workplaces are specific spaces that must be studied in detail to identify actions and actors, as well as dependencies between actors and between actors and the place and their tasks. The quarries must therefore be examined for usable traces and remains in terms of archaeological and epigraphic sources. Unfortunately, actual workplaces or workshops are extant in only very few places.¹⁰¹ Problems in identifying such workplaces include the fact that buildings have been destroyed, there were later alterations or remodelling, as well as backfilling or even the absence of permanent workspaces. However, in very few cases, for example, at Simitthus and in some Egyptian quarries, there were specialized workshops and shelters in the Roman imperial period which can still be investigated in terms of their actors and their social status. Inscriptions found in the quarries make it possible to locate individual workshops within the quarry areas, and also to date their working period (fig. 2). Some processing remains, and saw marks also show the technical aspects of quarrying and allow these to be hypothetically linked to certain work processes and workshops.¹⁰² However, the mapping of the workshops only shows the distribution and concentration of the work areas. There are areas close to the city as well as more distant areas, although the remains do not reveal any details about ownership. In the quarries, the material was not only quarried but also largely processed

¹⁰⁰ In this case, too, the Egyptian quarries provide evidence of interaction between the military and procurators, but some tasks in the quarries of Egypt could only be managed and supervised by soldiers, see Hirt, *Imperial Mines*: 94–98; Groen-Vallinga and Tacoma, "Hard Labour": 62.

¹⁰¹ Röder, "Die Steinbrüche"; Hirt, *Imperial Mines*; Beck, *Simitthus*.

¹⁰² See Röder, "Die Steinbrüche," with some descriptions and observations in combination with fig. 2.

and manufactured for transport. Specialized craftsmen worked side by side with unspecialized workers (see 3.1).

Moreover, at Simitthus, a partially excavated large building complex – the so-called labour camp or, in German, ‘Arbeits- und Steinbruchlager’ – makes it possible to study actors and (inter)actions at work in space.¹⁰³ The architectural context can be complemented by archaeological and epigraphical finds to form an overall picture. The archaeological findings as well as inscriptions testify to its use as a so-called *ergastulum* (a prison-like building) where slaves were housed and very probably kept under surveillance by the Roman military during the first phase of the building.¹⁰⁴ Individual remains of discarded workpieces as well as substances like sawdust are archaeological legacies of the activi-

¹⁰³ For the investigations at the camp in Simitthus, see Khanoussi, “L’armée romaine”: 65–68; Friedrich Rakob, “Das römische Steinbruchlager (praesidium),” in *Simitthus II. Der Tempelberg und das Römische Lager*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1994): 51–139; and Mackensen, *Simitthus III*.

¹⁰⁴ The area was discovered during aerial surveys by the Service Topographique Tunis in 1962. In a joint project of the Institut National du Patrimoine, Tunis, and the German Archaeological Institute, the first excavations took place between 1968–1974 and 1978–1979. They focused on the central building with its six naves. Excavations in the eastern sector were carried out under the direction of Mustapha Khanoussi. The most recent excavations were carried out by Michael Mackensen in 1998; see Mackensen, *Simitthus III*. Geophysical investigations in 2010–2013 brought further information on the internal organization and extent of the complex; see von Rummel et al., “Geophysikalische Prospektionen in Simitthus (Chimtou, Tunesien). Vorbericht zu den Kampagnen 2010–2013,” *Kölner und Bonner Archaeologica (KuBA)* 3 (2013): 203–16. The construction process of the central building has been dated to the 170s AD by means of an inscribed block from the year 154 AD with a terminus post quem (earliest possible date for the building process), ceramics, coins and construction techniques. In the first phase, the building complex was 95 m wide, 105 m long and covered an area of 0.96 ha. All buildings were oriented north to south. There were no excavations in the western district, but in light of the same *opus africanum* construction technique and wall thickness there, it may belong to the same phase. The building with six naves was 37 m wide and 80 m long. The foundations of the nave walls were two metres deep; the perimeter wall, 4.5 m high. In the second phase, starting in the 3rd century AD, the central building was converted into a *fabrica* (factory) with a new internal organisation and the construction of grinding machines, small workplaces and sawing devices. Huge layers of rubble were found inside the building during the excavations. It can only have been used as a *fabrica* from about the 230s until 253 because large parts were destroyed when the ceiling collapsed. At that time, the entire complex covered an area of 1.8 ha; buildings were added to it along the sides. After several modifications, marble was processed in the central building until the 280s, when a collapse brought production to a halt. For the chronology, see Mackensen, *Simitthus III*: 100.

