UNDERSTANDING THE POST-POMPEIAN ERA

## Wall painting in the Roman Empire (AD 79-395)

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1 Introduction

Roman painting has been studied extensively on the basis of the excavations carried out in the city of Pompeii. As early as the nineteenth century, four Pompeian Styles were defined by August Mau, who studied the wall paintings dating up to AD 79, the year in which Mount Vesuvius erupted.[1] Naturally, the destruction of Pompeii did not mean the end of Roman painting. The medium of wall and ceiling painting continued to be in use to decorate buildings of all sorts within Roman Empire for at least three centuries. Since there is no city like Pompeii that functioned as its representative, the remnants are instead distributed over many archaeological sites.

In the meantime, countless painted walls and ceilings have been excavated both in Pompeii and beyond, and still more are being discovered. The Roman Empire reached its greatest extent only in AD 117, stretching from the modern countries England in the north to Egypt in the south, and from Portugal in the west to Iran in the east. Most of these territories continued to be ruled from Rome until the end of the fourth century, in AD 395, when the Empire was divided in two, the East and the West. Because of this vast area and time span, the amount of preserved wall and ceiling decorations is exceedingly great.

Within the study of Roman painting it is common to distinguish between time and space. The most recent publication *Antike Malerei zwischen Lokalstil und Zeitstil* (2014), edited by Norbert Zimmermann, fits perfectly within this tradition.[2] The *Lokalstil*, or local style, is focussed on a particular area, however large or small, whereas the *Zeitstil* is primarily concerned with a certain timeframe. Nowadays, the development of Roman wall painting up to the end of the first century AD is relatively well understood. For the centuries after AD 79, however, no such clear overview exists, caused by the scarcity of research on post-Pompeian paintings.

In order to be able to gain a better understanding of the ever-growing amount of unearthed monumental paintings originating from the post-Pompeian era, it will be necessary to eliminate this distinction between time and space. As this initially results in even more obscurity, a different approach is needed to deal with the extensive and complex corpus. This issue provides an interesting starting point to explore the possibilities of modern digital research methods. In all probability such

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[1] Mau 1882.
[2] Zimmermann 2014.

methods will offer the opportunity to present an alternative perspective on the still largely unknown nature of post-Pompeian Roman wall painting.

1.1 Current state of research

The study of Roman wall painting as a scholarly practice originates from the nineteenth century. The German art historian and archaeologist August Mau (1840-1909) studied the paintings of Pompeii extensively, and made it his life work to classify them. Pompeii was abandoned after the eruption of Mount Vesuvius in AD 79, which buried the city in volcanic ashes. As a result, many walls and wall paintings remained intact, and were retrieved during archaeological excavations since the middle of the eighteenth century. In 1882, Mau divided these paintings into four Pompeian Styles that correspond to four temporal phases in his publication entitled '*Geschichte der decorativen Wandmalerei in Pompeji*'.[3] Naturally, these Pompeian Styles deal with Roman wall paintings dating before AD 79.

Nowadays, Mau's four Pompeian Styles are still being used in the study of Roman wall paintings in a largely unchanged manner. In the words of Irene Bragantini,

> [i]f it is useful to have confirmation of the accuracy of the archaeological analysis carried out by Mau, it is of much greater importance to reflect on the fact that the feasibility of this typology, the actual possibility of its application, is a direct consequence of the function that domestic culture (and as a part of it, supported by ample evidence, wall painting) fulfils in Roman society during this period. […] Painting is now in fact an integral part of the social code expressed by the domestic system in the Roman house, a code produced by the interaction between the stereotypes of social imagination and their figurative articulation, a task that was entrusted to the 'producers of images'.[4]

Although Bragantini did not make use of the typology in her discussion of Roman painting, she did come to this conclusion in her final remarks on the period prior to the final episode of Roman painting.

To sum up, the so-called First, or 'Encrustation', Style was in vogue from circa 200 up to 90 BC. This style is an imitation of monumental masonry in stucco relief, which could be painted in bright colours (Fig. 1.1). The Second, or 'Architectural', Style primarily made use of paintings that 'opened up' the wall, and

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[3] Mau 1882.
[4] Bragantini in Pollitt 2014, 361-362.

roughly covers the period from 90 to 15 BC. The 'splendour of oriental palaces' was evoked by 'illusions of architectural grandeur' (Fig. 1.2). The Third Style, also known as the 'Ornamental' Style, on the other hand, dates from approximately 15 BC up to AD 45, and treated the wall in a predominantly two-dimensional manner. Centrally on large coloured areas were depicted framed picture panels (Fig. 1.3).[5]

Lastly, the Fourth, or 'Fantasy', Style is regarded as a combination of the preceding two styles turning the wall 'into a kind of baroque stage set' (Fig. 1.4). This style ranges from around AD 45 to 79 in Mau's classification, although the end date of the painting style is still disputed. Recently, Volker Michael Strocka has argued that the Fourth Style continued to be in use until around AD 120,[6] while in the same publication Eric Moormann and Stephan Mols postulated that this style came to an end at the latest in AD 140.[7] According to Roger Ling, it is already from the late first century onwards that the situation changes. Invoking the general assumption, he suggested that the number of surviving paintings decreased rapidly.[8]

Fritz Wirth made one of the first attempts to analyse the post-Pompeian material available to him in 1934.[9] Since then, these wall paintings have commonly been divided into the 'Hadrianic' (ca. 117-138 AD), 'Antonine' (ca. 138-193 AD), and 'Severan' (ca. 193-235 AD) period, based loosely on the reigns of the Roman Emperors, as well as the 'post-Severan' or 'Late third to fourth century' period.[10] In the most recent overview, however, Ling merely distinguished between the 'Middle' (late first century to the mid-third) and 'Late' (mid-third to the fourth century) Empire.[11]

In addition, there has been the study of Roman provincial styles, since the paintings retrieved from these provinces have their own characteristics and chronologies in comparison with the ones scholars like Mau encountered in Pompeii. The most prominent are Gallo-Roman, Romano-British, Romano-Egyptian, and Romano-German, which make use of the Pompeian Styles as well as the aforementioned indicators of time periods, with regard to the relevant region.[12]

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[5] Bragantini in Pollitt 2014, 359-361; Ling in Pollitt 2014, 370-371.
[6] Strocka in Zimmermann 2014, 30.
[7] Mols & Moormann in Zimmermann 2014, 106.
[8] Ling in Pollitt 2014, 371.
[9] Wirth 1968.
[10] Liedtke 2003, 5; Mielsch 2001, 5-6.
[11] Ling in Pollitt 2014, 373 & 405.
[12] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Roman provincial styles (consulted on June 29, 2015).

However, the relationship between these regions and the Roman Empire as a whole is still fairly unclear: mainly studies relating one region to the centre of the Empire, the Italian peninsula, have been carried out.

One other attempt to categorize the post-Pompeian Roman wall paintings of ancient Italy stands out. In her publication of 2003, Claudia Liedtke discussed the 'simpler' interior decorations, having a monochrome background colour, and originating from ancient Italy, with a strong focus on the excavated city of Ostia. She composed her own typology, consisting of the '*Ädikuladekoration*', the '*Felderdekoration*', the '*Rahmendekoration*', and the '*Lineardekoration*' (Fig. 1.5).[13] Unfortunately, these types proved to be inconclusive, as for the Italian peninsula alone it was impossible to assign 17 per cent of the wall paintings under study to either one of the four groups. Furthermore, they are incompatible with the wall paintings originating from other parts of the Roman Empire.[14]

Hitherto, scientific publications have dealt with post-Pompeian Roman wall painting on various levels: per building,[15] per building type,[16] per city,[17] per region,[18] and ultimately the whole realm.[19] The publications on painting within the Roman Empire in general discuss developments rather briefly, and mainly with a focus on the Italian peninsula. In addition, the proceedings of the three-yearly congresses of the *Association Internationale pour la Peinture Murale Antique* (AIPMA) provide bundled articles and other relevant material with respect to a specific theme.[20] Their latest publication, Zimmermann 2014, contains numerous articles of great importance to this study.

One of them is by Moormann and Mols, who present some interesting figures in their introduction to research on post-Pompeian painting:

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[13] Liedtke 2003, 9-12.

[14] Based on a paper by the author, entitled '*Nebenraumdekorationen des 2. und 3. Jahrhunderts in Ephesos*; Analysing the Wall Paintings of Terrace House 2' (2014), in which Liedtke's method was applied to the excavated city of Ephesus.

[15] E.g.: Strocka 1977 (on Terrace House 1 and 2 of Ephesus in modern Turkey); Weitzmann & Kessler 1990 (on the synagogue of Dura-Europos in modern Syria).

[16] E.g.: Moormann 2011 (on Roman sanctuaries).

[17] E.g.: Falzone 2004 (on ancient Ostia); Fink & Asamer 1997 (on ancient Rome); Thomas 1993 (on ancient Cologne); Thomas 2014 (on ancient Straubing); Willburger 2004 (on ancient Augsburg); Zimmermann & Ladstätter 2010 (on ancient Ephesus).

[18] E.g.: Abad Casal 1982 (on Roman Spain); Barbet 1974 (on Roman Gaul); Barbet 2013 (on Roman Tunisia); Clarke 1991 (on Roman Italy); Davey & Ling 1982 (on Roman Britain); Drack 1950 & 1986 (on Roman Switzerland); Gogräfe 1999 (on Roman Germany); Joyce 1981 (on Roman Italy); Liedtke 2003 (on Roman Italy).

[19] E.g.: Baldassarre & Müller Renzoni 2002; Ling 1991; Mielsch 2001; Pollitt 2014; Wirth 1968.

[20] E.g.: Barbet 2001; Moormann 1993; Scagliarini Corlàita 1997; Zimmermann 2014.

Let us consider some recent publications, beginning with two French ones, the influential book of A. Barbet from 1985 and the 2005 publication of J.-M. Croisille, respectively entitled: *La peinture murale romaine*, and *La peinture romaine*. A. Barbet primarily discusses the Campanian material, and did not treat post-Pompeian paintings at all. In only 24 of his 300 pages, does J.-M. Croisille discuss examples after 79 AD. R. Ling's *Roman Painting*, published in 1991, has 24 of 222 pages on later material. H. Mielsch's monograph is rather the exception: one quarter of his *Römische Wandmalerei* from 2001 deals with paintings from the 2nd centuries onwards. […] The Italian publication by I. Baldassarre, *Pittura Romana* from 2002 is to a certain extent comparable with H. Mielsch's. One quarter of the work, 106 pages, concentrates on post-Pompeian painting, of which half of the examples are from Rome and Ostia. Both works demonstrate the lack of absolute dates for many of these later paintings.

In contrast, some older works treat the material from Rome and its surroundings, but these studies are partially of low quality, like V. Dorigo's *Pittura tardoromana* or its translation *Late Roman Painting*, and the articles of C. C. van Essen, on the paintings from Ostia. An exception is M. Borda's *La Pittura Romana*. This author actually tried to give a complete overview of Roman painting. He clearly put an emphasis on the Italian peninsula as a whole and collected material from Hellenistic to late Roman times. An absolute chronology for late Roman painting, however, is almost entirely absent.[21]

The only publication missing in this literature review is *The Cambridge History of Painting in the Classical World*, hot off the press in 2014. This most recent review includes 'Chapter 9; Roman Painting of the Middle and Late Empire', written by Ling. The chapter consists of 58 pages, out of a total of 427 dealing with painting from the Bronze Age up to the end of the fourth century AD. Ling offers a sincere attempt to create a general review of the post-Pompeian period, but nevertheless starts 'with the proviso that the conclusions are tentative and may have to be revised in the light of future discoveries'.[22]

1.2 Approach

It is the aim of this study to find a way to create a clear overview of post-Pompeian Roman wall painting, in order to gain a better understanding of its developments over time and place. Therefore, the main research question is how to render the

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[21] Mols & Moormann in Zimmermann 2014, 105-106.
[22] Ling in Pollitt 2014, 374.

current and ever-growing corpus insightful. Because of the elusive quantity of the post-Pompeian paintings excavated so far, the choice was made to explore the possibilities of a dataset. A dataset represents a phenomenon 'as a set of objects (also called data points, measurements, samples, or records) that have features (also called attributes, characteristics, variables, or metadata)'.[23]

Digital means have become increasingly important for the humanities in general, and art history in particular. As part of the dataset that will be created for this study, an ontology or hierarchical list of terms will be needed in order to annotate or label the 'features'.[24] Furthermore, the dataset would have to encompass as many 'objects' or images of post-Pompeian Roman wall paintings as possible, considering the scope of this study. In its entirety, the dataset will be accessible via a web application. This way knowledge on the subject becomes more readily available, in contrast to the current situation where the required information is dispersed over (or, perhaps even better, 'hidden' in) numerous, highly specialised and/or locally restricted publications, in a plurality of languages.

Information visualisation forms an indispensable basis for gaining insight into extensive datasets. With the aid of a number of visualisation tools the contents of the dataset will be analysed. In addition, statistics will be employed to highlight various aspects of post-Pompeian painting. With regard to the painted representations themselves, popular elements will be identified, developments mapped, and some iconographical themes explored. Subsequently, the dataset will be of use in order to verify the most recent, albeit provisional, overview as proposed by Ling. After some brief reflections on the results, three case studies will follow, making use of the dataset in yet another way: by asking art historical questions to the material collected.

The first case study will focus on the end of Mau's Fourth Style, which may be determined by means of the dataset. Because this Pompeian Style usually consists of a combination of visual elements,[25] it will be possible to appoint the images that conform to this description. A second case study will explore if a centre-periphery

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[23] Manovich in Klinke & Surkemper, 23.

[24] An ontology is, within the context of information science, a model to describe the world, which is used to help computers and humans share knowledge. See: http://whatis.techtarget.com/definition/ontology (consulted on June 29, 2015).

[25] Namely: 'elaborate architectural schemes, trompe l'oeil, genre scenes, still lifes, and juxtapositions between painted and actual moldings', according to http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Fourth Style (consulted on June 29, 2015).

model could be distinguished for post-Pompeian Roman wall painting. Research on Roman wall painting is often Romano-centric, placing importance on the Italian peninsula above other regions in order to explain local and more widespread developments.[26] The proposed synchronic approach, on the other hand, might reveal different interrelationships. The third and last will deal with the possible links between the context, either built environment or geographic area, and the visual features of the paintings included in the dataset.

Ultimately, this study investigates the ways in which digital research methods can nowadays be used to the advantage of art historical research. Just the fact that all associated data can be digitised 'opens up a whole universe of possibilities'.[27] Although it will be a time consuming activity to gather the necessary information, this data can subsequently be analysed with relative ease. As a result, the scope of the dataset will self-evidently be limited, but may nevertheless serve as an exemplary tool to tackle fundamental art historical issues that would otherwise remain out of reach. The possibilities of this approach may lead to a revision of presently held views, and perhaps even to a whole new direction for research into post-Pompeian Roman wall painting.

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[26] Mols & Moormann in Zimmermann 2014, 109.
[27] Klinke & Surkemper 2015, 6.

2 Creating the Poporowapa dataset

Especially for this study, the Poporowapa – short for POst-POmpeian ROman WAll PAinting – dataset has been created. Since this is not something that is done overnight, the current chapter will discuss the process of, as well as the need for, creating such a dataset. First of all, a closer look will be taken at the digital research methods that are nowadays part of the repertoire of art historical research. Subsequently, the creation of the ontology, tailored to the study of post-Pompeian paintings, will be discussed. Finally, the manner in which the data was gathered, and organised in the dataset, will be addressed.

2.1 Going digital

There has recently been much ado about digital art history: while some scholars express the 'pervasive sense that the discipline is too cautious, moves too slowly, and has to "catch up" in the digital arena',[28] others emphasise that it is 'no longer necessary to argue for the wise use of computers'.[29] In any case, the earliest art historical projects based on computer technologies date from the late 1970s and early 1980s, and emerged within the context of museums and libraries.[30] One of the first such initiatives dates back to 1983, when the Getty Art History Information Program (AHIP) was established, the predecessor of the Getty Research Institute (GRI), based in Los Angeles (CA).

   In London, the Computers and the History of Art (CHArt) group was founded in 1985, which publishes a journal ever since 1991 in order to promote the 'interaction between the rapidly developing new IT and the study and practice of Art'.[31] Digital tools are since then being employed in art historical research, as well as other disciplines related to the humanities. A clear distinction between digital humanities and digital art history is therefore non-existent. One development that

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[28] According to Diane Zorich, *Transitioning to a Digital World; Art History, its Research Centers, and Digital Scholarship*, New York 2012, 20. Quote partly reproduced from: Zweig in Klinke & Surkemper 2015, 39.
[29] Bentkowska-Kafel in Klinke & Surkemper 2015, 51.
[30] Zweig in Klinke & Surkemper 2015, 40.
[31] Bentkowska-Kafel in Klinke & Surkemper 2015, 55; Greenhalgh in Schreibman, Siemens & Unsworth 2004, N/A. See: http://www.digitalhumanities.org/companion/ -> Art History (consulted on July 6, 2015).

influenced the humanities at large is the foundation of the Online Computer Library Center (OCLC), the former Ohio College Library Center, as early as 1967.

The OCLC has created the online dataset WorldCat, which represents a 'collective collection' of the world's libraries.[32] The WorldCat is used on a global scale, whereas no Dutch scholar is a stranger to PiCarta, a meta-catalogue of OCLC.[33] PiCarta was launched in 1998, and has changed the way in which the published resources of the Netherlands Central Catalogue (NCC) are searched within the humanities in general, and art history in particular. Whether we are actively seeking to employ computers or not, nowadays there is no escaping the use of digital methods and techniques in many a scholarly practice.

Terminology was (and still is) one of the first challenges for the establishment of art historical datasets. For this reason, the GRI has established multiple vocabularies, starting with the Art & Architecture Thesaurus (AAT). Being an avid proponent of digital art history, the GRI 'continues to develop tools and methods aimed at enabling the study of art history to take advantage of information technology, in order to pose new questions, offer multiple perspectives, and revivify a discipline that otherwise risks remaining largely elitist and increasingly irrelevant'.[34] Digital techniques thus not only facilitate art historical research, they also make it possible to approach a subject, and engage with an audience, in a different way.

Nowadays, one of the big voices of the digital humanities is Lev Manovich, founder and director of the Software Studies Initiative. As he explains it, by using

> modern data analysis and visualization software, we can generate multiple views of the same data quickly and compare them. This helps us to expand our understanding of a cultural phenomenon, and also notice the relations and patterns we did not see before. In other words, data science allows us not only just to see the data that is too big for our unaided perception and cognition; it also allows us to see data of any size (including very familiar canonical cultural datasets) *differently*.[35]

As visualisation and analysis is the subject of the next chapter of this study, it is important to already realise that going digital offers the exciting potential to expand

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[32] http://www.oclc.org/worldcat.en.html (consulted on July 6, 2015).
[33] http://www.picarta.nl/ (consulted on July 6, 2015).
[34] http://www.getty.edu/about/governance/trustreport/2014/gri.html (consulted on June 21, 2015).
[35] Manovich in Klinke & Surkemper 2015, 28-29.

our understanding of post-Pompeian Roman wall painting, as well as its still not well-known developments over time and place.

2.1.1 Semantic Web

Projects by major research institutions increasingly operate in a digital fashion. The most relevant for this study is the Print Room Online project by the Rijksmuseum, Amsterdam. The Rijksmuseum annotates or describes its print collection 'using terms from domain-specific thesauri'.[36] The thesauri used are the AAT and ICONCLASS, 'an iconographical classification system that began without any connection with a computer'.[37] Furthermore, the Census of Antique Works of Art and Architecture Known in the Renaissance, Berlin,[38] and the Digital Montagny Project of the *Institut National d'Histoire de l'Art* (INHA), Paris,[39] are of significance, both of which also collaborate with the GRI, to name just a few.

What these projects engaged with large datasets have in common is their current focus on the Semantic Web. This term refers to the vision of the World Wide Web Consortium (W3C) on 'the Web of linked data'.[40] A Web of linked data, referring to the kind of data that can be found in datasets, requires access to data as well as relationships among data. This way, the Semantic Web 'provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries'.[41] As a result, projects and facilities that 'put machine-understandable data on the Web are quickly becoming a high priority for many organizations, individuals and communities'.[42]

Although the Rijksmuseum, for example, implements the concept of the Semantic Web in its dataset, the linked information, annotated with the aid of the AAT and ICONCLASS, is not yet put to use in the interface of its website. The only indication for this method can be found in the sustainable URL added to each work

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[36] Hildebrand in Sheth 2008, 915.
[37] http://www.semantic-web-journal.net/ -> Rijksmuseum collection (consulted on June 30, 2015); Greenhalgh in Schreibman, Siemens & Unsworth 2004, N/A. See: http://www.digitalhumanities.org/companion/ -> Art History (consulted on July 6, 2015). The thesauri will be discussed in detail below.
[38] http://www.census.de/census (consulted on June 30, 2015).
[39] http://www.inha.fr/en/index.html (consulted on June 30, 2015); http://www.culingtec.uni-leipzig.de/ESU_C_T/node/317 (consulted on June 30, 2015).
[40] http://www.w3.org/standards/semanticweb/ (consulted on July 6, 2015).
[41] http://www.w3.org/2001/sw/ (consulted on July 6, 2015).
[42] http://www.w3.org/2001/sw/Activity (consulted on July 6, 2015).

of art, and displayed in the online catalogue.[43] Nevertheless, this implementation could in the future be used by means of queries or 'technologies and protocols that can programmatically retrieve information' from the Web of linked data.[44] This study, by contrast, will actively explore the possibilities of using the Semantic Web as a medium for the exchange of data.