ties in the respective workshop areas. These show a general separation. Larger workpieces were always processed in the quarries at workplaces or stations, while only smaller workpieces were processed in the workshops. In the so-called labour camp, the central building has six naves with narrow entrances and workplaces between the sleeping quarters.¹⁰⁵ Since the sleeping quarters are located between the workplaces and are generally cramped, scholars assume that a large number of slaves and convicts were housed here. The gates of the massive building could only be locked from the inside, which is why surveillance by military units is always assumed in research¹⁰⁶. Due to the accommodation of slaves and prisoners as well as soldiers and possibly the imperial quarry administration in various buildings within the large complex, security measures were immense. The separation of the different groups was possible inside the buildings, but in the quarry area slaves and prisoners worked side by side with free citizens and workshop personnel, so that supervision by the military was necessary. The heavy work in particular required a large number of workers, who together might start a mutiny.¹⁰⁷ In addition, the inhabitants of the nearby civilian town of Simitthus also had to be protected from attacks or escaping prisoners. The presence of military units is a strong indicator of interdependence of provincial administration and imperial quarries, because the soldiers must have worked for the provincial governor and belonged to the legion stationed in the province.¹⁰⁸

¹⁰⁵ Röder, “Die Steinbrüche”; Rakob, “Das römische”; Mackensen, *Simitthus III*; Beck, *Simitthus*.

¹⁰⁶ Khanoussi, “Les Officiales”; Mustapha Khanoussi, “L’armée romaine et les carrières impériales de marbre numidique,” in *Simitthus I. Die Steinbrüche und die antike Stadt*, ed. Friedrich Rakob (Mainz: Philipp von Zabern, 1993): 65–68; Hirt, *Imperial Mines*; Beck, *Simitthus*.

¹⁰⁷ See Groen-Vallinga and Tacoma, “Hard Labour”: 53; Fernández-Götz et al., “Dark Side”: 1635–38.

¹⁰⁸ See Hirt, *Imperial Mines*: 210, on this issue. “Army detachments deployed on guard duty, and possibly for the technical support of imperial quarrying establishments, usually came from the same provinces where the quarries were located, with the exception of the administrative or technical specialists brought in for specific tasks. *Procuratores metallorum* (and *marmorum*) could very probably rely on military commanders and officials to assume additional administrative functions if required to do so. As the legions and/or auxiliary units stood under the command of the provincial governor, he probably ordered their deployment to the imperial quarries or mines. Moreover, the

It was therefore probably mainly slaves and prisoners who carried out the grinding work on the marble objects inside the building. At this location, parallel to the workshops in the quarry, there was thus another space for interaction between actors of different statuses, especially since the administration of the quarries – the procurator and his staff – was housed in an adjacent building. In these workshop units, there were specialized workers who carried out the fine work, while others only carried out rough work and rubble clearance. The most dangerous work took place in the quarries themselves, namely the quarrying of blocks and columns as well as their removal and transport. These most dangerous tasks were probably carried out by the unskilled workers and convicts, especially those that involved mortal dangers, to which slaves from private workshops or imperial slaves would not have been readily exposed. By contrast, despite their confinement, the workers in the labour camp were likely to have been skilled craftsmen assisted by less skilled people. Different officials of the administration, possibly the procurator himself, were probably also present in the workshops during inspections of the material. Both areas, the quarries and the workshops, were dependent on the constant supply of workers, labour and also on the constant training of specialists. Although the imperial administration was in charge under the direction of an imperial freedman as *procurator marmorum*, the chaîne opératoire analysed above and the further considerations of place-space analyses and interdependencies show that probably the provincial administration, citizens of the city of Simitthus and various private entrepreneurs were also always involved in the operation of the quarries. Marble procurement was therefore strongly dependent on the different actors and status groups, while these were to some degree dependent on the system in order to rise socially, to extract resources or to earn money.

provincial governors also remained responsible for the pay and supply of the troops with basic provisions.”

4. Summary and Further Questions

To sum up, the rich evidence at Simitthus allows for the reconstruction of process chains in the quarrying of marbles as well as the administrative networks, which were mostly based on individual and economical dependencies between the emperor, imperial freedmen, contractors, slaves, and convicts. I have thus been able to show different degrees of both asymmetrical and strong asymmetrical dependencies at the quarries. Both personal and structural dependencies were driving forces in the processing of marbles in several quarries in the Roman Empire, Simitthus included. For this system to work, the emperor relied on a whole network of people and institutions who were mainly, albeit in varying degrees, dependent on him. In fact, the interconnection of individual, personal and economical dependencies, some of them strong, guaranteed both continuous quarrying and the constant supply of some highly valuable marbles during the high empire in general. However, these individual and economic dependencies were in some perspectives necessarily reciprocal. Freedmen, slaves and entrepreneurs in the business could benefit from them, as could the emperor, too. These administrative networks in quarrying and marble trading have comparable equivalents in other economic sectors. Similar contract models are known from the operation of imperial *latifundia* in Roman North Africa, for which we have information from the *lex Hadriana de agris rudibus* and *lex Manciana*. In addition, the procurement of material by freedmen and slaves was a common practice in the economy in the Roman world, usually based on the system of support, patronage and obligations. The *procuratores marmorum* were economically heavily dependent on the emperor because of their personal connection to the emperor as their patron. The more skilfully they operated, the higher were the profits they made from producing and marketing surpluses.