2.2 Formulating the ontology

In order to see what kind of data could be related specifically to post-Pompeian Roman wall painting, a preparatory mind map was drawn up. This raised the awareness of a dichotomy in the associated information. On the one hand, there is the designation of the representations on the paintings, on the other, the appointment of contextual details. Subsequently, a random selection of about ten examples of post-Pompeian paintings was made in order to find out what kind of keywords or terms would be applicable to each of them, and how these could be grouped (Fig. 2.1). This provided an initial view on the work at hand.

Exploring the ways in which post-Pompeian Roman wall paintings could be described or annotated soon resulted in hierarchical lists. As the amount of associated information grew, it became more and more difficult to incorporate all of these terms in tree structures, and as such the need for some kind of predetermined lists became all the more obvious. By extension, due to the scattered and fragmented nature of post-Pompeian paintings, dealing with these paintings meant to overcome language barriers. The material was and is studied by scholars from various countries, and the available academic literature is thus published in diverse languages.

Earlier attempts to define a common terminology have been made in the French language. This was done as a '*base future pour un vocabulaire internationalisé*' for Roman wall painting in general, with a focus on the Pompeian Styles,[45] and for imitations of *opus sectile* and wallpaper or all-over patterns in particular.[46] For this study, however, the English language is used, but nevertheless

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[43] A sustainable URL enables information to be linked, and stay linked. One such example is for instance: http://hdl.handle.net/10934/RM0001.COLLECT.146090 (consulted on July 6, 2015).
[44] http://www.w3.org/standards/semanticweb/query (consulted on July 6, 2015).
[45] Barbet 1984.
[46] Barbet, Douaud & Lanièpe 1997. *Opus sectile* refers to the technique of creating images or patterns with 'individually shaped pieces of durable material', originating from Egypt and Asia Minor. See:

there is the same need for a shared terminology. An ontology is suitable for this purpose, as it provides 'an abstract, simplified view of the world' by means of a thematic list of terms or nodes, each of which describes a conceptualisation related to post-Pompeian painting in this case, which is organised hierarchically.[47] The Poporowapa ontology is largely based on the following classification systems.

2.2.1 Getty vocabularies

In the English language, a common terminology can be found in the multilingual electronic vocabularies Getty Thesaurus of Geographic Names (TGN) and Art & Architecture Thesaurus (AAT), created by the Getty Research Institute (GRI). As their website states, the 'TGN is a structured vocabulary, including names, descriptions, and other metadata for extant and historical sites, […] and may be linked to GIS, maps, and other geographic resources', whereas the AAT includes 'terms, descriptions, and other metadata for generic concepts related to art, architecture, conservation, archaeology, and other cultural heritage'.[48]

Since the Getty vocabularies have been developed for an international audience of cataloguers and researchers, the AAT and TGN will be helpful to describe both the painted representations on post-Pompeian Roman wall painting, and their geographic locations of origin. The Getty vocabularies are available in the form of Linked Open Data (LOD), 'a data format that is seen as a key element of the Semantic Web – the structured linking of web-based information to enable users anywhere to find, share, and combine information more easily'.[49] Furthermore, they are structured in a hierarchical manner.

To start with the AAT, so-called 'facets' constitute the major subdivisions.[50] The *Top of the AAT hierarchies* leads directly to eight facets, namely: *Associated Concepts*, *Physical Attributes*, *Styles and Periods*, *Agents*, *Activities*, *Materials*, *Objects*, and *Brand Names* (Fig. 2.2). Hierarchies, or '[h]omogenous groupings of terminology' are arranged within the facets of the AAT, where a 'broader term provides an immediate class or genus to a concept, and serves to clarify its meaning.

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http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Opus sectile (consulted on June 30, 2015).
[47] Gruber 1995, 908.
[48] http://www.getty.edu/research/tools/ vocabularies/index.html (consulted on June 21, 2015).
[49] http://www.getty.edu/about/governance/trustreport/2014/gri.html (consulted on June 21, 2015).
[50] http://www.getty.edu/research/tools/vocabularies/aat/about.html (consulted on June 30, 2015).

The narrower term is always a type of, kind of, example of, or manifestation of its broader context'.[51] Of interest for the Poporowapa ontology are the first seven facets.

When browsing the AAT hierarchies, one might come across the record *Still lifes*. The corresponding website has an ID (300015638), and displays a note (describing what the term means within the context of AAT), terms (a preferred term as well as synonyms in various languages), the hierarchical position of the term, additional notes (in languages other than English), related concepts, and sources and contributors (often including the Netherlands Institute for Art History (RKD), The Hague).[52] Since some terms have different meanings in different contexts, use is being made of 'qualifiers' that refer to a significant distinguishing characteristic.[53] The term *flower*, for instance, can refer either to plant material, or a motif.

The TGN, on the other hand, deals exclusively with geographic locations. 'Names for a place may include names in the vernacular language, English, other languages, historical names', one of which is the preferred name.[54] The trees of the TGN branch from the root called *Top of the TGN hierarchies*, starting with two facets: *Extraterrestrial Places*, currently confined to the *Milky Way Galaxy*, and the *World*, containing continents, general, geographic and historical regions, former nations/states/empires and groups of nations/states/cities, associations and organisations, miscellaneous, and the *Silk Road*, as indicated by means of labels that are placed in between brackets behind each record (Fig. 2.3).[55]

Just like the AAT, the TGN is 'polyhierarchical', meaning that one record can be part of more than one tree structure. *Colchester*, United Kingdom, for instance, can also be found under Britannia, the province of the former Roman Empire. The website belonging to the record *Colchester* holds its ID (7011866), and furthermore displays a note (describing the history and the physical location of the place, or its relevance for art and architectural history), names (the preferred as well as variants), the hierarchical position of the record, place types (describing a role or

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[51] http://www.getty.edu/research/tools/vocabularies/aat/about.html (consulted on June 30, 2015).
[52] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Still life (consulted on June 30, 2015).
[53] http://www.getty.edu/research/tools/vocabularies/aat/about.html (consulted on June 30, 2015).
[54] http://www.getty.edu/research/tools/vocabularies/tgn/about.html (consulted on July 1, 2015).
[55] http://www.getty.edu/research/tools/vocabularies/tgn/index.html -> Browse the TGN hierarchies (consulted on July 1, 2015).

characteristic of the place), and sources and contributors.[56] Furthermore, of great importance are the provided coordinates.

Many of the TGN records include coordinates, that is, the latitude and longitude of a place that specifies its location on the surface of the earth. Although these coordinates are approximate and 'intended for reference only', the indicated single points do represent a location 'in or near the center of the inhabited place, political entity, or physical feature'.[57] For the Poporowapa ontology, the choice was made to focus on the current territories of the world as listed under the modern continents *Africa*, *Asia*, and *Europe*, since these encompass all locations of origin of the post-Pompeian Roman wall paintings.

Based on the ten examples mentioned before, a first inventory was made of the terms and places relevant for post-Pompeian paintings. As the Getty vocabularies are very extensive, a selection was made to reduce the length of the individual trees. This means that for the records originating from the TGN record *World* the following subdivision exists in the Poporowapa ontology: continent -> nation -> province -> inhabited place or deserted settlement. With regard to the AAT, some steps were skipped, while other were incorporated in the hierarchical structure, varying per root node. The result, however, is not fixed, but rather continually subject to change (see 2.2.4 Result).

2.2.2 ICONCLASS

Since the Getty vocabularies focus on generic concepts, terms concerning subjects of classical mythology and ancient history, as well as biblical themes, are not included. Therefore, use will be made of the ICONCLASS multilingual electronic classification system for cultural content managed by the Netherlands Institute for Art History (RKD).[58] This scientific tool is presented as 'a hierarchically ordered collection of definitions of objects, people, events and abstract ideas that serve as the subject of an image. Art historians, researchers and curators use it to describe,

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[56] http://www.getty.edu/research/tools/vocabularies/tgn/index.html -> Colchester (consulted on July 1, 2015). According to the note, Colchester is 'Britain's oldest recorded town and Britain's first Roman colony founded by Claudius ca. 43'.
[57] http://www.getty.edu/research/tools/vocabularies/tgn/about.html (consulted on July 1, 2015).
[58] http://www.iconclass.org/ (consulted on June 30, 2015).

classify and examine the subjects of images represented in various media such as paintings, drawings and photographs'.[59]

ICONCLASS was developed by Dutch art historian Henri van de Waal (1910-1972) in the early 1950s.[60] In the years up to 2006, the Royal Netherlands Academy of Arts and Sciences (KNAW) as well as the University of Utrecht were involved, whereas after 2006 management of the classification system is conducted by the RKD, which makes extensive use of it on its own website.[61] Of the nine main divisions of ICONCLASS, *9 Classical Mythology and Ancient History* is of most interest to this study (Fig. 2.4). Although it proved to be necessary to include subjects of Christian iconography as well, since these emerged in post-Pompeian Roman wall painting as early as the third century AD, ICONCLASS was not considered useful for this particular purpose.[62]

The main division *Classical Mythology and Ancient History* is divided into subdivisions that are increasingly specific. ICONCLASS is very extensive, containing just like the AAT almost 40,000 concepts.[63] Furthermore, the structure of ICONCLASS can be quite confusing, for example in the case of the Olympian gods. *92A the Olympian gods together: Jupiter, Juno, Neptune, Ceres, Apollo, Diana, Mars, Venus, Mercury, Minerva, Vulcan, Vesta (or Bacchus)* can be found in the hierarchical structure under the subdivision *92 gods ~ classical mythology*.[64] The individual gods, on the other hand, are classified under various subdivisions of the latter, *92B the great gods of Heaven, and their train*, for instance. Therefore, a selection, as well as adjustments, was made for the Poporowapa ontology.

In the end, each division or subdivision is identified by a code composed of numbers and letters, and sometimes even bracketed texts or so-called keys (i.e. elements that are declared in a list).[65] These codes were incorporated into the Poporowapa ontology, in order to be able to retrieve the definitions as specified by ICONCLASS. Included are persons from classical history, gods, Greek heroes, heroines, and heroic legends, metamorphoses, myths about creation, as well as

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[59] http://www.iconclass.nl/about-iconclass/what-is-iconclass (consulted on June 30, 2015).

[60] http://www.iconclass.nl/about-iconclass/history-of-iconclass (consulted on July 1, 2015).

[61] http://rkd.nl/en/ (consulted on July 1, 2015).

[62] This was concluded because ICONCLASS makes a division between *7 Bible* and *11 Christian religion*. As a result, Moses, for instance, is included in both, according to the action he is performing in an image. In short, there is no one record for Moses in general.

[63] http://www.semantic-web-journal.net/ -> Rijksmuseum collection (consulted on June 30, 2015).

[64] http://www.iconclass.org/rkd/92A/ (consulted on July 1, 2015).

[65] http://www.iconclass.nl/contents-of-iconclass (consulted on July 1, 2015).

Roman deities and legends. Again, the hierarchy of the Poporowapa ontology is not static, but instead may be altered or added to at any given moment in time.

2.2.3 DBpedia

In order to incorporate representations of biblical themes, the possibilities of DBpedia were explored.[66] In short, DBpedia is 'a crowd-sourced community effort to extract structured information from Wikipedia and make this information available on the Web'.[67] As such, Wikipedia provides the information that is displayed in a structured manner on a certain DBpedia page. The page on Moses, for example, denotes the prophet of, among others, Christian religion.[68] These and other key figures have been included in the Poporowapa ontology under *Christian iconography*, without further subdivision.

2.2.4 Result

The Poporowapa ontology is based on these three sources, and consists of ten root nodes: *Activities*, *Agents*, *Associated concepts*, *Christian iconography*, *Classical mythology and ancient history*, *Geography*, *Materials*, *Objects*, *Physical attributes*, *Styles and periods* (Fig. 2.5). Three of them deserve some extra attention, as their denominations may not be as straightforward as the others. The root node *Agents*, first of all, comprises the branches *Animal*, *Person*, and *Plant*, in other words all living organisms. Secondly, *Objects* is a comprehensive category, encompassing objects from all dimensions, from *Built complex* to *Costume* and *Visual work*. The root node *Physical attributes*, finally, is primarily made up of a diversity of motifs and patterns, as well as other formal properties.

The ontology initially took shape by means of browsing both the Getty vocabularies and ICONCLASS. During the process of annotation (see 2.3.3 Task of annotating) additions were being made, as well as revisions of the basic structure. This has resulted in an ontology that at this point contains 1,251 nodes in total, including all root, branch, and leaf nodes, which can be viewed in Appendix I.[69] With this hierarchical structure, almost every visual aspect of post-Pompeian Roman

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[66] http://wiki.dbpedia.org/ (consulted on July 1, 2015).
[67] http://wiki.dbpedia.org/about (consulted on July 1, 2015).
[68] http://dbpedia.org/page/Moses (consulted on July 27, 2015).
[69] For example: *Classical mythology and ancient history* (root) -> *Gods* (branch) -> *Serving and attending* (branch) -> *Muses* (branch) -> *Melpomene* (leaf).

wall painting can be described in more or less detail. At the most, within *Geography*, it takes five steps to arrive from a root to a leaf node. For all other root nodes the maximum amount is four, rendering the ontology as complete as possible yet clearly organised.[70]

The Getty vocabularies and ICONCLASS, as well as to a lesser extent DBpedia, were not only of interest because of their hierarchical structures. Each record of these providers of information is outfitted with a unique and sustainable URL to the appropriate website.[71] As they are available as Linked Open Data, others may use the contents of these websites without inhibition. Therefore, the URLs have been added as a Semantic link to each of the nodes of the Poporowapa ontology (Fig. 2.6). This will be of value for visualisation and analysis purposes based on the usage of the ontology at a later stage.

Missing links

As the Getty vocabularies are not specifically tailored to the study of post-Pompeian Roman wall painting, not all terms pertaining to the professional jargon are extant. In other cases, the correct English term had to be found for a concept usually identified in another language. An interesting example is the German term *Streublumen*, also known as *fleurs jonchées* in French, *fiori sparsi* in Italian, and 'scattered flowers' in English (Fig. 2.7).[72] The English term, however, was not included in the AAT. During the study of this vocabulary, the term *Millefleurs* was encountered, designating patterns 'characterized by a mass of scattered flowers or plants that form a background to a scene'.[73] Therefore, this term was chosen as a substitute for all aforementioned ones.

Substitutes had to be found for the terms entirely absent in the Getty vocabularies. One of the most prominent missing terms is the marble incrustation, the stuccoed equivalent of which was encountered before in the description of the first Pompeian Style (or Encrustation Style). *Crustae* or slabs are veneers, usually of

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[70] In technical terms, the structure of the Poporowapa ontology conforms to the so-called Nested Set Model. See: http://web.archive.org/web/20110606032941/http://dev.mysql.com/techresources/articles/hierarchical-data.html (consulted on July 8, 2015).

[71] See, for instance: http://vocab.getty.edu/aat/300015638 (consulted on July 7, 2015); http://vocab.getty.edu/tgn/7011866 (consulted on July 7, 2015); http://www.iconclass.org/rkd/92A/ (consulted on July 1, 2015); http://dbpedia.org/page/Moses (consulted on July 7, 2015).

[72] Barbet in Zimmermann 2014, 204.

[73] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Millefleurs (consulted on July 1, 2015).

various coloured marbles, applied to the walls in Roman decoration,[74] and this term would therefore fit very well as a narrower term of the AAT *Veneered walls*. At this point, the Poporowapa ontology merely refers to *Marble* as an indication of the material that is being represented in many a post-Pompeian painting. Marble inlay, on the other hand, is usually referred to as *Opus sectile* (Fig. 2.8).

Another example for which an alternative had to be found is Pygmy, referring to African peoples. *Pygmy* as an African culture or style does exist in the AAT, whereas to refer to the peoples the link to the term *Dwarf* is currently being used. The German *Gartendarstellung*, or garden painting, is commonly used in the study of Roman wall painting, which now links to the AAT's plain *Garden* (Fig. 2.9). Nevertheless, it would be more appropriate to include a narrower term of *Visual works* in the AAT for this kind of representation. Furthermore, the garland is at present equivalent to *Festoon*, and the embroidered or openwork border (from the French *bordure ajouré*) to the term *Border* (Fig. 2.10).

Terms for which no alternative could be found are, among others, gravedigger, *opus alexandrinum*, and *pedum*. Furthermore, the classic tripartite division of wall decorations in the lower (or dado), middle, and upper zone is lacking. The German *Tapetenmuster*, also known as wallpaper pattern, could only be described as an *Allover* pattern (Fig. 2.11). Illusionism in general is provided within the AAT, although not in great detail. As a result, when materials are imitated in post-Pompeian painting, the Poporowapa ontology refers to the appropriate materials (i.e. *Marble*, *Wood*, etc.), the material or technique of the represented visual work (i.e. *Opus sectile*), or the visualised process or technique (i.e. *Opus tessellatum*).[75]

In the case of animals, the AAT proved to be, on the one hand, too complicated, but on the other, not as comprehensive as expected. The *Animalia (kingdom)* is subdivided by means of the Latin designation for the taxonomic ranks related to natural history. Although a peacock, for instance, could be found by its English name, this redirects to the preferred term *Pavo (genus)*.[76] *Fish (animals)* is also included, although this is 'not properly a taxonomic group'.[77] Nevertheless, the

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[74] http://www.britannica.com/art/Incrustation-style (consulted on July 1, 2015).

[75] In all of these instances, the structure of the AAT was maintained. Components of illusionism are thus to be found under multiple facets, *Materials*, *Objects*, and *Activities*, respectively.

[76] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Peacock (consulted on July 2, 2015).

[77] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Fish (consulted on July 2, 2015).

species European bee-eater is not represented in the hierarchical structure, and the same applies to other species. In order to be able to add a Semantic link to these Poporowapa ontology nodes after all, use was made of DBpedia.

With regard to the TGN, not all places were included either. In order to be able to locate these places, a city nearby was appointed as replacement. One of these is Lohamei HaGeta'ot, situated in the northern part of Israel as a search with Google pointed out.[78] Subsequently, Google Maps revealed that Acre was the biggest city nearby. Therefore, the URL of *Acre* was added instead of the actual city of Lohamei HaGeta'ot. Otherwise, a province could be used as an indicator of place instead of the specified inhabited place or deserted settlement. This was done for *Meikirch*, for instance, because of the absence of coordinates on this particular TGN record.

2.3 Determining the data

For this study, it was chosen to accommodate the ontology as well as the other relevant data in a relational database, which basically means that information is stored in various tables with rows and columns that are linked to each other. Appendix II, Illustration 1, shows the underlying structure of the Poporowapa dataset, consisting of the tables 'item', 'latlong', 'link', 'ontology', and 'option'. The first of these will contain all collected images, each of which will be assigned one of the geographic locations stored in the second table, derived from the TGN records. Furthermore, the Poporowapa ontology is listed in one, and several options in another, table. Except for 'latlong', all tables are directly connected to the table 'link'.

The latter contains links to an 'item_id', referring to an image and its associated information, an 'option_id', or number to identify a certain option, and a 'value', either referring to an 'ontology_id', or a 'dating' that can be entered as text. While each of these tables may be edited independently, the links existing between them are updated instantly. Especially when reuse occurs, the relational database is more efficient in use than a regular database, which consists of just one extensive table. The database has been outfitted with an online interface, which was primarily used to create and explore the Poporowapa dataset. This section will elaborate on the establishment of data in the different stages involved.

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[78] http://www.google.com -> Lohamei HaGeta'ot (consulted on July 1, 2015). The Google search results referred to Google Maps and Wikipedia.

2.3.1 Collecting images

In order to create the dataset, it was decided to make use of published sources, because of the additional information that could be extracted from them, such as precise location of origin, dating, and interpretation of the visual characteristics. As already mentioned, the relevant publications relate to post-Pompeian Roman wall painting on different levels. A selection was made on the basis of diversity, comprising no less than thirteen books on the subject.[79] Although each publication has its own peculiarities, combined they form the basis of the contents of the Poporowapa dataset.

The images were gathered from these publications in print, with the exception of Zimmermann 2014, which is available online.[80] From the printed resources, photographs were taken with an iPad. The digitised pages were subsequently uploaded to a computer, whereas the images themselves were cut out with the help of Grab, an application to capture images. In general, the rule applies that one image equals one painted wall or ceiling, so that of the photographs different parts could be captured if more than one wall, or a combination with the ceiling, was visible. These images were saved in a .jpg format according to a devised standard. This way, information associated with the images could be stored for future use.

The devised standard involved saving the images in a folder per publication, with the name of the book as the folder name: 'Mielsch2001', for example. The title of the image consisted of several successive elements, namely: the page number (on which the image could be retrieved) followed by an underscore, the location of origin ('Ephesus', for instance) followed by an underscore, and the caption of the image (as published in the original source). When importing these images into the Poporowapa dataset, this information could be extracted from each of the image's folder name and title (see Appendix II, Ill. 1, bullet points four to seven under 'item'), thus facilitating the annotation of these images.

It was decided to include all types of representations of post-Pompeian Roman wall paintings, ranging from drawings to photographs, both in black-and-

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[79] The selected publications are: Baldassarre & Müller Renzoni 2002; Clarke 1991; Davey & Ling 1982; Drack 1950; Drack 1986; Fink & Asamer 1997; Joyce 1981; Liedtke 2003; Ling 1991; Mielsch 2001; Strocka 1977; Zimmermann & Ladstätter 2010; Zimmermann 2014. Pollitt 2014 is not included in this enumeration, because virtually all images had already been published in the thirteen books listed here. Naturally, this selection is reflected in the upcoming research results.
[80] http://hw.oeaw.ac.at/7658-9?frames=yes (consulted on June 13, 2015).

white and in colour (Fig. 2.1). Since of one painting images in a variety of media, or of viewing angles, could be included in one publication, sometimes combinations of these representations would be saved as one image. It also occurred that representations of the same wall painting were included in more than one publication, resulting in duplicates. This was especially true for the painted walls of the Villa Piccola, Rome, of which representations featured in no less than six of the thirteen consulted books.[81] Of the 1433 images, most duplicates were disregarded during the process of annotating.

2.3.2 Adding options

The images imported into the Poporowapa dataset are shown in lists of twenty images per page in the online interface of the web application (Fig. 2.12). Per item, a small thumbnail is displayed, as well as the location of origin, the source (both book and page number(s)), and the caption, which serves as the title of the image. These items may be edited in order to describe their visual and contextual characteristics, making use of the Poporowapa ontology as well as text input fields (Fig. 2.13). In order to do so, first of all some options had to be defined that explain the relationship between the image and the ontology node or text.

To this end, eight options were appointed, of which six refer to the Poporowapa ontology. These six are *Building type*, *Field colour*, *Location of origin*, *Room type*, *Surface*, and *Visual feature* (Fig. 2.14). The other two, *Dating lower limit*, and *Dating upper limit*, refer to a text input field. Furthermore, each of these options was assigned its own Semantic link that describes the relationship, in order to again structure the data in a linked manner. Both Schema.org and DCMI Metadata Terms were used, the former being 'a collaborative, community activity with a mission to create, maintain, and promote schemas for structured data',[82] whereas the latter offers an 'authoritative specification of all metadata terms maintained by the Dublin Core Metadata Initiative' (hence DCMI).[83]

Six out of eight options are equipped with Semantic links derived from the VisualArtwork schema.[84] Respectively, the properties used are contentLocation

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[81] Baldassarre & Müller Renzoni 2002; Fink & Asamer 1997; Joyce 1981; Liedtke 2003; Ling 1991; Mielsch 2001.
[82] http://schema.org/ (consulted on July 2, 2015).
[83] http://dublincore.org/documents/dcmi-terms/ (consulted on July 2, 2015).
[84] http://schema.org/VisualArtwork (consulted on July 2, 2015).

(*Location of origin*), dateCreated (*Dating lower limit & Dating upper limit*), hasPart (*Field colour & Visual feature*), and artworkSurface (*Surface*). To the options *Building type* and *Room type* the DCMI Metadata Term 'spatial' was applied, referring to the spatial environment associated with a certain post-Pompeian painting (Fig. 2.15).[85] This Semantic specification of the relationships among data renders the data machine-understandable, and enables researchers to connect information when performing queries at a later stage.

2.3.3 Task of annotating

As mentioned before, annotation means adding metadata manually to the items under study, the collected images in this case.[86] It was decided to start with annotating the location of origin to each of these images. This was done by adding an ontology field (see Fig. 2.13, upper right corner) and choosing the option *Location of origin*. Usually, this location ws already on display (see Fig. 2.13, left in the middle). By typing the first letters into the ontology field, a box appears underneath showing which ontology nodes match this sequence of letters. When selecting one of these, the branch nodes as well as the root node are displayed (Fig. 2.16). The item that is being edited is thus annotated with the selected ontology node.

More often than not is was necessary to consult the publication from which the image originated during the process of annotating. This was especially true for the dating of the post-Pompeian paintings. As their dating is virtually never absolute, use was made of a lower and an upper limit. These limits could be indicated by adding two text fields, choosing both dating options, and numerically typing in the appropriate dates, (Fig. 2.17). Usually some dating was provided in the publication, however broad or specific. If none was available, and the image surely did survive from the post-Pompeian period, the complete time span was denoted (i.e. from AD 79 to 395). Fink & Asamer 1997, however, did not include any specific dating, which is why all circa 100 images extracted from this publication have received the same broad dating of a lower limit of AD 240 and an upper limit of AD 400.

In the same manner, additional information could be added to an image. The remaining five options that refer to the ontology could be used to annotate an item,

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[85] http://purl.org/dc/terms/spatial (consulted on July 7, 2015).
[86] Manovich in Klinke & Surkemper 2015, 16 & 28.

depending on the available textual and visual information. Whereas dating, location of origin, and surface were added to each and every image, the other options were entirely optional. Usually, though, *Building type* was added, and whenever possible so were *Room type*, and *Field colour* (only once or several times). Most use was made of the option *Visual feature*, as this describes the actual visual qualities of the painting. This option could be added as many times as was necessary to annotate the image, depending on the properties of each and every painting.

The result of these efforts can be viewed in Figure 2.18 (the online interface), as compared to Appendix II, Illustration 2 (the underlying tables of the relational database). The 'link' table first of all holds a 'link_id' for each unique link that has been made. '31487', for example, is related to all numbers in the column underneath. That is, the 'item_id' (in green), which refers to the 'item' table, the 'option_id' (various shades of red), which refers to the 'option' table, and the 'value', which refers to an 'ontology_id' (various shades of pink) of the 'ontology' table, or should be interpreted as a text entry (in yellow). The numbers expressed in these cells thus refer to other tables that hold additional information to explain these numbers.

The item with 'item_id' 1 consists of a .jpg image (named according to the devised standard), published source, page number, location of origin, and descriptive title. This record was created on May 15, 2015 around noon, whereas the dating of the image (in yellow) is the average of the two values specified in the 'link' table. Here, the options 2 and 3 refer to the second and third column of the 'option' table, with the titles *Dating lower limit* and *Dating upper limit*, which both have the same Semantic link (http://schema.org/dateCreated), and are of the type 'text'. Lastly, the 'latlong_id' (in blue) of item number 1 refers to the 'latlong' table, which consists of latitude and longitude coordinates as well as a Semantic link, of the TGN record of Rome, in this case.

Six out of eight times, the values assigned to the 'link' table refer to the 'ontology' table. One of them has the 'ontology_id' 723, which is related to the 'parent_ontology_id' 720. Number 723 (light pink) has the title *Flower*, which is a leaf node branching from the *Plant-derived* motif (nr. 720). Based on the tree structure of the Poporowapa ontology, it becomes clear what kind of flower is designated. 'lft' and 'rgt' refer to this ontology structure, since a relational database

is actually not intended for managing hierarchical data.[87] Furthermore, the Semantic link of the associated AAT record of the flower as a motif is part of the 'ontology' table. As can be seen in the 'link' table, 'ontology_id' 723 is associated with 'option_id' 29 (light red), which is equal to the option *Visual feature*.

Textual and visual information could go hand in hand when annotating subjects related to classical mythology, for instance. This way, *Mithras* could be annotated, in addition to merely a male human figure (i.e. *Man*, and *Figure*). In the same vain, particular animal species could be appointed, such as the *White-throated Robin* instead of the more general *Bird*. Except for the duplicates, all images at present included in the Poporowapa dataset have been annotated, that is, provided with links.[88] The established links, however, represent a moment in time: they can always be extended or altered, just like all other components that together make up the dataset (the items, geographic coordinates, options, and ontology). Nevertheless, somewhere a line had to be drawn in order to be able to start with the data analysis.

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[87] See note 70.

[88] Although it was the intention of the author not to annotate any duplicates, it is of course possible that some have been overlooked. This may be due to the inclusion of detail shots, as well as other causes. Approximately 1 per cent of the annotated images are duplicates, based on an estimate made by the author. On the whole, this is a negligible amount.

3 Visualisation & Analysis

The process of collecting data by means of the web application (Fig. 3.1) has resulted in the Poporowapa dataset,[89] containing 1,433 images or items. 1,242 of these have been annotated, while the other 191 are duplicates that were cast aside. A total number of 635 ontology nodes, about half of the full amount of ontology nodes (i.e. 1,251, from root to leaf nodes), was used to annotate the 1,242 images. Thus far, no less than 12,516 links have been established, consisting of an option and a filled out text or ontology field related to a particular item. These numbers seem to indicate a solid basis for the subsequent visualisation and analysis of this dataset.

To start with the aspect of visualisation, this particular field of study will be introduced with reference to a number of examples. Next, the tools used for the study of the Poporowapa dataset will be discussed. Subsequently, the data will be interpreted using statistics in combination with the aforementioned visualisation tools. The quantitative results may shed light on the popular themes of post-Pompeian Roman wall painting, and developments over place and time may also be recognised. In addition, the Poporowapa dataset will be deployed to check the results of the most recent overview as presented in Roger Ling's 'Chapter 9; Roman Painting of the Middle and Late Empire' of 2014.[90]

3.1 Information visualisation

Information visualisation has its origins in the eighteenth century, with William Playfair as the one who first published the bar chart and the line graph in his *The Commercial and Political Atlas; Representing by Means of Stained Copper-Plate Charts, the Progress of the Commerce, Revenues, Expenditure and Debts of England during the Whole of the Eighteenth Century* of 1786.[91] About a century later, Charles Minard made his famous visualisation of Napoleon's march on Moscow, in 1869 (Fig 3.2). This flow map shows the route of Napoleon's army in the Russian campaign of 1812, with the thickness of the band indicating the diminishing size of the army along the way. The brownish band represents the outward journey, whereas

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[89] http://poporowapa.midasweb.nl/index.php/ (consulted July 5, 2015). Currently, a login is required. Please enter the following email address: bezoeker@bezoeker.nl , and password: nijmegen, in order to get access and explore the dataset yourself.
[90] Ling in Pollitt 2014, 370-427.
[91] Manovich 2011, 39; Manovich in Klinke & Surkemper 2015, 19.

the black band represents the retreat, which is related to temperature and time scales.[92]

In the twentieth century, the theories of both Jacques Bertin and Edward Tufte, on *Sémiologie Graphique; les Diagrammes, les Réseaux, les Cartes* (1967) and *The Visual Display of Quantitative Information* (1983), respectively, laid the foundations for the development of information visualisation as a discipline.[93] Today this discipline has turned into a widespread practice, and many impressive projects have been established. One of them is The Fallen of World War II, an interactive documentary that examines 'the human cost of the second World War' as well as the decline in battle death in the years thereafter.[94] Additionally, this data visualisation uses techniques of cinematic storytelling to create a compelling narrative.

In general, graphical means are used either to communicate an idea, or to create or discover the idea itself.[95] In other words,

> The goal of visualization is to aid our understanding of data by leveraging the human visual system's highly tuned ability to see patterns, spot trends, and identify outliers. Well-designed visual representations can replace cognitive calculations with simple perceptual inferences and improve comprehension, memory, and decision making. By making data more accessible and appealing, visual representations may also help engage more diverse audiences in exploration and analysis. The challenge is to create effective and engaging visualizations that are appropriate to the data.[96]

The development of tools for visualisation has a history of its own, although all tools have in common that they are variations on positions, sizes, shapes, and colours.

The ways in which information is being visualised are becoming more and more complex. This is not only due to increased computer power, but also to advanced means of gathering data. As a study by Google shows, search engine query data may be used to track influenza-like illness in a population.[97] Apparently, the frequency of certain searches with Google correlates with the amount of people suffering from flu-related complaints. Visualised on a map, trends can be explored

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[92] Mazza 2009, N/A. See: http://linux3.dti.supsi.ch/~mazza/infovis_introduction.pdf (consulted July 8, 2015).
[93] Card, Mackinlay & Shneiderman 1999, 7.
[94] http://www.fallen.io/ww2/ (consulted on July 8, 2015).
[95] Card, Mackinlay & Shneiderman 1999, 1.
[96] Heer, Bostock & Ogievetsky 2010, 59.
[97] Ginsberg 2009, N/A. See: http://static.googleusercontent.com/media/research.google.com/en// archive/papers/detecting-influenza-epidemics.pdf (consulted on July 8, 2015).

all over the world on the basis of these queries (Fig. 3.3).[98] Relatively simple data can thus be used to solve rather difficult issues, as long as enough data is available. The study of post-Pompeian painting is based on this premise, and uses the tools for information visualisation that will be introduced below in order to interpret the Poporowapa dataset.

3.1.1 Map

A very prominent feature of the Poporowapa web application is the Map, as devised by Google. This chart displays a map that automatically scales so that it includes or centres identified coordinates.[99] As these coordinates are given in the TGN, and linked to each annotated location of origin, the appropriate latitudes and longitudes are known. As a result, each image or item of the dataset includes a little Map indicating its geographic location of origin on a map of the world (Fig. 2.18). In addition, the Poporowapa web application features a large Map displaying all annotated locations of origin at once.

The latter Map (Fig. 3.4) shows the distribution of the post-Pompeian paintings included in the dataset over the former territory of the Roman Empire.[100] A total amount of 175 arrows indicate an equal amount of different locations. By clicking on an arrow, the name of the geographic location as well as the amount of painted walls and ceilings represented is revealed ('Brigetio, 3 item(s)', for example). Because of the publications used to collect images, the density of arrows is sometimes higher, especially with regard to Roman Britain and Switzerland, than others. One arrow represents a number of paintings ranging from 1 to 265. Although at a glance the large Map does not reveal much information, it does provide a first glimpse of the contents of the Poporowapa dataset.

Exploring the Map reveals that three major locations of origin stand out, namely Rome with 265, Ephesus with 263, and Ostia with 215 items. All other geographic locations usually represent a number somewhere between one and ten. A comparison between Figures 3.4 and 3.5 shows that a large part of the ancient Roman Empire is covered with arrows, and thus represented in the dataset. Nevertheless, arrows are lacking for, among others, the modern countries of *Algeria*,

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[98] http://www.google.org/flutrends/intl/nl/ (consulted on July 8, 2015).
[99] http://developers.google.com/chart/interactive/docs/gallery/map (consulted July 3, 2015).
[100] http://poporowapa.midasweb.nl/items/map/ (consulted July 5, 2015).

and *Morocco* (in *Africa*), *Armenia*, and *Iraq* (in *Asia*), and *Croatia,* and the *Netherlands* (in *Europe*). For a more comprehensive analysis of the locations of origin that are displayed on the Map, see 3.2.4 Locations of origin.

3.1.2 Line Chart

Another chart included in the Poporowapa web application is the Material Line Chart, also devised by Google. So-called 'tooltips' appear when hovering over points in the line chart, which provide additional information.[101] The Line Chart may be used as follows. Under the button 'Ontology', available at the online interface, there is a link to a webpage called 'Analyse' (Fig. 3.1). A search bar is present at this page, in which the first letters of an ontology node can be entered. Similar to the task of annotating, a box appears underneath showing which ontology nodes match the sequence of letters. This way, the ontology node *Architectural element*, for example, may be selected, which will subsequently be visualised in the emerging chart (Fig 3.6).

The Line Chart consists of a horizontal axis representing a timeline, ranging from 0 to the year AD 400. The vertical axis shows the amount of times an ontology node was used to annotate the images of the dataset. This axis is flexible and scales along with the amounts to be displayed.[102] This way, the Line Chart visualises the occurrences of objects, themes, etcetera painted on walls and ceilings between AD 79 and 395. Various steps (1, 10, 25, or 50) may be used to influence the visual characteristics of the chart. A step of 1 shows the amount of occurrences per year, a step of 10 the amount per 10 years, and so on (Fig. 3.7).

The various steps are of relevance with regard to the dating of post-Pompeian paintings. Since virtually no dating is absolute, the average of both upper and lower limit is calculated. This average is being used in the Line Chart visualisation, and as such is reduced to a single date (AD 273, for instance), which becomes visible when a step of 1 is selected. The other steps come in handy to expand this dating. A step of 10 means that data points are shown with intervals of ten years. A dating of AD 273 is therefore included in the data point of the year AD 270, which is the sum of all dates ranging from 5 years before to 5 years after this date. Since usually a wide dating has been added to the images of the dataset, the larger steps are more relevant.

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[101] http://developers.google.com/chart/interactive/docs/gallery/linechart (consulted July 5, 2015).
[102] http://poporowapa.midasweb.nl/analyse/ (consulted July 5, 2015).

It is important to realise that certain dates occur more often than others based on the publications that were consulted. Because of the division of post-Pompeian painting in predominantly the Hadrianic, Antonine, and Severan periods, a number of items have received the same general creation date. Furthermore, a great deal of the paintings originating from Ephesus dates from the same period of time, construction phase IV (i.e. AD 225 to 250). As the second most items come from this city, this inevitably means a spike in almost every Line Chart visualisation around AD 238. Additionally, all circa 100 images included from Fink & Asamer 1997 have received an average dating of AD 320, unavoidably resulting in a spike in the charts around this time as well.

These reservations come to mind when looking at the Line Chart in which all root nodes are selected (Fig. 3.7). This visualisation points out that the root node *Physical attributes* was used most to annotate the items of the Poporowapa dataset. *Objects* and *Agents* follow this frequency of occurrences, in descending order. What is striking is that the ontology nodes pertaining to *Christian iconography* were almost exclusively used in AD 320 (thus pointing to Fink & Asamer 1997), which suggests that this was a major theme for the decoration of Rome's catacombs. Both *Geography* and *Styles and periods* turn out to be used least. All ontology nodes can be studied in this way, individually as well as in relation to others.

3.1.3 Geochart

The third visualisation tool could be understood as a combination of the former two. The Geochart, developed by Google, consists of a map of a country, continent, or region, with markers to designate places.[103] To this Geochart, a timeline was added, ranging from AD 79 to 395, in order to be able to study developments over time.[104] This extended Geochart comprises even more additional components: a search bar, with which an ontology item can be selected, various steps, with which the visualisation may be influenced, and buttons to animate or pause the timeline (Fig. 3.8).

The size and colour of the marker (ranging from darker to lighter orange), indicated by a dot on the map, reflects the amount of post-Pompeian paintings originating from a given place and time. The scale for both size and colour adjusts

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[103] http://developers.google.com/chart/interactive/docs/gallery/geochart (consulted July 5, 2015).
[104] http://poporowapa.midasweb.nl/geochart/ (consulted July 5, 2015).

automatically in relation to the data that has to be visualised on the Geochart. Hovering over closely spaced dots results in the appearance of a magnified view, whereas hovering over a single dots reveals the name of the geographic location as well as the amount of occurrences of the selected ontology node at this particular place and time.

With this tool, the occurrences of one ontology node at a time may be studied. The steps available range from 1 year, to 100 years (with 10, 25, and 50 in between) in order to include all relevant items of the Poporowapa dataset from either solely the averaged date, or this date within the period as indicated by the chosen step. For clarification, a step of 50 years means that the Geochart shows the total amount of relevant items from 25 years before to 25 years after the date selected on the timeline, with respect to the ontology node under study (Fig. 3.9). When animating this extended version of the Geochart, the visualisation is adjusted automatically according to the progression of time (per 10 years), resulting in a sequence of visualisations.

In this manner, the occurrences of certain visual characteristics, and possibly also their journey within the Roman Empire, can be traced. A closer look at a leaf node, *Peacock*, for instance, exemplifies the possibilities of such an approach.[105] This animal first occurred in modern Italy around AD 150, based on the images gathered in the Poporowapa dataset (Figures 3.10 and 3.11). About fifty years later, the *Peacock* shows up in Turkey as well. Around AD 250, this painted decoration was applied in Israel, and travelled north within both Italy and Turkey. There it remained in use for over fifty years, whereas around 350 AD the animal spread even further in the northerly direction, to Bulgaria. This seems to suggest a travel of the *Peacock* from Rome, the centre of the Empire, to the east, via the Mediterranean Sea, and subsequently a journey over land, to the north.

Interaction

An important aspect of all visualisation tools applied to this study, but for the Geochart in particular, is the ability to interact. Interactive visualisation

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[105] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Peacock (consulted on July 2, 2015).

takes advantage of people's ability to also identify interesting facts when the visual display changes, and allows them to manipulate the visualization or the underlying data to explore such changes.[106]

Exploring is comparing, essentially, but in order to compare it is required to be able to see, as Lev Manovich explains.[107] To see big cultural data, too big to grasp for the human mind, interactive data visualisation is used to aid our understanding. Even the Poporowapa ontology is a type of interactive hierarchy, usually called the 'indented tree', which provides insight into the ontology.[108] This interactive, instead of static, component is of great importance for the study of the contents of the Poporowapa dataset, as it might disclose unexpected patterns, trends, and outliers, as well as attract a renewed public interest in post-Pompeian Roman wall painting.

3.2 Interpreting the data

The Poporowapa dataset, that is, the collection of 1,242 images and their annotations, is now ready to be analysed. In order to get familiar with the dataset, it will first be introduced by means of a quantitative analysis. These numbers and charts will be studied according to the options that describe the relation of an ontology node or text to the corresponding item. Special attention will be paid to the option *Visual feature*, because this is ideally suited to explore with the visualisation tools Line Chart and Geochart. As a result, the gathered data will be interpreted, and this interpretation will function as a basis for the subsequent sections of this study.

3.2.1 Building types

A total of 1,100 images have been assigned a building type (Appendix III). Five major and two minor types could be distinguished. These types are grouped by their function, as can be seen in Appendix III, Illustration 1. Wall and ceiling paintings of the Poporowapa dataset were predominantly retrieved from residential structures, including terrace houses, villa's, and *peristyle* houses. About a fifth of the paintings originate from a funerary context, either from a cemetery or a single burial structure. Institutional buildings (thermal baths, latrines, etc.) account for 4 per cent, whereas

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[106] Quote by the Information Visualisation Research Group of the University of California (Irvine), reproduced from Mazza 2009, N/A. See: http://linux3.dti.supsi.ch/~mazza/infovis_introduction.pdf (consulted July 8, 2015).
[107] Manovich in Klinke & Surkemper 2015, 33.
[108] http://poporowapa.midasweb.nl/ontology/ (consulted on July 8, 2015); Heer, Bostock & Ogievetsky 2010, 64.

both religious (*mithraeum*, temple, etc.) and commercial (*taberna*, *macellum*, etc.) buildings represent 3 per cent. The *mansio* (transportation structure) and *castrum* (military building) are not well represented in the dataset.