These results and hypothesis show a need for further research, especially in the interlocking of networks and groups in economic sectors. It should be emphasized that an individual's legal status could be less important than their expertise and specialization, and that the various dependency systems, such as the patron-client system or the Roman con-

cept of *amicitia*, also played a major role in the economic development of the quarries. On the one hand, the knowledge and specialisation of the individual slaves and freedmen were used specifically in the individual economic sectors. On the other hand, slaves were also used en masse, just like prisoners, to perform heavy and dangerous works. Slaves and convicts usually worked under the supervision of experienced persons from workshops and often supervised by guards and soldiers. In these cases, it can be assumed that they were considered as a mere mass of people necessary to carry out menial tasks. If there were experienced workers among these slaves, they were probably specifically employed for certain activities and thus bore greater responsibility than others in their status group. It is essential to realize that in almost all the central steps of marble extraction and processing, slaves and sometimes convicts were involved. Without their work, extensive production could not have taken place in antiquity. However, these are often not accessible through self-testimonies, which is why specific models have to be developed to ensure a comparable investigation.

Appendix

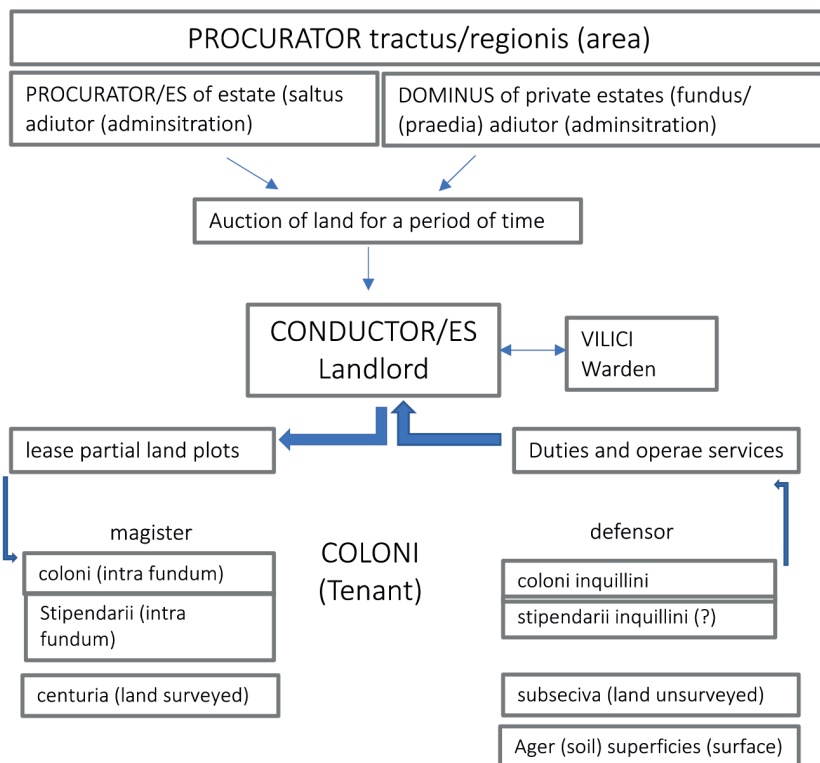


Fig. 1: Schematic of the administrative and organizational structure of imperial possessions based on the *lex Manciana*. Translated and modified according to the original by P. Scheduling.