3.2.2 Dating

All 1,242 items of the Poporowapa dataset have received a dating (Appendix IV). This dating is the average of the lower and upper limit, reduced to a single year. As a result, it becomes easier to study the items over time, although this date cannot be regarded as absolute. The occurrences of these dates are shown on a chart (Appendix IV, Ill. 1) that takes the entire post-Pompeian period into account. This chart reveals that most items of the Poporowapa dataset were created around AD 238 (amounting to 171 painted walls and ceilings), followed by AD 320 and 150 (104 and 95 items, respectively). Based on the table it becomes clear that almost 75 per cent dates from before AD 250, compared to roughly 25 per cent dating from AD 250 and thereafter (Appendix IV, Ill. 1).

3.2.3 Field colours

The field colours, or colours that cover part of a wall or ceiling, or even the entire background, that have been annotated are listed in Appendix V. Illustration 1 shows that white was used as a field colour the most by far (575 times), applied to almost half of the 1,242 items included in the Poporowapa dataset. Other colours that were frequently used to annotate the items are red and yellow, consisting of 13 and 11 per cent of all 851 field colours. The field colour blue occurred only in 44 instances, whereas green, black, brown, and purple, in descending order, were used in negligible amounts to annotate the items of the Poporowapa dataset.

3.2.4 Locations of origin

Exactly 175 different locations of origin were used to annotate the items of the Poporowapa dataset (Appendix VI). Of these 175 places, over 70 per cent originates from Europe (Appendix VI, Ill. 1). About a quarter of the post-Pompeian paintings represented were retrieved from the continent of Asia, whereas only a minor 3 per cent of them originate from Africa. As these numbers indicate, the items of the Poporowapa dataset are unequally distributed over the former Roman Empire. The main focus of the study of Roman painting is on Europe, which is reflected in the

dataset based on the selected publications. This selection has led to cities being represented by an amount of paintings varying from 1 to 265 (Appendix VI).

The locations of origin are located in 23 (or about half of the) modern countries that lay within the limits of the ancient Roman Empire (Fig. 3.5), as can be derived from Appendix VI, Illustration 2. Post-Pompeian paintings from what is now Italy make up almost half of the dataset, as opposed to a quarter of the items that originate from modern Turkey. As could be expected, subsequently in number are the United Kingdom and Switzerland. Each country represents a number of cities ranging from 1 to 41. The average number of wall and ceiling paintings retrieved per city, per country, is situated somewhere between 1 and 37. Appendix VI confirms that the cities of Rome, Ephesus, and Ostia are the outliers, with occurrences well above the 200.

3.2.5 Room types

In total, a number of 23 different types were used to denominate the rooms from which post-Pompeian paintings were retrieved (Appendix VII). In only 242 instances mention was made of a room type in the publications used to create the Poporowapa dataset. In these instances, most often a room was referred to as a cubiculum (in both residential and funerary contexts), see Appendix VII, Illustration 1. Tied for second place, with 30 occurrences, are the circulation space, used to annotate rooms and spaces such as hallways, and the *peristyle*, a courtyard usually to be found in a *peristyle* house. Thirdly, the *arcosolium*, or recess in a Roman catacomb,[109] and the bathroom, both in public and private contexts, are represented by ten per cent.

3.2.6 Surfaces

The surface on which was painted is, as mentioned before, either a wall (including wall components such as niches and lunettes) or a ceiling (Appendix VIII). The Poporowapa dataset contains 88 per cent wall paintings, that is paintings on a vertical surface (Appendix VIII, Ill. 1). The other 12 per cent or 155 items account for ceiling paintings, which might be painted on a flat horizontal surface or a vault of any kind. The surface has been annotated on account of Ling in Pollitt 2014, who claims that the 'most interesting and impressive experiments take place, not on

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[109] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Arcosolium (consulted on July 14, 2015).

walls, but on ceilings, where new structural dispositions, namely groined cross-vaults and various forms of dome, gave painters new inspiration'.[110] Whether this is indeed the case will be studied, *inter alia*, in the following section (Chapter 3.3).

3.2.7 Visual features

The option *Visual feature* was used to annotate the objects and other elements depicted on post-Pompeian Roman murals. No less than 5,372 times a node from the ontology was linked to an image (Appendix IX). Of the root nodes, *Objects* were represented most, of about 128 different types. Illustration 1 of Appendix IX shows the amount of occurrences per root node, and the percentage this represents in relation to the total number of 5,372 occurrences. Besides the objects, *Physical attributes* and *Agents* were in large numbers depicted on the items included in the Poporowapa dataset, followed by subjects from *Classical mythology and ancient history* (6 per cent), as well as *Materials* (5 per cent).

Looking at this data according to smaller groups of ontology nodes, it is striking that most use was made of patterns and motifs (1,035 times), that is, in one out of five instances (Appendix IX, Ill. 2). However, more than one pattern or motif could have been used to annotate just one image. On average, four visual features were used to annotate one item (5,372 occurrences distributed over 1,242 items). About 10 per cent of the visual features annotate a human figure of some kind, whereas various species of animals were linked to the items 444 times. Other prominent groups are the *Architectural element*, subjects from *Classical mythology and ancient history*, as well as *Geometric* elements and *Inorganic* materials (see Appendix IX, Ill. 2). The data can also be reviewed according to single ontology nodes, which gives a whole other view altogether.

The ontology node that was used most is *Panel*, to indicate a painting that disposes of ornament areas, 'usually rectangular and enframed'.[111] Next in line is the *Full-length* human figure, succeeded by the motifs *Festoon*, *Candelabrum*, and *Flower*, as can be seen in Appendix IX. About 111 ontology nodes were used only once, indicating either a more specified annotation or a relatively uncommon element. *Ball game* is one such node, for instance, as are *Cyclops* and *Shrimp*. As a

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[110] Ling in Pollitt 2014, 371.
[111] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Panel (consulted on July 14, 2015).

result, the number of occurrences may vary greatly, ranging from 1 to 337 times. In total, 412 nodes were used to annotate the visual characteristics of the Poporowapa items. This means that on average, each of these nodes was used thirteen times to annotate all of the images.

<u>Popular elements</u>

Except by means of these tables, the occurrences of these visual features may be studied over time with the aid of the Line Chart. Figure 3.12 shows the top ten of most frequently used ontology leaf nodes in relation to each other. It becomes clear that the *Panel* was only sporadically used after AD 250, and occurred on the many paintings originating from Ephesus (hence the spike on AD 240). The leaf node *Full-length* has been added to items dating from AD 79 to 395, but particularly around AD 320, which suggests that this was a significant feature of the catacombs of the city of Rome. *Festoon* was increasingly used up to AD 180, and thereafter again circa AD 240 and 320, just like the foregoing popular examples.

In accordance with *Panel*, *Candelabrum* was used to annotate items dating mostly before AD 250. The leaf node *Flower*, on the other hand, occurs regularly throughout the period under study, with a special emphasis on circa AD 240 (Ephesus), representing almost a ten-fold increase in number (see Fig. 3.12). There seems to be a decrease in popularity for *Architectural fantasy* after AD 250, the ontology node used to describe depictions of the so-called *Architekturmalerei*, or *Reduktion von Architekturformen* (Fig. 3.13).[112] Surprisingly, representations of men occur almost as many as those of women, usually in the aforementioned *Full-length* stature.

The Line Chart of the ontology leaf node *Marble* shows three spikes, in AD 150, 240 (Ephesus), and 350, respectively. It could be noted that imitations of marble were thus not in favour for the decoration of the Roman catacombs, but nevertheless this type of decoration was in use throughout the centuries. On eleventh place is the associated concept *Line*, used to annotate post-Pompeian paintings with an emphasis on lines, or *Lineardekorationen* (Fig. 3.14).[113] Decorations based on lines, or linearity, were most common around AD 210 (and thus not particularly in favour in

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[112] Terms used in German publications to describe paintings of simplified architectural forms. E.g. Zimmermann & Ladstätter 2010; Mielsch 2001.
[113] E.g. the decoration scheme defined by Claudia Liedtke in Liedtke 2003.

Ephesus) and regains popularity around AD 320 in the catacombs of Rome (Fig. 3.15).

With regard to groups of ontology nodes, more human figures than animals have been annotated, although their distribution over the years is rather equal (Fig. 3.16). Of the animals, birds are depicted most on the items of the Poporowapa dataset, a feature that also remained in use from AD 79 to 395. Architectural elements seem to have been in vogue predominantly in the second century AD (Fig. 3.6). In general, no specific range of years could be determined for the occurrences of visual features: they continue to return over the entire post-Pompeian period. Studying these elements by means of the Geochart may generate different results, because in this way their locations of origin will be included into the equation.

Travelling concepts[114]

With the Geochart, the diffusion of visual features over the former Roman Empire can be explored. As Figure 3.17 reveals, by the end of the first century AD the ontology node *Figure* was mostly depicted on murals originating from central Europe. By the first half of the second century, figures were depicted on walls and ceilings all over the Roman territories, and the same could be said for the next century. In the period from AD 250 to 300 the number of paintings representing figures declined, whereas for the next 50 years Rome was the main spot where representations of a *Figure* could be found. According to the Poporowapa dataset, figures were still depicted on walls and ceilings all over the Roman Empire in the second half of the fourth century. As a result, figurative painting seems to have spread from central Europe to the continents of Africa and Asia.

Different patterns can be observed for the various ontology nodes used. One of the exceptions to the rule is the root node *Christian iconography*. Images related to this concept first occur in or after AD 240, and then only in Rome (the catacombs), and a single time Ephesus (Fig. 3.18). The depiction of Muses, on the other hand, appears to go out of fashion after AD 240 (Fig. 3.19). Examples from before this date could at least be encountered in *Sirmium*, Ostia, Rome, Ephesus, and *Leptis Magna*. Although no clear travel of this theme emerges from the Geochart, the

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[114] The term 'travelling concept' is derived from the writings of theorist Edward Said, who used it to describe the transfer of ideas in the humanities and social sciences. According to Said, a theory's 'movement into a new environment is never unimpeded', but is 'influenced by both 'conditions of acceptance' and 'resistances''. See Frank 2009, 61-63.

decreased interest in depicting Muses might be understood as an indication of a diminishing interest in (Greek) literature, science, and the arts, followed by an orientation increasingly geared towards other (religious) values.

<u>Other notable findings</u>

Remarkable is that the leaf node *Line* was used almost exclusively in Rome and its direct surroundings, in other words the modern province of Lazio, during the entire post-Pompeian period (Fig. 3.14).[115] The only other places where paintings of this type, and included in the Poporowapa dataset, were found are Sybaris (southern Italy), Ephesus, and by the end of the fourth century AD in Sofia (Bulgaria). With regard to *Millefleurs* (Fig. 2.7) another trend may be spotted. This decorative pattern first appears in the dataset around AD 100, and was used most circa AD 240 (in Ephesus), as well as AD 350.[116] Visualised on the map of the world, *Millefleurs* seems to originate from Rome, and then spread to Asia, followed by Africa. Subsequently, the pattern travels northwards into Eastern Europe, and finally makes its appearance across the English Channel, in Lullingstone (United Kingdom). This pattern is often, but not exclusively, related to the leaf node *Peacock*, which made a, to a large extent, similar journey (Fig. 3.11).

Of the root node *Classical mythology and ancient history*, the leaf node *Cupid, Amor, or Eros* was used most as a link between item and ontology, followed by the personification of *Victoria*, and the *Gorgon*, usually Medusa (Appendix IX, Ill. 3). In general, two thirds of the annotations of or related to this root node consist of *Gods*, with a preference for those associated with *Serving and attending* (Appendix IX, Ill. 4). Based on Appendix IX, the occupation of a person that occurred most is that of a *Servant* (34 times), instead of that of the *Philosopher* (merely 9 times), for example. This makes the servant of comparatively more interest to this study.[117]

The unspecified *Christian iconography* leads the ranks of this root node (20 times), followed by *Christ* (applied 14 times). The *Activity* depicted most is *Sacrifice*, which shares its first place with *Masonry* (used to denote 14 painted imitations akin to the first Pompeian Style). For the root node *Geography* there is

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[115] http://poporowapa.midasweb.nl/geochart/ -> Line (consulted, and animated, on July 27, 2015).
[116] http://poporowapa.midasweb.nl/geochart/ -> Millefleurs (consulted, and animated, on July 27, 2015).
[117] http://poporowapa.midasweb.nl/geochart/ -> Servant (consulted, and animated, on July 29, 2015).

also a shared first place between the Red Sea in *Egypt*, and the *Moon*, both depicted twice (Appendix IX). Of the *Styles and periods* only one root node was used once, the Roman provincial style *Romano-Egyptian*, for one of the items of the Poporowapa dataset that will pass in review below.

3.3 Testing Roger Ling's conclusions

Roger Ling made the most recent attempt to create an overview of Roman painting of the Middle and Late Empire, that is, broadly the second, third, and fourth centuries AD.[118] According to Ling, Roman painting of the post-Pompeian period 'is best known from the murals of domestic interiors'.[119] As has already become clear, the same conclusion could be made on the basis of the Poporowapa dataset, in which residential structures account for 67 per cent of the known associated building types (Appendix III, Ill. 1). Although paintings from this period are indeed 'scattered both in time and in space', Ling furthermore suggests that the surviving examples are 'far fewer' than from the previous centuries.[120] On the contrary, the opposite appears to be the case, as the actual number is still elusive.

A first comparison between Ling's 'dataset' and the Poporowapa dataset reveals some interesting numbers. In his chapter in Pollitt 2014, Ling analyses 100 paintings originating from 41 locations, as opposed to the 1,242 paintings originating from 175 locations that make up the Poporowapa dataset. This means that over 12 times as many post-Pompeian paintings are at the basis of this study, retrieved from over 4 times as many places. As a result, it seems very worthwhile to compare Roger Ling's conclusions with those that can be derived from the Poporowapa dataset, in order to analyse both the differences and similarities. Ideally, this will lead to either a (partial) confirmation or revision of the current state of research.

3.3.1 The Middle Empire

Ling carefully suggests that the turn of the Early to the Middle Empire brought about a decline, first of all in 'a lack of invention', and secondly in 'techniques of production'.[121] This general assumption may account for the lesser degree of interest in Roman painting from the second century AD onwards. To start with the Middle

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[118] Ling in Pollitt 2014, 370.
[119] Ling in Pollitt 2014, 370.
[120] Ling in Pollitt 2014, 371.
[121] Ling in Pollitt 2014, 371.

Empire (roughly AD 100 to 250), Ling explains that due to the 'imbalance of the evidence' generalising is highly problematic. 67 examples are discussed dating from this period, compared to 903 items of the Poporowapa dataset. Painting of this period predominantly comes from Rome and Ostia, 'neither of which were typical centres', as well as Ephesus, in accordance with the Poporowapa dataset.[122] Of the rest of the Empire, scattered and fragmentary examples have been preserved, mostly from residential structures, as well as funerary tombs supposedly located 'mainly in the eastern provinces'.[123] However, the Poporowapa dataset does not support this claim: funerary contexts are mainly distributed over Europe, most notably the Italian peninsula, and to a lesser extent over Asia, as well as Africa (see Appendix X, Ill. 1).

As mentioned before, 'dating is often extremely uncertain, especially in the provinces', a difficulty that was encountered first-hand when creating the Poporowapa dataset. In his review, Ling puts emphasis on four main themes: '(1) decorative schemes in wall painting, (2) the treatment of ceilings, (3) choices of subject matter and their development […], and (4) the relationship between painting and the other media of interior decoration, notably stuccowork and mosaic'.[124] The fourth theme, however interesting, falls beyond the scope of this study. In addition, one of the excursuses on related issues is of relevance, dealing with 'the interaction between mainstream Graeco-Roman painting and the artistic traditions of other cultures on the margins of the Empire, notably in Egypt and the eastern frontier'.[125]

Ling argues that because of a disinterest in invention, 'there was thus nothing that we can call a fifth or sixth style, merely pastiches incorporating elements of the Second, Third, and Fourth'.[126] This issue will be studied below, in Chapter 4.1. Ling continues that above all in Italy figurative scenes, placed centrally on the wall, were increasingly reduced to single-figure emblems or vignettes, placed centrally on coloured fields. Groups of figures, on the other hand, could more often be found within panels on ceilings.[127] Although Ling seems to use 'panels' in another way as defined in the Poporowapa ontology (i.e. an ornament area), denoting a depiction of a pictorial work of art (i.e. a painting within a painting), a visual comparison shows

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[122] Ling in Pollitt 2014, 373.
[123] Ling in Pollitt 2014, 374.
[124] Ling in Pollitt 2014, 374.
[125] Ling in Pollitt 2014, 374.
[126] Ling in Pollitt 2014, 375.
[127] Ling in Pollitt 2014, 375.

that single-figure depictions do not occur more often than groups, and in addition no preference for the surface of the ceiling could be detected.[128]

As is so often done, Ling differentiates between 'more important rooms' and 'minor decorations', or *Nebenraumdekorationen*.[129] White grounds became more and more in demand for the latter category of paintings, and then mostly within the context of ill-lit chambers, according to Ling. Analysis of the Poporowapa reveals that although a white field colour was mostly applied to the *cubiculum*, one such *Nebenraum*, this colour is not confined to this type of room (Appendix X, Ill. 2). As a result, white seems to gain in popularity in general, regardless of known room types.[130] Architectural painting, or the *Architectural fantasy* of the Poporowapa ontology, supposedly used to decorate the main rooms, gradually lost its three-dimensional effects as time progressed. This type of painting mainly dates before AD 250, but occurs in all kinds of rooms, and in various forms (Appendix X, Ill. 3).

'From the provinces come various decorations which reflect late Antonine and Severan work in the capital'.[131] This is a generalisation that deserves some special attention, and will be discussed in Chapter 4.2. From a stylistic point of view, however, this generalisation is not very suitable to study by means of the Poporowapa dataset (the focus is on *what* is depicted, not *how*). With regard to painted ceilings, Ling notes that the trend emerged to make use of diagonal schemes that reflect the shape of the vault.[132] However, such vaults are not well represented in the Poporowapa dataset. Instead, it seems more common to use geometrical patterns or motifs to cover the entire surface of the ceiling, based on a visual analysis of the ceiling paintings included. This corresponds to the ceiling paintings Ling refers to as executed in 'simpler modes', such as imitations of stucco and stone coffering.[133]

The Poporowapa dataset contains annotations naming individual gods of classical mythology, rather than designations of specific stories. Depictions of *Gods* in general account for 4 per cent of the annotations in the Poporowapa dataset, a minor part of which are mythological scenes (Appendix IX, Ill. 2). Ling states that

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[128] Based on the images related to the ontology node *Figure*, on display underneath the Line Chart of the Poporowapa web application. See http://poporowapa.midasweb.nl/analyse/ -> Figure (consulted on August 10, 2015).
[129] Ling in Pollitt 2014, 375; Liedtke 2003.
[130] http://poporowapa.midasweb.nl/analyse/ -> White (consulted on July 27, 2015).
[131] Ling in Pollitt 2014, 379.
[132] Ling in Pollitt 2014, 381.
[133] Ling in Pollitt 2014, 387.

most of these scenes used to decorate tombs, that is, funerary structures, which the dataset does not confirm (Appendix X, Ill. 4). Most of the items annotated with mythological themes pertain to gods of the category *Serving and attending*, as was already illustrated by Appendix IX, Illustrations 3 and 4.

In addition, Ling comments on the inscriptions that were used to label figures, especially in the Levant and Egypt. In the Poporowapa dataset, the images that display inscriptions have been annotated with the ontology node *Language-related*. Strikingly, these exclusively occur in Europe, for the Middle, and additionally in Turkey, for the Late Empire.[134] The use of inscriptions is thus not restricted to a particular part of the Roman Empire, while on the other hand the dataset of this study indicates an increase in use especially after AD 250.

Still lifes were only sporadically applied in this period, whereas landscapes generally lost their vigour, to the benefit of realistic depictions of everyday subjects. 'Painted aquaria remained popular, especially in the decoration of bath chambers, and came to be associated with genre and idyllic […] subjects' (Fig. 3.20).[135] Although the latter is an assumption that seems rather hard to prove, the Poporowapa dataset does show that painted aquaria occurred especially within the confines of the *Public bath* (Appendix X, Ill. 5). Ling also mentions the portrait in particular, which is understandable from the vantage point of a contemporary art historical study. However, the aforementioned types of visual works (*Still life*, *Landscape*, *Seascape*, and *Portrait*) make up less than 2 per cent of the annotations (i.e. 98 items out of 5,372, based on Appendix IX).

Ling subsequently notes that, apart from the water themes used for the murals of bath-related spaces, scenes 'of hunting or references to the wine god Bacchus appeared in the decoration of reception rooms', whereas scenes 'related to the Underworld or myths involving symbolic victories over death, such as the rape of Persephone or Heracles' capture of Cerberus, were naturally found in funerary contexts'.[136] The latter also becomes clear when looking at the Poporowapa dataset (Appendix X, Ill. 4 (*Underworld*) and 6). The former, however, is less obvious to detect, since the way in which a room was used is often hard to establish. Numerous studies have been made, and although no consensus was reached, rooms that are

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[134] http://poporowapa.midasweb.nl/geochart/ -> Language-related (consulted on July 27, 2015).
[135] Ling in Pollitt 2014, 390.
[136] Ling in Pollitt 2014, 392.

usually appointed 'reception room' within the Poporowapa ontology are the *Triclinium*, *Tablinum*, and *Oecus*. On the one hand, since more often than not the room type or function was not indicated, firm statements cannot be made. On the other, the Poporowapa dataset does reveal that hunting scenes and depictions of Bacchus occurred predominantly, but not exclusively, within a residential context (Appendix X, Ill. 7).

Another iconographic subject is the oriental deity of Mithras that was incorporated in this period in the Roman pantheon. The half-underground temples or *mithraea* associated with this cult depict the god as slaying a bull, which is also called a 'tauroctony', usually executed in stuccowork.[137] The Poporowapa dataset contains only three painted examples (Fig. 3.21), and thus constitutes a minor subject within post-Pompeian Roman wall painting. Furthermore, these three examples all originate from the Italian peninsula,[138] suggesting that it was peculiar to the Romans to represent this foreign deity in the medium of paint.

The last case that will be discussed with regard to the Middle Empire is the relationship between the Roman conqueror and its newly acquired territories. Ling notices that in these regions along the Danube River and north-western Europe, as well as North Africa, 'there was no pre-existing tradition of monumental wall painting'.[139] Nevertheless, it is striking that in all of these regions, including Asia Minor and the Levant, and despite regional variations, 'we have no paintings that depict native subjects or are rendered in a non-classical manner'.[140] This implies that in the process of acculturation wall and ceiling painting is a specific aspect of the adoption of Roman visual culture. This concept will be studied in more detail in one of the case studies of the next chapter (4.2 Centre and periphery?).

According to Ling, the visual idiom of the Empire stretching from the Atlantic Ocean to the Near East, and from the Danube River right to the edge of the Sahara desert was one and the same. Modern Egypt would be the exception to the rule, since there already existed a 'long-standing tradition of funerary painting going back to Pharaonic times'.[141] This supposedly resulted into a 'bilingual' or *Romano-Egyptian* style. Nevertheless, only one unique example is mentioned, recurring in

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[137] Ling in Pollitt 2014, 392.
[138] http://poporowapa.midasweb.nl/geochart/ -> Mithras (consulted on July 27, 2015).
[139] Ling in Pollitt 2014, 395.
[140] Ling in Pollitt 2014, 395.
[141] Ling in Pollitt 2014, 396.

various publications as well as the Poporowapa dataset, which is a rather small number as a foundation for this argument.[142] The example is exceptional though, and definitely worth further consideration in order to shed more light on this issue.

Parthian influences could on the other hand be found in the murals originating from modern Syria, most notably the cities of Palmyra and Dura-Europos. In addition to the paintings of the Temple of Bel, the house-synagogue of Dura-Europos is extensively discussed; the only major example of post-Pompeian painting that is not included in the Poporowapa dataset. The influences may be characterised by the figures displaying a 'hieratic frontality', and sometimes wearing Asiatic dress.[143] The few Syrian examples of the Poporowapa dataset do seem to conform to this description of being rendered in a flat and linear manner.[144] Ling cautiously ascribes the tendency to turn away from illusionistic and towards stylised representations as an Eastern influence, although a visual overview of the Poporowapa dataset points out that stylisation took place especially within the context of the Roman catacombs in relation to subjects of Christian iconography.[145]

3.3.2 The Late Empire

Tainted by unstable governments and frontiers, epidemics and financial collapse, Roman wall painting was in crisis by the second half of the third century. This mainly affected modern Italy, and Europe as a whole, whereas Africa and the East are said to have suffered to a lesser extent of these conditions.[146] Ling furthermore states that from AD 284 up to the end of the reign of Constantine (AD 337) 'there was a revival of good-quality wall painting', as well as a 'dissemination of a court style to the provinces'.[147] 'Good quality' and 'court style' are rather dubious terms, which are not exemplified by Ling, and as such these conclusions are difficult to check. The overall distribution of ontology nodes used, however, does show that after AD 250 a smaller number of paintings have been preserved, of which most are

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[142] http://poporowapa.midasweb.nl/index.php/items/edit/23 (consulted on July 27, 2015).
[143] Ling in Pollitt 2014, 397-399.
[144] Zimmermann 2014, CXII, CXIII, CXIV, CXV, CXCVII, CXXII & CXXIV.
[145] http://poporowapa.midasweb.nl/analyse/ -> Activities, Agents, Associated concepts, Christian iconography, Classical mythology and ancient history, Geography, Materials, Objects, Physical attributes, Styles and periods (consulted on August 10, 2015).
[146] Ling in Pollitt 2014, 405.
[147] Ling in Pollitt 2014, 405.

dated within the first half of the fourth century (Fig. 3.7), which is confirmed by Appendix IV.

Besides painting, in the Late Empire works 'in mosaic and *opus sectile*' grew increasingly popular.[148] Imitations of *opus sectile* in the medium of paint were in use in the period ranging from AD 79 to 350, as opposed to the single painted imitation of mosaic or *opus tessellatum* dating from around AD 150, based on the Poporowapa dataset (Fig. 3.22). Apparently, the increased popularity was not reflected in Roman painting, but applied only to the original medium of stone. Furthermore,

> The lack of paintings in well-dated contexts and the simplicity of the schemes in use make any analysis of work in this period more difficult than it was for the preceding period. […] For the third century in particular the chronological fabric remains completely uncertain, and only the most generalised statements can be offered. Unfortunately, the evidence from Africa and the East is as exiguous as elsewhere and not nearly as well known.[149]

Therefore, it will be especially challenging to check if using the Poporowapa dataset may result in a clearer overview than hitherto exists.

A third of the examples Ling chose to highlight in his chapter (i.e. 33 out of a 100), date from between AD 250 and 400, compared to over a quarter of the Poporowapa dataset (i.e. 339, or ten times as many). Ling broadly classified the types of paintings as 'architectural schemes, linear schemes, "wallpaper" patterns, imitation veneer, and large-scale figure compositions', of which the last two especially pertain to the fourth century, although all 'have precedents in earlier times'.[150] To start with the first type, according to the Poporowapa dataset the depiction of *Architectural fantasies* sees a decline after AD 250. *Architectural elements*, referring to more realistic depictions of individual elements, such as columns and *aediculae*, do reveal resurgence in the Late Empire, visualised by the Line Chart.[151] A visual comparison, however, does not confirm Ling's conclusion that architectural paintings became 'heavier', so to speak.[152] Only the *Column* seems to be depicted more crudely as time progresses (compare Figure 3.13 to 3.23).[153]

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[148] Ling in Pollitt 2014, 405.
[149] Ling in Pollitt 2014, 405-406.
[150] Ling in Pollitt 2014, 406.
[151] Figures 3.6 and 3.12, or see http://poporowapa.midasweb.nl/analyse/ -> Architectural element, and Architectural fantasy (consulted on July 27, 2015).
[152] Ling in Pollitt 2014, 406.
[153] http://poporowapa.midasweb.nl/analyse/ -> Column (consulted on July 27, 2015).

Secondly, the linear style gets special mention, which usually consists of red and green lines arranged on a white ground. As has already been discussed, the preserved examples were almost exclusively retrieved from Rome and its surroundings, and occur throughout the post-Pompeian period. Ling characterises this style as 'cheap and economical', often combined with 'stock decorative motifs'.[154] These expressions of value cannot be derived from the Poporowapa dataset, while visually speaking this type of painting does stand apart. According to Ling, a strong link with the catacombs of Rome exists, although actually linear decorations were retrieved mostly from residential structures (Appendix XI, Ill. 1). Only sporadically was the *Line* used in combination with *Christian iconography* (possibly Fig. 3.15), exclusively found in a funerary context (Appendix XI, Ill. 2), although these examples are especially well published.

Furthermore, Ling particularly refers to the depiction of the four Seasons, depicted in the corners of ceilings.[155] In the Poporowapa dataset, however, this element occurs only eight times, both on walls and ceilings, and predominantly in the Middle Empire (Appendix XI, Ill. 3). The same applies to the wallpaper pattern, indicated in the Poporowapa dataset by the *Allover* pattern type, which Ling distinguishes from the coffer-based schemes, or imitations of a *Coffered ceiling*. The all-over pattern is often based on geometrical networks, and less frequently on vegetal or floral forms (see Appendix XI, Illustrations 4 and 5, although the latter may include imitations of coffered ceilings), which is the opposite of what Ling noted.[156] Nevertheless, Ling surprisingly pays most attention to the category of geometrical networks.

Ling suggests curvilinear schemes (tangent as well as intersecting circles, or *Roundels* and *Interlocking circles*) were preferred for ceilings,[157] but nothing gave rise to this assumption based on the Poporowapa dataset. Polygonal or angular patterns were presumably also applied 'chiefly on ceilings' (possibly Fig. 2.11),[158] of which no indication could be found either. Lattice works, or intersecting diagonals, were applied mainly to walls, and in combination with roundels both on walls and

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[154] Ling in Pollitt 2014, 407.
[155] Ling in Pollitt 2014, 408.
[156] Ling in Pollitt 2014, 410.
[157] Ling in Pollitt 2014, 410.
[158] Figure 2.11 corresponds to item number 604 of the Poporowapa dataset. See http://poporowapa. midasweb.nl/index.php/items/edit/604 (consulted on August 14, 2015). It is unclear whether these fragments formerly belonged to the surface of a wall or a ceiling.

ceilings. This view corresponds to the contents of the Poporowapa dataset, which contains five such examples (*Lattice*), complemented by 27 items annotated with *Fence* (intersecting diagonals that only partly cover the surface of the wall or ceiling).[159] In the end, analysis reveals that geometric 'wallpaper' patterns were applied both on walls (ca. 25 per cent) and on ceilings (ca. 75 per cent). Roughly the same goes for all-over patterns based on vegetal or floral forms (Appendix XI, Illustrations 4 and 5).

The fourth painting type is that of imitated marble veneer, which for Ling includes imitation inlay or *opus sectile* (see Figure 2.8).[160] Based on the Poporowapa dataset, there seems to be a decline in the application of paintings imitating *Marble* and *Opus sectile* after AD 350, while prior to this date they could be found all over the Roman Empire.[161] As a result, no specific significance for the Late Empire could be detected. Lastly, figurative compositions that largely occupy the wall surface came especially in vogue in the Late Empire according to Ling.[162] Understandably, figures do present challenging visual evidence, and in addition they make up the second largest group of depictions within the Poporowapa dataset (Appendix IX, Ill. 2). Especially around AD 320 (related to the catacombs of Rome) Figure 3.16 shows a spike, associated with as much as 89 paintings representing one or more figures.

Large-scale figure compositions sometimes 'represent ceremonial and documentary subjects', and within the built context of the aristocratic villa 'they perhaps represent a new kind of self-advertisement on the part of the wealthy owners'.[163] Numerous paintings of figures date from the Late Empire, although their actual sizes are often hard to tell, based on the images of the Poporowapa dataset.[164] Ling furthermore notices a new classicising phase 'which prevailed in good-quality paintings of the Constantinian period',[165] for which no evidence could be found in the Poporowapa dataset. This is due to the fact that the dataset does not differentiate

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[159] http://poporowapa.midasweb.nl/analyse/ -> Lattice, and Fence (consulted on July 30, 2015).
[160] Ling refers to pseudo-veneer as a 'cheap substitute for the real thing', which was by the fourth century represented less carefully or illusionistic than the centuries before. See Ling in Pollitt 2014, 413. It may be questioned whether or not this take on the painted imitations of marble veneer is correct: the forthcoming doctoral thesis by Suzanne van de Liefvoort is very promising in this respect.
[161] http://poporowapa.midasweb.nl/analyse/ -> Marble, and Opus sectile (consulted on July 27, 2015).
[162] Ling in Pollitt 2014, 414.
[163] Ling in Pollitt 2014, 415-417.
[164] http://poporowapa.midasweb.nl/analyse/ -> Figure (consulted on August 10, 2015).
[165] Ling in Pollitt 2014, 417-418.

between 'good' and 'bad' quality paintings, a rather subjective affair, and because variations on *how* something was depicted could not be annotated.

Subsequently, Ling states that 'the general predominance of blue and red in the ceiling reflects a favourite late antique colour combination'.[166] This is simply not true, as Appendix XI, Illustration 6, demonstrates. As opposed to the Constantinian illusionism, the second half of the fourth century is said to lead the way 'to Byzantine and medieval painting', which makes use of stylised or simplified forms.[167] As already mentioned, a visual comparison of all items of the Poporowapa dataset shows that stylisation took place especially within the context of the Christian iconography related to the Roman catacombs.[168] Lastly, 'the Peace of the Church and the triumph of Christianity presaged the phasing out of pagan iconography in favour of Christian subjects', according to Ling.[169] Although this sounds reasonable within the grand narrative of art history, the Poporowapa dataset nevertheless shows that *Christian iconography* did not yet gain the upper hand within the Late Empire, and was limited to the decoration of funerary building types (Appendix XI, Ill. 2).

In conclusion, the Poporowapa dataset has proven to be an extremely useful tool to review the most recently formulated take on post-Pompeian painting. Some general assumptions could be confirmed, others refuted, and still others require further study. More than once, too much emphasis was placed on the 'wrong' subjects, the so-called outliers, guided by preferences of this age instead of those of the post-Pompeian period. Such overemphasised subjects could be put into perspective by the extended number of paintings that could be involved through the use of the Poporowapa dataset. As a result, by aiding our perception with this tool, the reliability of our conception of Roman painting can be improved.

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[166] Ling in Pollitt 2014, 419.
[167] Ling in Pollitt 2014, 419.
[168] See note 145.
[169] Ling in Pollitt 2014, 419.

4 Case studies

So far, the Poporowapa dataset has been used to perform a quantitative analysis, study developments over space and time, and to verify the current state of research on post-Pompeian Roman wall painting. In addition, this chapter will discuss several case studies that may answer some questions not yet explored. First of all there is the issue of end date of the fourth Pompeian Style. Secondly, the Poporowapa dataset will be used to study whether a centre-periphery model exists for the dissemination of visual features over the Roman Empire. Lastly, the possible relationships between (built) environment and post-Pompeian painting will be placed under close scrutiny.

4.1 The Fourth Style and beyond

The Fourth Style is of interest to this study since it was still in vogue by the time Mount Vesuvius erupted, and various suggestions have been made concerning the end date of this Pompeian Style. Up to now, the end dates given by prominent scholars range from the late first century AD to about AD 140.[170] In order to be able to establish the end date of the Fourth Style by means of the Poporowapa dataset, it will first be necessary to gain more knowledge about the style itself, which came into use around AD 45. Consequently, the ascertained definition of this 'Fantasy' Style will serve as a means to study which post-Pompeian paintings meet this requirement, and which do not, in correlation with the dating assigned to them.

August Mau already made a value judgement about the Fourth Style, which he saw as a time of decline in Roman painting.[171] Value judgements are an important factor for the study of Pompeian as well as post-Pompeian painting that have led to a one-sided view over the years. As Volker Michael Strocka explains, even

> *Die Mehrzahl der Räume Pompejis sind sogenannte Nebenzimmer oder gehören zu schlichten Häusern, die gar nichts Anderes kennen als Feldermalereien mit oder ohne Lisenen und diese mal mit Kandelabern, mal mit Ranken oder Ähnlichem gefüllt.* [...] *Wie E. Heinrich in seiner Untersuchung über den zweiten Stil in pompejanischen Wohnhäusern zu dem Ergebnis gekommen ist* [2002]*, dass die meisten Wände ohne einen perspektivischen Durchblick auskamen, der gemeinhin als das Charakteristikum des Zweiten Stils gilt, so bestanden auch die meisten*

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[170] E.g.: Ling in Pollitt 2014, 371; Strocka in Zimmermann 2014, 30; Mols & Moormann in Zimmermann 2014, 106.

[171] Strocka in Zimmermann 2014, 30.

Wände Vierten Stils in Pompeji nicht aus Architekturprospekten, sondern waren mehr oder weniger schlichte Kandelaberwände, manchmal selbst ohne Lisenen. Dieser Umstand ist uns nicht bewusst, weil viele solcher Wände als belanglos nicht publiziert wurden und längst zerstört sind. Sie galten den Besitzern dieser Räume aber jeweils als angemessene Ausstattung.[172]

Previously, Strocka discussed the so-called *Nebenzimmer* of Pompeii in an article dating from 1975, as well as the downside of the neglect of this type of room. The Pompeian Styles are based solely on impressive decorations with architectural representations, and as such are misleading in terms both of the diversity of painting types and functionality, according to Strocka.[173]

Since 1975, remarkably little has changed. As a result, Irene Bragantini's statement on the accuracy of Mau's archaeological analysis may be questioned.[174] The 'good' quality paintings have not loosened their grip on those of 'bad' quality. In the meantime, Claudia Liedtke is one of the few scholars who engaged with the *Nebenraumdekoration* as a distinct category in 2003.[175] The term was first used for decorations applied to rooms such as hallways and workspaces, and the dwellings of the less well-to-do inhabitants of Pompeii.[176] These 'secondary' rooms were presumably decorated with second-rate wall and ceiling paintings that consisted of a monochrome background, as opposed to the polychrome backgrounds used in *Hauptraumdekorationen*, or the decorations of the main rooms.

Not only were the *Hauptraumdekorationen* more colourful, they also depicted a wide range of mythological scenes, and a schema was employed to divide the wall into three horizontal parts (the base, a large middle, and an upper zone). This classical tripartite division was to some extent abolished in the *Nebenraumdekoration*, whereas vignettes or isolated figurative images were introduced.[177] In numerous buildings, the latter form of decoration took the place of the former in the course of the second century AD, and thus became the sole form of decoration.[178] Because of its simpler appearance, Liedtke assumed that the

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[172] Strocka in Zimmermann 2014, 36.
[173] Strocka 1975, 101.
[174] Bragantini in Pollitt 2014, 361-362.
[175] Liedtke 2003.
[176] Liedtke 2003, 2.
[177] Liedtke 2003, 1.
[178] Liedtke 2003, 2.

Nebenraumdekoration was a cheaper form of interior decoration, again resorting to a value judgement in her analysis.[179]

The distinction between *Haupt-* and *Nebenraumdekorationen* is problematic, as no such distinction exists for post-Pompeian Roman wall painting. Moreover, the architectural vistas considered to be typical for the Fourth Style should as a result be seen as one type of painting among others,[180] rather than a self-contained style. In addition, the use of the term 'style' is itself problematic, because this is a nineteenth- and early twentieth-century concept. At the time, style was closely related to time (rather than space), and mainly used to develop chronologies, or explicitly time-sensitive typologies.[181] By 1983, style was already regarded as 'a highly conditioned and ambivalent hermeneutical 'construct' worked out at a distinct moment in social and intellectual history', in the words of art historian Willibald Sauerländer.[182]

Nevertheless, this construct may be put to use in order to query the Poporowapa dataset. So, what exactly constitutes the Fourth Style, commonly referred to within the study of Roman painting? First of all, this style denotes a certain period of time, as a *Zeitstil*, of which the end date is disputed. Secondly, it may be regarded as a *Lokalstil*, specifically referring to the city of Pompeii since the murals preserved from other cities destroyed by the eruption of Mount Vesuvius are less uniform than is usually assumed.[183] Already between the cities of Herculaneum and Pompeii, no more than fifteen kilometres apart, a distinction in local style could be observed, even though Pompeian wall painting has become generic for the entire corpus of Roman painting, regardless of the actual locations of origin involved.[184]

The earthquake of AD 62 resulted in the redecoration of numerous walls in Pompeii in the Fourth Style,[185] which was characterised by Strocka as follows.

> *Typische Kennzeichen des Vierten Stils sind die felderrahmenden oder -teilenden Filigranmuster* [embroidered or openwork borders], *die das rechtwinklige Rahmensystem auflockernden kurvigen Gebälke und Rahmen oder nach oben wie*

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[179] Liedtke 2003, 1-2.
[180] Allroggen-Bedel in Zimmermann 2014, 48.
[181] Conkey & Hasdorf 1990, 3.
[182] Quotation taken from Conkey & Hasdorf 1990, 1.
[183] Strocka in Zimmermann 2014, 35; Allroggen-Bedel in Zimmermann 2014, 45.
[184] Allroggen-Bedel in Zimmermann 2014, 50.
[185] As Agnes Allroggen-Bedel pointed out, restoration works could be carried out as well, resulting in the phenomenon of the '*Ungleichzeitigkeit des (scheinbar) Gleichzeitigen*', which adds an extra layer of complexity to the study of Roman painting. See: Allroggen-Bedel in Zimmermann 2014, 44.

nach unten schwingende Girlanden, schließlich allerlei flatterndes oder

balancierendes Getier oder an Fäden hängende Gegenstände.[186]

Irene Bragantini explicitly mentions '*aediculae* and examples of architectural foreshortening, enlivened by garlands, masks, and fantastic *acroteria* and accompanied by the characteristic "embroidered borders"'.[187] The Getty AAT, on the other hand, characterises the Fourth Style as a style 'that developed after the earthquake in Pompeii in 62 CE, and was made fashionable by painters working for Nero in Rome', consisting of 'elaborate architectural schemes, trompe l'oeil, genre scenes, still lifes, and juxtapositions between painted and actual moldings'.[188]

Applied to the Poporowapa ontology, this means that a combination of visual features should be present on certain wall (or ceiling) paintings. In this respect, *Architectural fantasy*, *Architectural element* (such as the *Aedicule*), and *Openwork border* are particularly dominant, complemented by *Panel*, *Festoon, Animal*, *Objects*, *Mask*, *Acroterion*, *Trompe-l'oeil*, *Landscape* and *Seascape* (genre scenes), *Still life*, and *Molding* (painted imitation). As the definitions of the Fourth Style are flexible, and the style itself changed gradually over time,[189] the query performed on the Poporowapa dataset highlights those items annotated with two or more of these ontology nodes. Appendix XII makes the results of this query insightful.