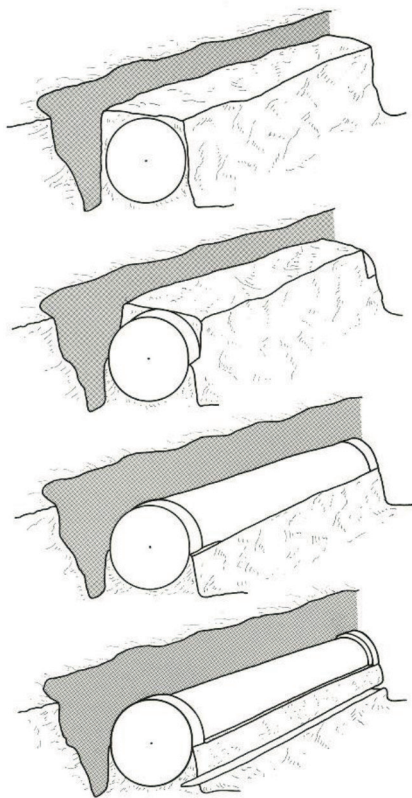


Fig. 3: Degradation process of a column.

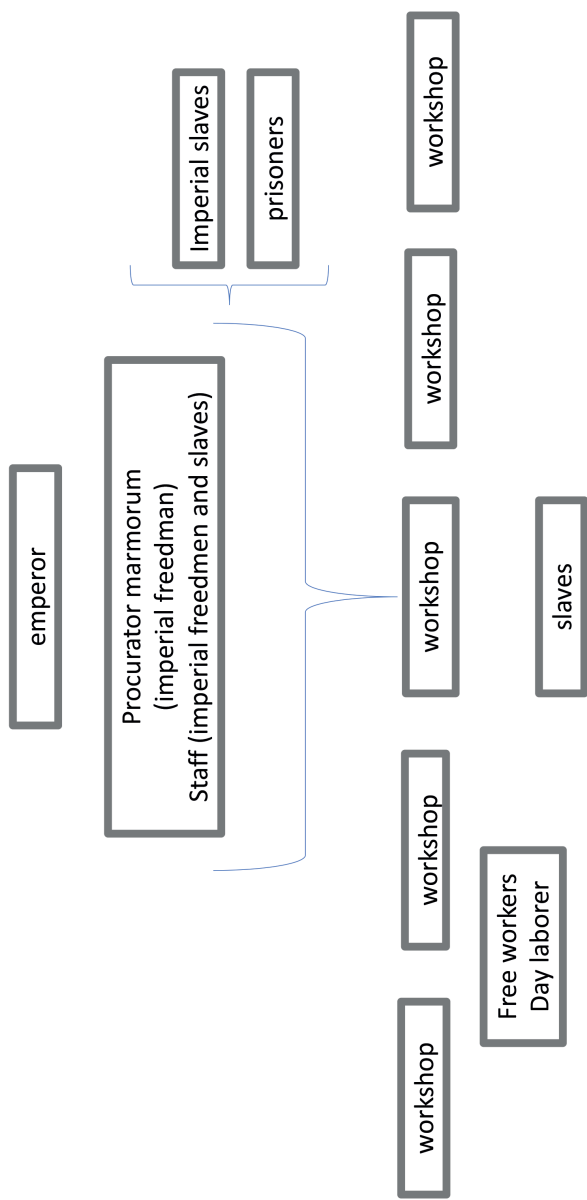


Fig. 4: Structure of administration in the quarries at Simitthus in the High Empire.

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Quarries are an interdisciplinary research topic for scholars who are interested in technical organization, economy, work processes and supply chains. In antiquity, the quarrying and trade of stone were highly dependent on persons from a variety of legal status groups and their cooperation in networks and institutions. Research shows that during the high Roman Empire, some quarries both belonged to the Roman emperor and were operated by an administrative structure that was highly dependent on him. Although the administrations were organized in a strict hierarchy, they depended much more on the emperor and the officials he employed than on the legal statuses of individuals. Slaves and freedmen gained importance due to their specialization in business. Characteristic is the cooperation of these actors within different fields of work in the economy, but in many cases it cannot be determined in detail merely from the sources, and requires research models. By using the chaîne opératoire and analyzing the quarry at Simitthus as an example, the paper shows to what extent this methodology is suitable for identifying dependency relationships between individuals. In addition, interagency and spatial relations can serve as indicators of dependencies among the actors, and network analysis offers insights into administrations in imperial quarries.

THE AUTHOR

Dennis Mario Beck is a classical archaeologist, employed at the Department for Classical Archaeology at the Institute for Archaeology and Cultural Anthropology at the University of Bonn. He uses both archaeological data and literary sources to study different forms of dependency in the Punic, Greek and Roman worlds. His focus is on the ancient economy and network systems that were based on various forms of personal and institutional dependencies in the extraction and trading of resources, especially stone. He has researched the operation of ancient quarries such as the marble quarries at Simitthus, taking into account various hierarchically structured networks of different social groups and their collaboration and interaction. His current research focuses on different actors in economic processes working together in networks of exploitation, trade, and completion, as well as on the methodological framework for investigating these actors, for example by mapping production chains.