Throughout the post-Pompeian era combinations of two or more of the aforementioned elements occurred on painted walls and ceilings from all over the Roman Empire. The maximum amount of links is 6, of which five examples were found in the Poporowapa dataset. As a result, these five should in theory be most typical of the Fourth Style. Figure 4.1 reveals that this is not per se the case. Item number 447 and 758 depict the six characteristic visual features within smaller scenes, instead of being at the basis of the overall decoration scheme. Of the five examples, item number 572 is the only one depicting the *Filigranmuster*, which was emphasised by Strocka and Bragantini. The other two items, 576 and 1413, do look somewhat alike, displaying a tripartite division of the wall, adorned with large figurative scenes in an architectural setting.

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[186] Strocka in Zimmermann 2014, 30-31.
[187] Bragantini in Pollitt 2014, 360.
[188] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Fourth Style (consulted on June 29, 2015).
[189] Strocka in Zimmermann 2014, 31.

Appendix XII, Illustration 1, shows that the amount of links rapidly declines. Most of the 314 items found have been annotated with only two of the visual features that are usually associated with the Fourth Style. Illustration 2 furthermore exemplifies the dating of these items of the Poporowapa dataset. Although most of them date from before AD 250, combinations continue to occur well into the fourth century. The five highlighted examples approximately date from AD 95, 142, 145, 166, and 238. Therefore, it seems impossible to determine an end date for the Fourth Style, based on the definitions used, and the links established. In addition, the visual comparison of the five examples has already pointed out that stylistically speaking the items listed in Appendix XII may look quite distinct from each other.

Regardless of this conclusion concerning the end date of the Fourth Style, the question itself seems to have lost its relevance. Although defining styles can be a very satisfactory practice, rendering 'the cultural materials of the past accessible',[190] this method has in the meantime become out-dated, and, moreover, appeared from the outset to be unsuitable for the study of post-Pompeian painting. Whatever the underlying reasons may be, Roger Ling was indeed right to state that there is nothing that resembles a Fifth or Sixth Style, while undoubtedly some elements of previous times remained in use.[191] By making use of a digital research method, intended for rendering large quantities of data easily accessible, the need to designate styles simply disappears.

4.2 Centre and periphery?

Within the study of Roman painting, the focus usually is on the Italian peninsula. As the centre of the Roman Empire, paintings originating from ancient Italy are assumed to set the example for paintings originating from other regions. This centre-periphery model, that is, 'a spatial metaphor which described and attempts to explain the structural relationship between the advanced or metropolitan 'centre' and a less developed 'periphery', either within a particular country, or (more commonly) as applied to the relationship between capitalist and developing societies', is still being used today, whether consciously or not.[192] The Poporowapa dataset will be used to examine the validity of this model for post-Pompeian painting.

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[190] Conkey & Hasdorf 1990, 2.
[191] Ling in Pollitt 2014, 375.
[192] http://www.encyclopedia.com/doc/1O88-centreperipherymodel.html (consulted on July 21, 2015).

In order to achieve this, it will be necessary to look for visual traits that first occurred in Rome, and its direct surroundings. This was done as follows; for each ontology node that was used to annotate the visual features of the 1,242 items of the Poporowapa dataset, the associated location of origin and dating was gathered, and saved in the form of a table consisting of all 5,373 established links. Subsequently, this table was filtered so that only the visual features that occurred for the first time in or near Rome remained. This region was limited to the province of Lazio, including Ladispoli, Marino, Ostia, Rome, Tivoli, and the Vatican or Holy See (Fig. 4.2). Based on the resulting table, the visual features of which the origin could be traced back to the vicinity of Rome could be determined.[193]

Some notable examples, however, may be discarded right away. First of all, the *Flower* is dated AD 50, as are *Line* and *Deer*. This dating is obviously incorrect, and does not belong in this study. As it turns out, a mistake was made when dating item 596 based on the caption in the original source of this image.[194] *Flower* is subsequently dated AD 75 (Plassac, Gironde), and AD 85 (Riom), and therefore does not originate from ancient Italy. The same goes for *Deer*, which was encountered in Plassac, Gironde (AD 75), and Caivano (AD 105). In addition, *Fish or sea creature* does not belong in the table, since the dating of the associated item already proved to be incorrect (ca. AD 130 instead of AD 123, see Appendix X, Ill. 5). The *Line*, on the other hand, was found in Rome for the second time as well, around AD 108.

Of the remaining visual features, those with a sufficient amount of occurrences could be studied in order to explore the centre-periphery model. In this respect, the visual feature *Line* is of most significance (*Full-length* indicates the presence of a full-length figure on the painting, which was already an extremely common feature by AD 79), see Appendix XIII, Illustration 1. As already mentioned, from around AD 100 onwards this visual feature is almost exclusively to be found in Rome and its vicinity, with the exception of Ephesus (ca. AD 150 and 238), Sybaris (ca. AD 214), and Sofia (ca. AD 383). As a result, for this stylistic element it could be true that it first emerged in the centre of the Roman Empire, to later on appear in the south-eastern 'periphery'.

Geometric forms in general seem to have been popular in and around Rome,

[193] http://poporowapa.midasweb.nl/analyse/firsts (consulted on August 15, 2015).
[194] Ling 1991, 187; http://poporowapa.midasweb.nl/index.php/items/edit/596 (consulted on August 7, 2015).

before they were applied to the walls and ceilings of other parts of the Empire. Closely related are the *Coffered ceiling* and the *Square*, both derived from geometrical motifs. The decorative element of the *Frieze,* which was used to annotate a horizontal ornamental band depicted on the upper part of the wall or on a ceiling, also began to be used in the modern province of Lazio, from where it spread throughout the Roman Empire. The *Peacock* is another one such visual feature (Fig. 2.7), the dispersion of which has been discussed above (Fig. 3.11). This animal had an underlying meaning in antiquity as the symbol of eternal life, 'due to the belief that its flesh did not rot'.[195] The occurrence of this bird in funerary contexts is therefore of added value (see 4.3 Post-Pompeian paintings within their context).

The *Flower basket* or some kind of container holding flowers is yet another visual feature that first occurred in Ladispoli, around AD 80. Subsequently, it was mainly used in the Roman territories adjacent to the Mediterranean Sea.[196] *Plant-derived* motifs in general, as well as the plant material *Branch*, could occur in a variety of forms and painted contexts in (the vicinity of) Rome, and then throughout the Empire. Lastly, *Fruit*, and in particular the *Grape*, seems to be of significance as an element of visual culture originating from ancient Italy. Only in the third and fourth centuries this feature occurred on paintings originating outside of modern Europe (Fig. 4.3), depicted as a decorative motif or as an edible foodstuff for animals and human figures.[197]

In addition, the table initially extracted from the Poporowapa dataset revealed that some visual features made their first and only appearance in Rome and its surroundings.[198] As these elements did not spread to other parts of the Roman Empire, they may be regarded as characteristic of this particular area. A prime example is *Christian iconography*, or more specifically *Christ,* which has its origins in the post-Pompeian period (Appendix XIII, Ill. 2). With regard to the introduction of Christian iconography in Roman painting, the dataset contains insufficient data to trace the exact location of origin. The only conclusion to be made is that examples existed both in Dura-Europos (the house synagogue) and in Rome around AD 240, but apart from this the development remains unknown.

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[195] http://www.getty.edu/research/tools/vocabularies/aat/index.html -> Peacock (consulted on July 2, 2015).
[196] http://poporowapa.midasweb.nl/geochart/ -> Flower basket (consulted on August 15, 2015).
[197] http://poporowapa.midasweb.nl/analyse/ -> Fruit (consulted on August 15, 2015).
[198] http://poporowapa.midasweb.nl/analyse/firsts (consulted on August 15, 2015).

Of the 412 ontology nodes used to annotate the visual features of the Poporowapa items, 43 (equivalent to 10 per cent) occurred more than once exclusively in relation to Rome and its vicinity, whereas 63 (or 15 per cent) seem to originate from this area, and then disperse over the Empire as time progressed. However, these amounts do not indicate a centre-periphery model for post-Pompeian Roman wall painting in general. Only some visual features conform to this model, based on the contents of the Poporowapa dataset. Nevertheless, a difficulty of this particular case study is the absence of Pompeian paintings. As the origins of numerous decorative elements can be traced back to the era of Pompeian painting, the development over time and place of those features is impossible to ascertain.

In addition, in the cases of merely two, or slightly more, occurrences of a visual feature (see both Illustrations of Appendix XIII), such small numbers have ultimately little meaning. Ultimately, it is most striking that all kinds of visual features could be found all over the Roman territories. Although they could be executed in various ways, the overall presence of these elements seems to be of great importance. Although based on the Poporowapa dataset no firm statements regarding the process of acculturation could be made, which had started well before AD 79, still a generally accepted mode of decoration seems to have existed in all corners of the Roman Empire, right from the start of the post-Pompeian period.

4.3 Post-Pompeian paintings within their context

Finally, the depiction of a particular visual feature can be studied in light of the possible relationship that this choice has with its original context. Ever since Mau devised the Pompeian Styles, there have been theories in circulation about room function in relation to decoration, that is, predominantly within the domestic context. Katharina Lorenz outlined a comprehensive overview of these theories for the past century and a half in her publication *Bilder machen Räume; Mythenbilder in Pompeianischen Häusern* (2008). As the title already suggests, this book deals exclusively with Pompeian paintings, but the highlighted theories have been applied to Roman painting in general. Unsurprisingly, Mau gave the first impetus to involve the use of space in the study of Pompeian painting, by citing designations of rooms and spaces as described by Vergilius.[199]

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[199] Lorenz 2008, 16-17. For example: *cubiculum*, *peristylium*, *tablinum*, and *triclinium*.

Subsequent research has proven that a multifunctional use of rooms is more probable, and in order to provide a renewed understanding of the spatial organisation of dwellings the *Access Analysis*, for instance, was introduced.[200] Socio-hierarchical studies, on the other hand, emphasize the public and private areas of the house, or their accessibility in relation to their representativeness, with Andrew Wallace-Hadrill as its most outspoken proponent.[201] Meanwhile, Volker Michael Strocka suggested that the iconography of wall paintings contains information about the use of the room in which they were applied, and vice versa.[202] In response, Penelope Allison has already questioned this assumption. As she pointed out, the relationship between type of decoration and room function would be more suitable to establish an overall insight in the composition of the different spaces that together form the *domus*, or ancient residential structure.[203]

These models generally apply to the circumstances in Pompeii, and are therefore not readily applicable to other cities. Because of the disputed nature of rooms and their function, and the relatively sparse annotation of room types with regard to the Poporowapa items, it was decided to skip the context of the room, and instead take a closer look at the level of the building type. To this end, the seven building types that already have been distinguished based on the Poporowapa ontology were used (Appendix III, Ill. 1). For each of these building types, a list was compiled consisting of the top ten visual characteristics used most to annotate the associated paintings (Appendix XIV, Ill. 1). Illustration 2 of Appendix XIV provides an overview of the previous tables combined, in order to be able to easily make comparisons.

Most Poporowapa items originate from a residential structure (737 out of 1,100 items), which resulted in the occurrences of the top ten visual features running into the hundreds. This contrasts sharply with the military context (4 out of 1,100 items), consisting of only six visual features on a shared first place with one occurrence each. Especially the transportation structure and military building type are of little consequence in this respect, whereas the residential structure and funerary building type are most representative in numbers. Interestingly, the top ten

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[200] Lorenz 2008, 18-19. The *Access Analysis* entails a method to define the accessibility of rooms within large building complexes, whereby the number of openings to a specific room, as well as the location of the room, plays an essential role.
[201] Wallace-Hadrill 1988.
[202] Liedtke 2003, 279-280.
[203] Liedtke 2003, 280.

most common features of the residential structure recur in all other building type top tens. As a result, the anomalies instead of the similarities seem to be of most significance. These might point out a special preference for certain visual features with regard to a specific built context.

In Appendix XIV, Illustration 2, the anomalies are shown in bold. For the funerary building type, these are *Millefleurs* (used 32 times), and *Peacock* (used 28 times). Both were also used to annotate items from a residential context, 28 times and once, respectively (Appendix XIV, Ill. 3). It is therefore more likely to encounter these elements painted on the walls and ceilings of buildings with a funerary function, or in second place those with a residential function, than in any other building type. The two visual features that stand out for the institutional structures are *Fish or sea creature* (used 11 times) and *Seascape* (used 6 times). These elements occur comparatively often, considering the total amount (46) of institutional built contexts included in the Poporowapa dataset. To a lesser extent, these visual features could also be found in residential and funerary structures, as well as only once in relation to a commercial context (Appendix XIV, Ill. 3).

Furthermore, it is remarkable that *Sacrifice* scores relatively well within the context of the religious building. This is also true for *Snake*, both of which could in these instances be awarded with religious significance. Three out of the four occurrences of the *Snake* are related to the 'tauroctonies' as displayed in Roman *mithraea* (Fig. 3.21). At least one other depiction could be found in Ephesus, this time on a house altar within a residential context (Fig. 4.4). This snake has been interpreted as Agathos Daimon, a god of domestic protection.[204] Although there are relatively few transportation structures and military buildings present in the Poporowapa dataset, eight and four respectively, the former stands out with regard to the use of geometric motifs, combined in an *Allover* pattern.

Zooming out still further, to the area of distribution in relation to building types, one last point of interest may be discussed. This concerns the relationship between depictions of animals and their built or geographic context. *Deer* for example occur in various building types (Appendix XIV, Ill. 4), which is very likely since no direct link between building type and painted elements could be recognised. Sometimes *Deer* were depicted together with other animals, but always within the

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[204] Zimmermann & Ladstätter 2010, 91 & 125; http://poporowapa.midasweb.nl/index.php/items/edit/ 1249 (consulted on August 9, 2015).

context of the contemporary European continent (Fig. 4.5). Therefore, a relationship could exist between the natural habitat of the deer and its depiction on post-Pompeian walls and ceilings. Although such patterns could not necessarily be established for the other animals that occur in the Poporowapa dataset, two additional examples deserve special mention.

Firstly, the *Ibex*, a '[g]eneral term for several species of wild goats inhabiting […] Asia, Africa, and the Alps and Apennines of Europe', occurred in Ephesus and (the vicinity of) Rome (Appendix XIV, Ill. 4).[205] In this case, the habitat of this animal is reflected in the geographic distribution of painted examples of the ibex. The *Leopard*, on the other hand, is a '[l]arge cat having a wide range in Africa and Asia'.[206] According to the Poporowapa dataset, this animal was indeed depicted in Africa (Alexandria, and Leptis Magna) and Asia (Ephesus). Additionally, depictions could be found at least in Altafulla and Valencia (modern Spain), as well as Cologne (modern Germany). Strikingly, the European examples show either the skin of the leopard (Altafulla) or the animal as a motif incorporated in a candelabrum, as exotic decorative details.[207]

These results show that the surroundings, that is, building type or geographic area, could exert an influence on the visual characteristics of post-Pompeian paintings, although this was not necessarily the case. The main finding is that the elements that make up these paintings could be found in practically all types of buildings. As a result, there seems to have existed only one comprehensive visual idiom that was applicable to the many contexts of post-Pompeian painting. The depiction of animal species could be restricted to their natural habitat, but could also be used as a decorative motif in other parts of the Roman Empire. These examples are just a few of the many issues that could be addressed by means of the Poporowapa dataset.

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[205] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Ibex (consulted on July 24, 2015).

[206] http://www.getty.edu/research/tools/ vocabularies/aat/index.html -> Leopard (consulted on August 10, 2015).

[207] http://poporowapa.midasweb.nl/analyse/ -> Leopard (consulted on August 10, 2015).

5 Conclusion

As has been demonstrated, digital research methods have become increasingly important within the field of art history, not only influencing how this discipline is being practiced, but also enabling art historians to ask different questions. In addition, the cultural material that is being studied, as well as research results, can be made more accessible to a broad interested audience. The incorporation of the Semantic Web, furthermore, allows for the easy exchange of knowledge in order to enrich the online available data. By connecting datasets that comply with this linked data format, a vast network can be created that pieces together all kinds of expertise in an interdisciplinary fashion.

With this in mind, the Poporowapa dataset was created in order to study the enormous quantity of preserved wall and ceiling paintings dating from the post-Pompeian period, of which as of yet no clear overview exists. This dataset makes use of the well-established Getty vocabularies AAT and TGN, in combination with ICONCLASS and DBpedia. These sources of information form the basis of the Poporowapa ontology that hierarchically lists terms that may be used for the annotation of post-Pompeian paintings. This ontology is anything but static, and was continuously extended and altered during the process of annotating. As a matter of fact, the entire dataset is structured in such a way that all linked tables may be added to, or modified, at any time.

Regardless of this in theory eternally on-going process, the current contents of the Poporowapa dataset were used to analyse wall and ceiling painting of the post-Pompeian period. Images of a selection of thirteen books were imported, and most (but not all) duplicates were disregarded. The remaining 1,242 items were annotated on the basis of various options that clarify the relationship between the images and the ontology nodes or texts linked to them. The predominance of post-Pompeian paintings originating from the Italian peninsula is well reflected in the Poporowapa dataset, as are the preserved examples dating from roughly the first half of the period under study (i.e. AD 79 to 250). The options, either alone or in combination, were of great importance for the subsequent visual and statistical analysis.

As Google is one of the most prominent players in the field of information visualisation, use was made of their Map, Line Chart, and Geochart. These

visualisation tools were included in the web application, which provides the online interface to interact with, as well as analyse, the Poporowapa dataset. The interpretation of the gathered data offers both expected (e.g. most building types had a residential function) and unexpected (e.g. the field colour mainly used is white) results. Popular elements could be detected, and their application studied over time, as well as the journeys made by groups of, or individual, visual features within the Roman Empire. In addition, the Poporowapa dataset was used in order to check the latest review of post-Pompeian painting, based on traditional research methods.

Testing Roger Ling's provisional conclusions revealed that the research method chosen does exert an influence on the obtained results. Some conclusions were maintained and others refuted, while still others proved to be in need of further study. An important finding, however, is that often special emphasis was placed on certain depictions, which occurred only by exception on the items of the Poporowapa dataset. These depictions, such as *Still life*, appear to be of modern concern, while it remains uncertain what value was actually attached to them in antiquity. Although dealing with the same difficulties related to the post-Pompeian era, the augmented range of painted walls and ceilings made it possible to generate a more comprehensive view on the preserved material.

In addition, multiple case studies were performed in order to approach the Poporowapa dataset from yet another angle. Of the four Pompeian Styles, so typical for the study of Roman painting, only the Fourth was of relevance for post-Pompeian painted walls and ceilings. As was demonstrated, this style has little representativeness regarding Roman painting in general. This has everything to do with judgements of value that influence(d) the current state of knowledge. Since the Poporowapa dataset is based on already published evidence, these judgements are naturally embedded to some extent. Instead of holding on to the practice of identifying styles, the Poporowapa dataset offers another way of rendering the available data insightful.

In a similar vein, the validity of the commonly used centre-periphery model was studied. Solely the period under study could be examined, and thus not the entire history of Roman painting and its recurrent themes, yet some conclusions could be made. The omnipresence of Roman painting implies visual expressions that are in constant flux, and therefore not propelled from one particular location. Placed within their original context, some patterns could be identified with regard to the use

of visual features. *Millefleurs* and *Peacock*, for instance, are typical of decorations of funerary, and to a lesser extent residential, structures, whereas *Deer* are exclusively depicted within the geographic confines of their natural habitat. In general, however, there is no immediate reason to believe that there is a strong connection between post-Pompeian paintings and their (built) surroundings. The combination of both quantitative and qualitative approaches has been most conducive for each of these case studies.

The search for a way to clarify the development of post-Pompeian Roman wall painting has led to the use of digital research methods. Already by means of limited resources it proved possible to present a more objective interpretation of the material under study. In addition to testing current opinions, new results could be generated based on the increased amount of data that could be taken into consideration. This demonstrates the potential of digital art history, as opposed to traditional research methods. Of course compelling narratives, such as presented in Pollitt 2014, could be seen as far more attractive compared to the quantitative values expressed in the statistics and information visualisations of this study. With regard to efficiency and accuracy, however, the former leaves much to be desired.

Usually, art history takes on a rather reactive attitude towards new methods, merely incorporating tools already developed for other disciplines. Digital art history, as a distinct discipline, could make a stand for the development of tools tailored to meet the needs of art historical research in a proactive manner. In order to ensure the collective interest in the history of art, research and research results can be made much more accessible to appeal to a wider interested public, and as such contribute to the valorisation of art history in general. This will result in the opportunity to tackle, or better yet question, major art historical issues. With the rate at which new technologies are being invented, digital art history moves towards a very promising future.

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http://poporowapa.midasweb.nl/index.php/items/edit/1249 (consulted on August 9, 2015).

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http://vocab.getty.edu/aat/300015638 (consulted on July 7, 2015).

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http://whatis.techtarget.com/definition/ontology (consulted on June 29, 2015).

http://wiki.dbpedia.org/ (consulted on July 1, 2015).

http://wiki.dbpedia.org/about (consulted on July 1, 2015).

http://www.britannica.com/art/Incrustation-style (consulted on July 1, 2015).

http://www.census.de/census (consulted on June 30, 2015).

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  o Art History (consulted on July 6, 2015).

http://www.encyclopedia.com/doc/1O88-centreperipherymodel.html (consulted on July 21, 2015).

http://www.fallen.io/ww2/ (consulted on July 8, 2015).

http://www.getty.edu/about/governance/trustreport/2014/gri.html (consulted on June 21, 2015).

http://www.getty.edu/research/tools/vocabularies/aat/about.html (consulted on June 30, 2015).

http://www.getty.edu/research/tools/vocabularies/aat/index.html
- Arcosolium (consulted on July 14, 2015).
- Fish (consulted on July 2, 2015).
- Fourth Style (consulted on June 29, 2015).
- Ibex (consulted on July 24, 2015).
- Leopard (consulted on August 10, 2015).
- Millefleurs (consulted on July 1, 2015).
- Opus sectile (consulted on June 30, 2015).
- Peacock (consulted on July 2, 2015).
- Panel (consulted on July 14, 2015).
- Roman provincial styles (consulted on June 29, 2015).
- Still life (consulted on June 30, 2015).

http://www.getty.edu/research/tools/vocabularies/index.html (consulted on June 21, 2015).

http://www.getty.edu/research/tools/vocabularies/tgn/about.html (consulted on July 1, 2015).

http://www.getty.edu/research/tools/vocabularies/tgn/index.html
- Browse the TGN hierarchies (consulted on July 1, 2015).
- Colchester (consulted on July 1, 2015).

http://www.google.com
- Lohamei HaGeta'ot (consulted on July 1, 2015).

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http://www.inha.fr/en/index.html (consulted on June 30, 2015).

http://www.oclc.org/worldcat.en.html (consulted on July 6, 2015).

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  o Rijksmuseum collection (consulted on June 30, 2015).

http://www.w3.org/2001/sw/ (consulted on July 6, 2015).

http://www.w3.org/2001/sw/Activity (consulted on July 6, 2015).

http://www.w3.org/standards/semanticweb/ (consulted on July 6, 2015).

http://www.w3.org/standards/semanticweb/query (consulted on July 6, 2015).

7 Figures

Fig. 1.1   Example of the First, or 'Encrustation', Style, in vogue from circa 200 to 90 BC. Pompeii, second century BC.

Fig. 1.2   Example of the Second, or 'Architectural', Style, in vogue from circa 90 to 15 BC. Boscoreale, 50-40 BC.
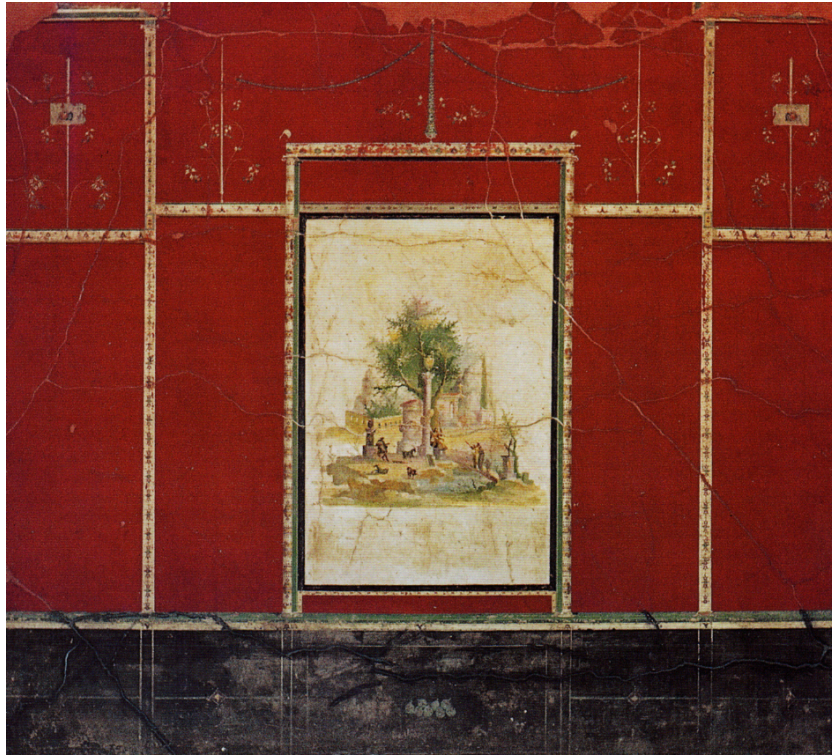
Fig. 1.3   Example of the Third, or 'Ornamental', Style, in vogue from circa 15
BC to AD 45. Boscotrecase, 11 BC or shortly thereafter.

Fig. 1.4   Example of the Fourth, or 'Fantasy', Style, in vogue from circa AD
45. Pompeii, first century AD.

'*Ädikuladekoration*' '*Felderdekoration*'

'*Rahmendekoration*' '*Lineardekoration*'
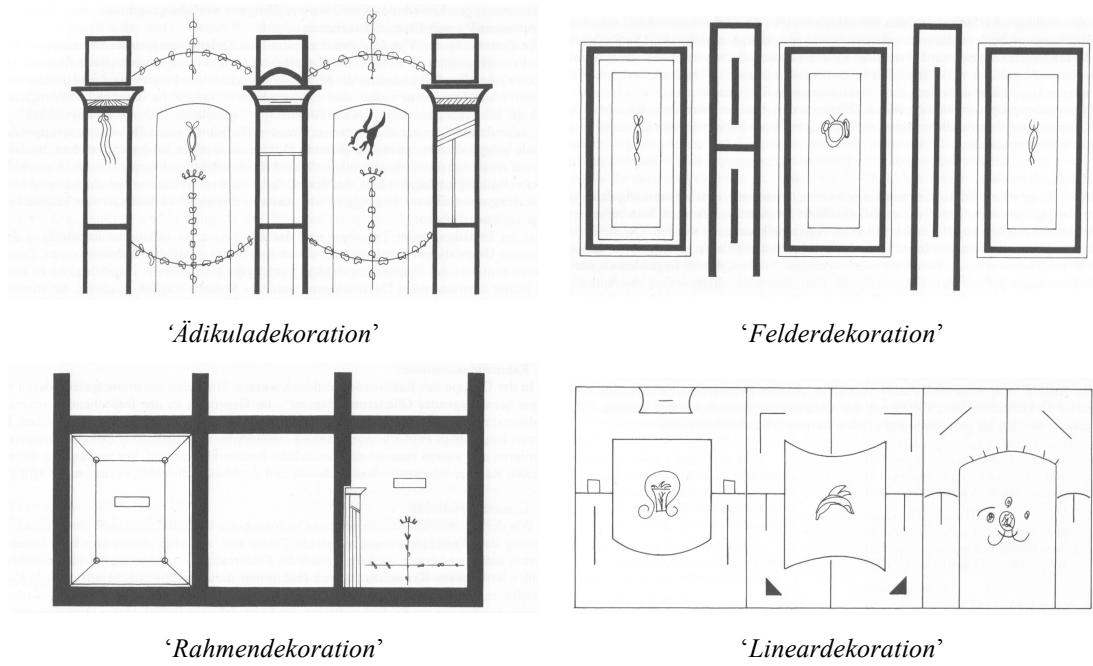
Fig. 1.5 The typology of second and third century wall paintings originating from the Italian peninsula, as defined by Claudia Liedtke.
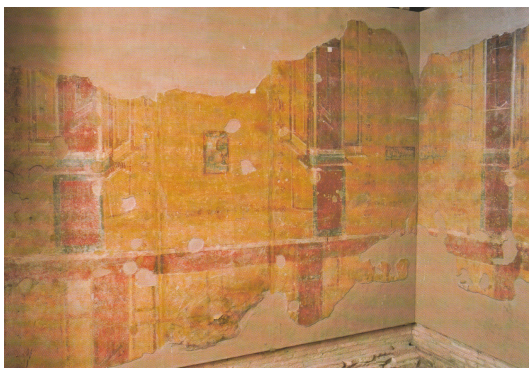
Ostia
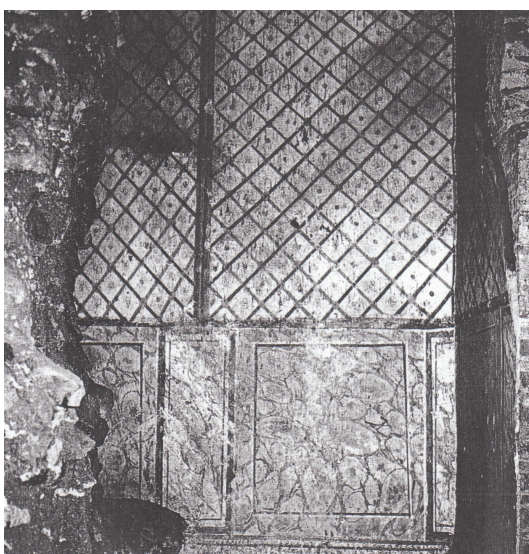
Rome

Ephesus

Rome

Piazza Armerina

Sardis

Leptis Magna

Sirmium

Palmyra

Dura-Europos

Amheida

Fig. 2.1   The preparatory selection of about ten examples of Roman painting dating from the period AD 79 to 395.

☐ ➡ Top of the AAT hierarchies
☐ ♣ .... Associated Concepts Facet
☐ ♣ .... Associated Concepts (hierarchy name)
☐ ♣ .... Physical Attributes Facet
☐ ♣ .... Attributes and Properties (hierarchy name)
☐ ♣ .... Conditions and Effects (hierarchy name)
☐ ♣ .... Design Elements (hierarchy name)
☐ ♣ .... Color (hierarchy name)
☐ ♣ .... Styles and Periods Facet
☐ ♣ .... Styles and Periods (hierarchy name)
☐ ♣ .... Agents Facet
☐ ♣ .... People (hierarchy name)
☐ ♣ .... Organizations (hierarchy name)
☐ ♣ .... Living Organisms (hierarchy name)
☐   .... agents (general) [N]
☐ ♣ .... Activities Facet
☐ ♣ .... Disciplines (hierarchy name)
☐ ♣ .... Functions (hierarchy name)
☐ ♣ .... Events (hierarchy name)
☐ ♣ .... Physical and Mental Activities (hierarchy name)
☐ ♣ .... Processes and Techniques (hierarchy name)
☐ ♣ .... Materials Facet
☐ ♣ .... Materials (hierarchy name)
☐ ♣ .... Objects Facet
☐ ♣ .... Built Environment (hierarchy name)
☐ ♣ .... Components (hierarchy name)
☐ ♣ .... Furnishings and Equipment (hierarchy name)
☐ ♣ .... Object Genres (hierarchy name)
☐ ♣ .... Object Groupings and Systems (hierarchy name)
☐ ♣ .... Visual and Verbal Communication (hierarchy name)
☐ ♣ .... Brand Names Facet
☐ ♣ .... Brand Names (hierarchy name)

Fig. 2.2   The Getty *Top of the AAT hierarchies*, displaying the eight facets of
the AAT and their first layer of subdivision.

☐ ⛬ Top of the TGN hierarchy (hierarchy root)
☐ ➡ .... World (facet)
⛬ .... [*view physical features*]
☐ .... Abbasid Caliphate (historical region)
☐ ⛬ .... Africa (continent)
☐ .... Alexandrian Empire (former nation/state/empire)
☐ ⛬ .... Antarctica (continent)
☐ .... Arctic (general region)
☐ ⛬ .... Asia (continent)
☐ .... British Empire (historical region)
☐ ⛬ .... Byzantine Empire (former nation/state/empire)
☐ ⛬ .... Carthaginian Empire (former nation/state/empire)
☐ .... Commonwealth of Independent States (association)
☐ .... Commonwealth of Nations (association)
☐ ⛬ .... Delian League (former group of nations/states/cities)
☐ .... Eastern Mediterranean (region (geographic))
☐ .... Eurasia (general region)
☐ ⛬ .... Europe (continent)
☐ ⛬ .... Holy Roman Empire (former nation/state/empire)
☐ .... Latin America (general region)
☐ ⛬ .... <lost & found/World> (miscellaneous)
☐ ⛬ .... Middle East (general region)
☐ ⛬ .... North and Central America (continent)
☐ .... North Atlantic Treaty Organization (organization)
☐ .... North Pacific Ocean (general region)
☐ ⛬ .... Oceania (continent)
☐ ⛬ .... <Oceans> (miscellaneous)
☐ .... Ottoman Empire (former nation/state/empire)
☐ .... Pacific Islands (general region)
☐ ⛬ .... Roman Empire (former nation/state/empire)
☐ .... Rome, Ancient (former nation/state/empire)
☐ ⛬ .... Seleucid Kingdom (former nation/state/empire)
☐ .... Silk Road (road)
☐ ⛬ .... South America (continent)
☐ .... South Pacific Ocean (general region)
☐ .... Third World (group of nations/states/cities)
☐ .... <Undersea Features> (miscellaneous)
☐ .... undetermined (miscellaneous)
☐ .... United Nations (organization)
☐ ⛬ .... United States Minor Outlying Islands (general region)
☐ .... Western Roman Empire (former nation/state/empire)

Fig. 2.3   The Getty *Top of the TGN hierarchies*, displaying the facet of the *World* of the TGN and its first layer of subdivision.

Fig. 2.4   The ICONCLASS hierarchy, displaying its nine main divisions as well as the first layer of subdivision for *9 Classical Mythology and Ancient History*.

Fig. 2.5   The ten root nodes of the Poporowapa ontology, as listed under 'Ontology' on the web application.

Edit Ontology Item

Title

Activities

Semantic Link

http://vocab.getty.edu/aat/300264090

Fig. 2.6   The root node *Activities* of the Poporowapa ontology, and its accompanying Semantic link.

Fig. 2.7   Example of the depiction of *Millefleurs*, also known as *Streublumen*, *fleurs jonchées*, *fiori sparsi*, and 'scattered flowers'. Sardis, AD 300-400 (see Fig. 2.1 Sardis).

Fig. 2.8   Reconstruction of a wall decorated with imitations of *Marble* (middle zone) and *Opus sectile* (upper zone). Carthago Nova, AD 200-300.
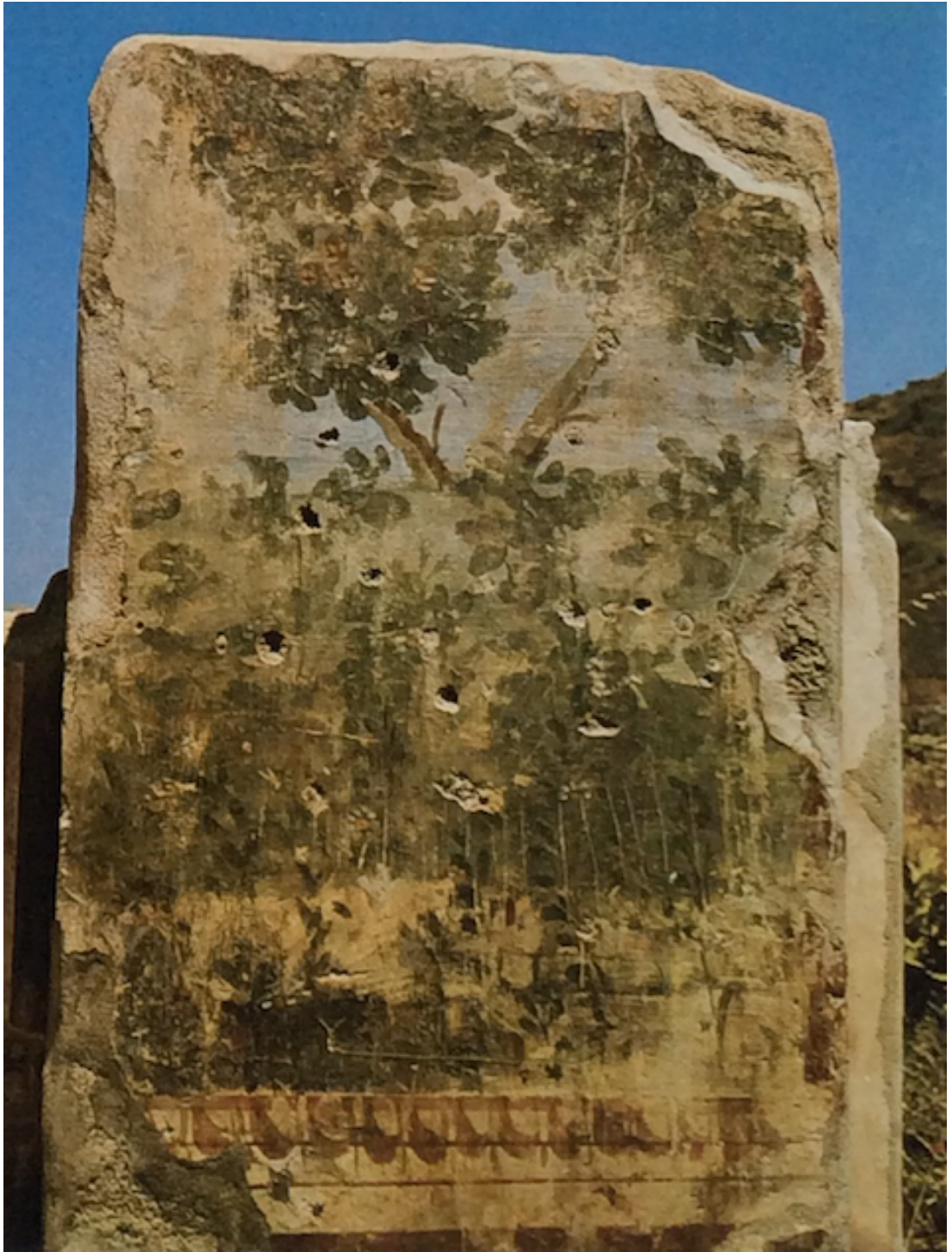
Fig. 2.9   Example of a *Garden* painting. Ephesus, AD 140-160.
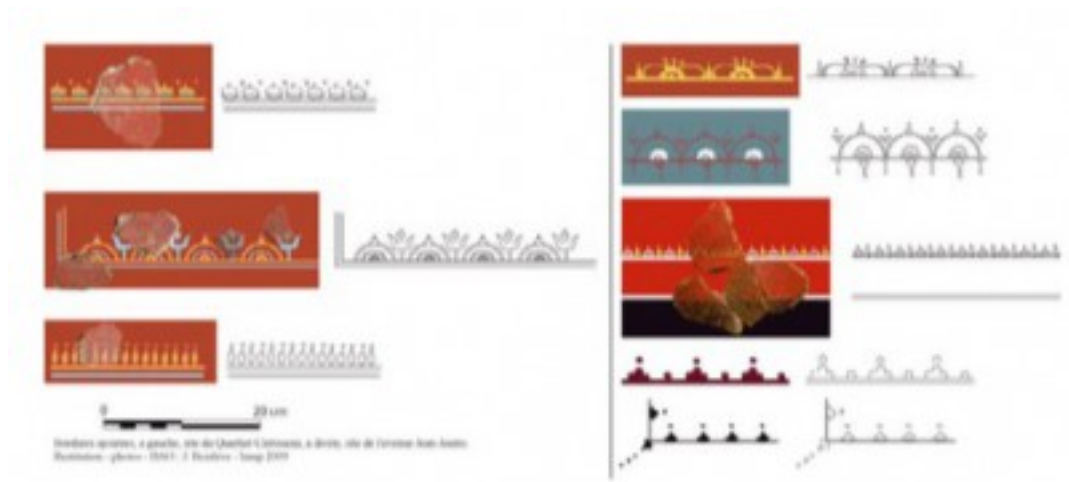
Fig. 2.10 Examples of embroidered or openwork borders. Nîmes, AD 75-150.

Fig. 2.11 Example of the depiction of the *Tapetenmuster*, or *Allover* pattern.
Avenches, AD 200-210.

Item List

Image	Origin	Source	Title	
	Rome	Baldassarre2002/279	Aventin privatwohnsitz kaiser Trajans deckengewolbe	✏
	Rome	Baldassarre2002/280	Aventin Domus neben dem Heiligtum des Jupiter Dolichenus gewolbe	✏
	Rome	Baldassarre2002/280	Aventin Domus neben dem Heiligtum des Jupiter Dolichenus lunette mit Okeanosmaske	✏
	Ostia	Baldassarre2002/282	Casa delle Muse raum V ruckwand Apollo und Musen	✏
	Ostia	Baldassarre2002/284	Casa delle Ierodoule decke zeichnerische rekonstruktion	✏
	Ostia	Baldassarre2002/284	Casa delle Volte dipinte cubiculum girlanden mit gorgonenhauptern	✏
	Rome	Baldassarre2002/285	Via dello Statuto thermenanlage in einem privathaus abschied eines reiters Rome Antiquarium Comunale	✏
	Rome	Baldassarre2002/286	Pietra Papa thermenanlage meereslandschaft Rome Museo Nazionale Romano	✏
	Rome	Baldassarre2002/287	Pietra Papa thermenanlage kampf zwischen einem oktopus languste und murane Rome Museo Nazionale Romano	✏
	Rome	Baldassarre2002/288	domus an der Piazza Sonnino scheinarchitektur Rome Museo Nazionale Romano	✏
	Rome	Baldassarre2002/289	domus di Piazza dei Cinquecento scheinarchitektur Rome Museo Nazionale Romano	✏
	Ostia	Baldassarre2002/290-291	casa di Giove e Ganimede tablinum 27 ruckwand Leda Gauymed und Jupiter	✏
	Ostia	Baldassarre2002/292	casa delle Volte dipinte hauptraum mit kreuzgratgewolbe gemalte lunetten pegasus im zentralen medaillon Ling 1991 181	✏
	Ostia	Baldassarre2002/293	Insula di Giove e Ganimede raum 33 gelber saal ausschnitt 1	✏
	Ostia	Baldassarre2002/293	Insula di Giove e Ganimede raum 33 gelber saal ausschnitt 2 Joyce 1981 X 20	✏
	Rome	Baldassarre2002/294	Casa di Via Genova Pan und Manade Rome Antiquarium Comunale see aquarel	✏
	Rome	Baldassarre2002/294	casa di Via Genova raum aquarell wand 1	✏
	Rome	Baldassarre2002/294	casa di Via Genova raum aquarell wand 2	✏
	Rome	Baldassarre2002/294	casa di Via Genova raum mit tonnengewolbe aquarell	✏
	Rome	Baldassarre2002/295	Villa Grande under S Sebastiano oecus malereien auf weissgrundigen wandfeldern landschaften architekturansichten und einzelfiguren 1	✏

| 1 | 2 | 3 | > | Last › |

Fig. 2.12 The Poporowapa items as listed under 'Items' on the web application.

Fig. 2.13   The online interface for editing item number 8 of the Poporowapa item list.

Fig. 2.14   The eight options as listed under 'Options' on the Poporowapa web application.

Edit Option
<div style="text-align:right">Save · Cancel</div>

Title

Building type

Type

Ontology

Semantic Link

http://purl.org/dc/terms/spatial

Fig. 2.15   The option *Building type*, which links to the ontology, and its accompanying Semantic link.

Location of origin

Geography » World » Europe » Italy » Lazio » Rome

Fig. 2.16   Annotating the city of Rome, by means of selecting the option *Location of origin*, and the Poporowapa ontology node *Rome*.

Dating lower limit

98

Dating upper limit

117

Fig. 2.17   Annotating the dating, by means of selecting the options *Dating lower limit* and *Dating upper limit*, and typing the dates into the text input fields.

Fig. 2.18 The annotated item number 1 of the Poporowapa item list.

Please sign in

Email address

Password

Sign in
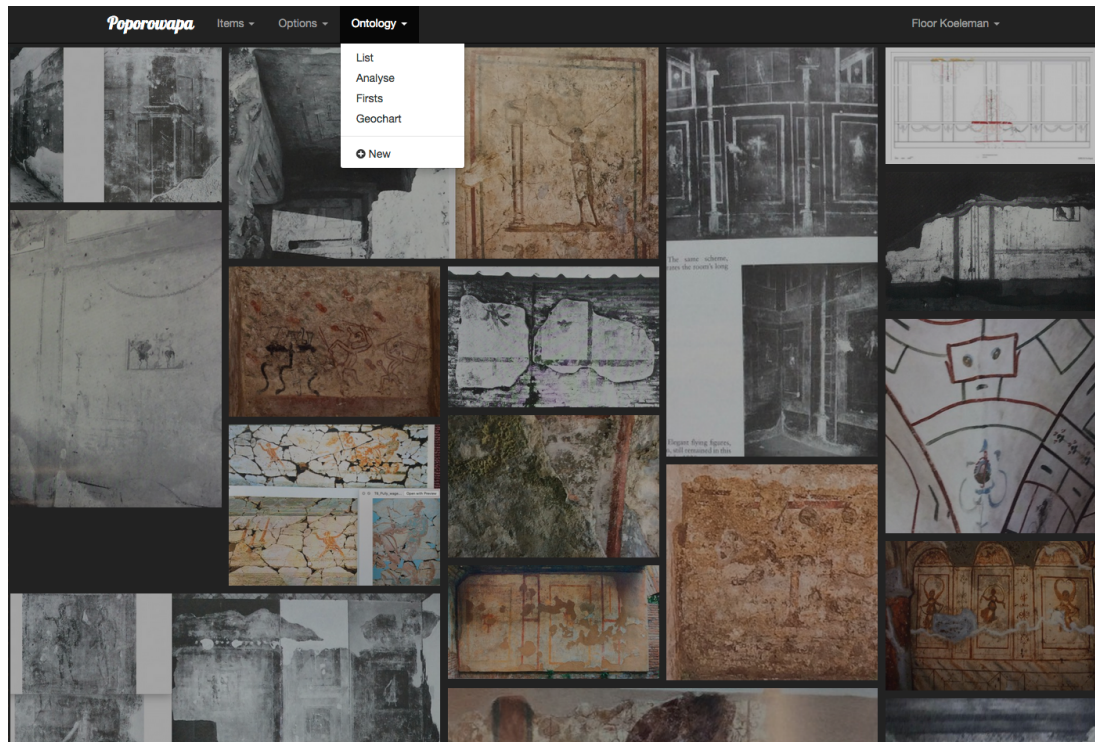
Fig. 3.1   The welcome screen of the Poporowapa web application.
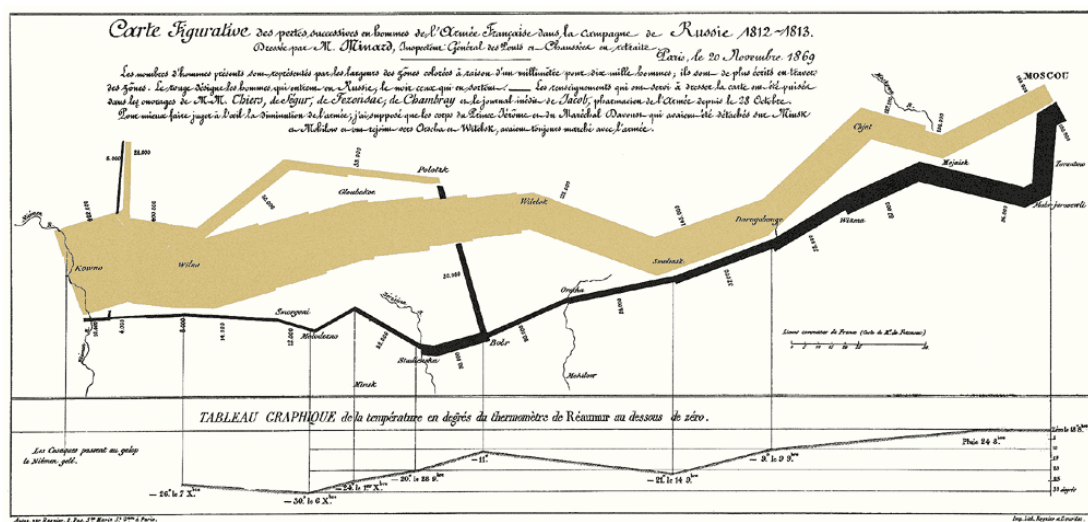
Fig. 3.2   The visualisation of the march of Napoleon on Moscow (1812), created by Charles Minard in 1869.
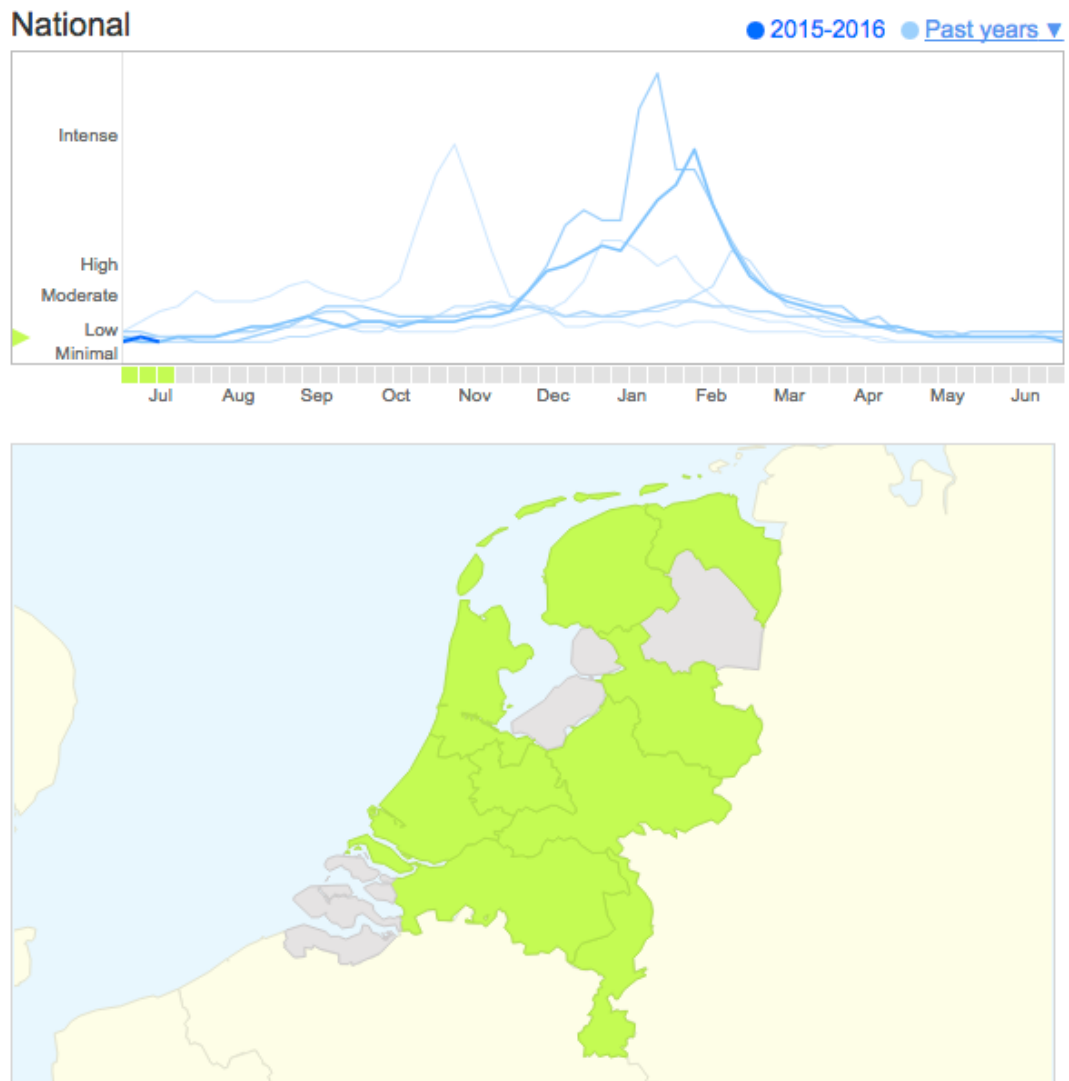
Fig. 3.3　　Search engine query data, used to track influenza-like illness in the population of, for example, the Netherlands, is visualised on this map for July 2015.

Fig. 3.4   Map displaying all locations of origin the Poporowapa items have been annotated with. By selecting an arrow, the name of the location as well as the amount of items linked to it appear.
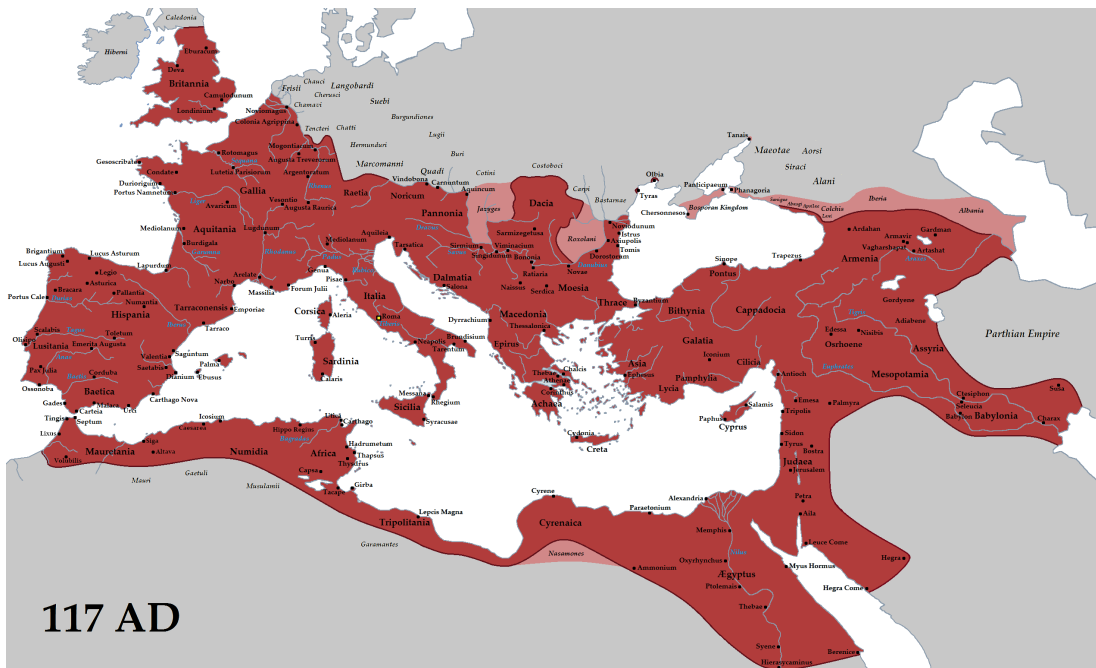
Fig. 3.5   Map of the Roman Empire at its greatest extent in AD 117.
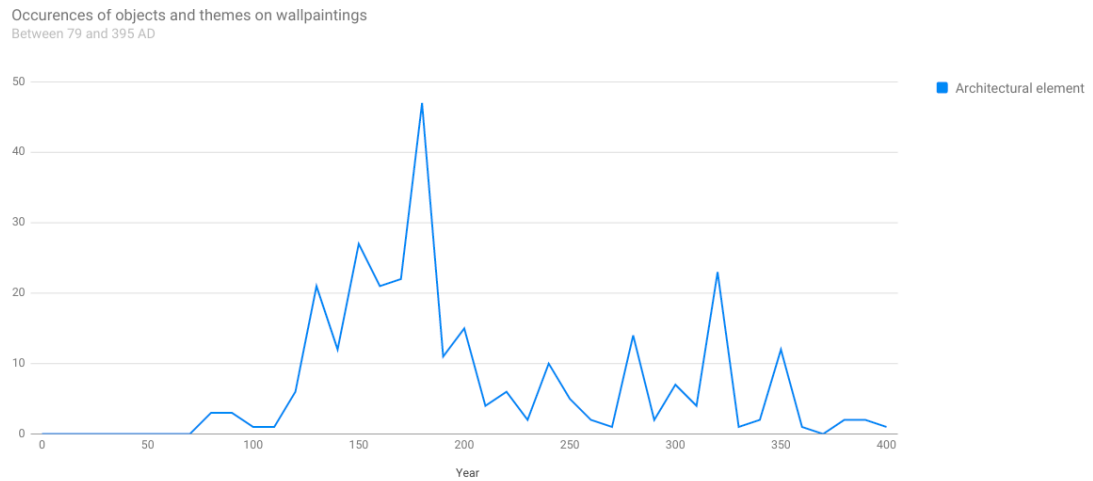
Fig. 3.6   The occurrences of the ontology node *Architectural element* (step 10).
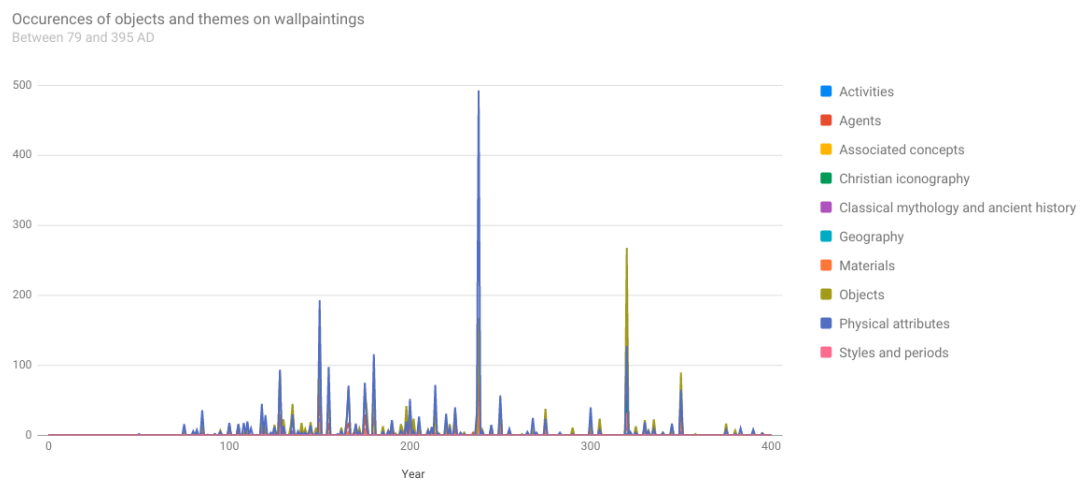
Step 1
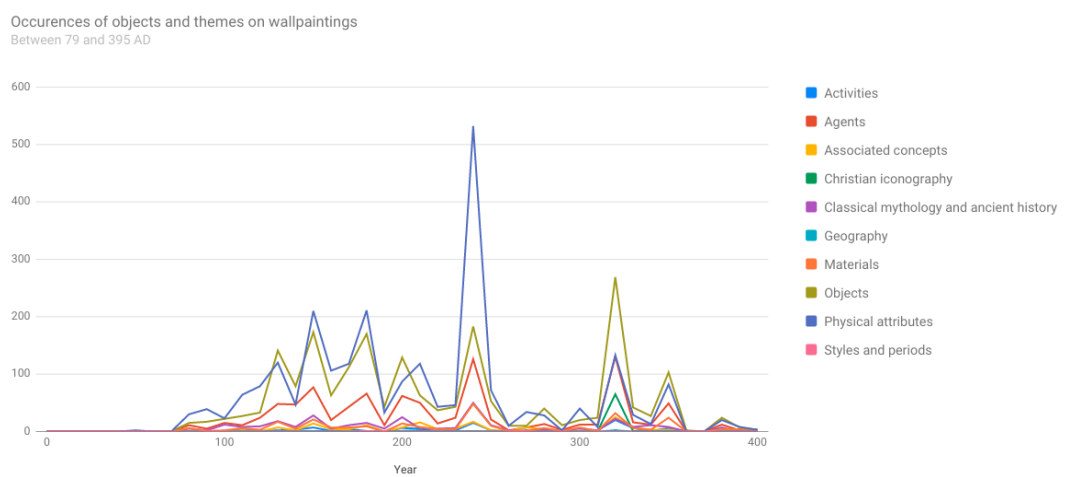
Step 10
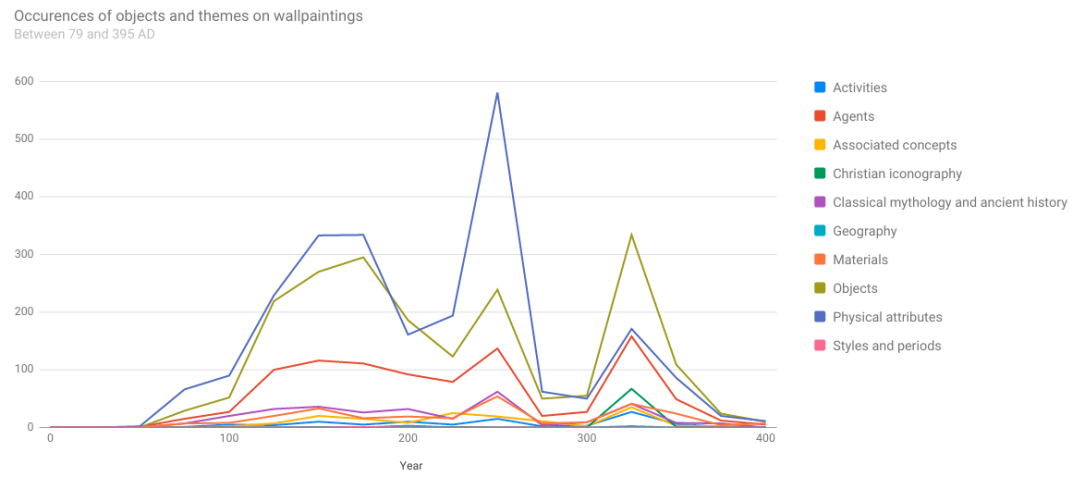
Step 25
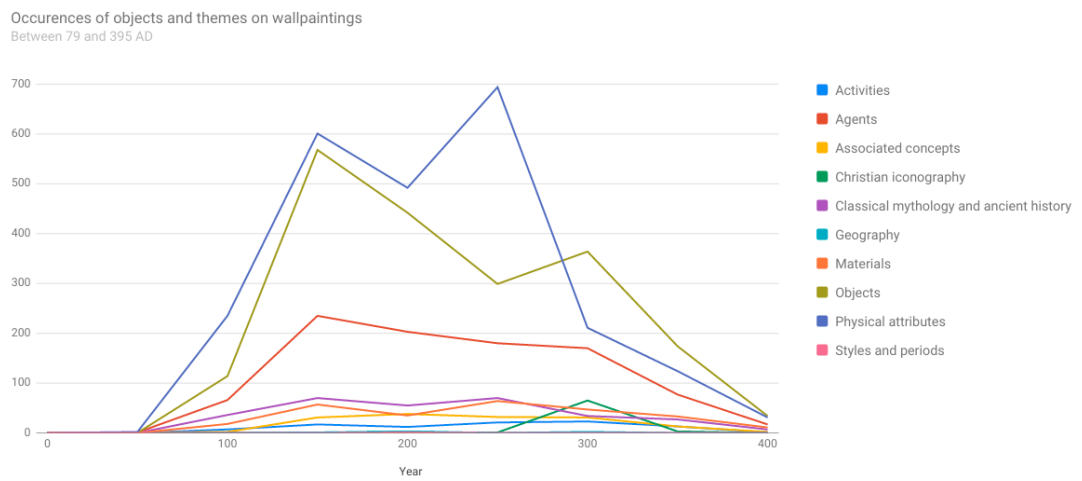
Step 50

Fig. 3.7   The occurrences of all ontology root nodes, according to steps 1 (above), 10, 25, and 50 (below).
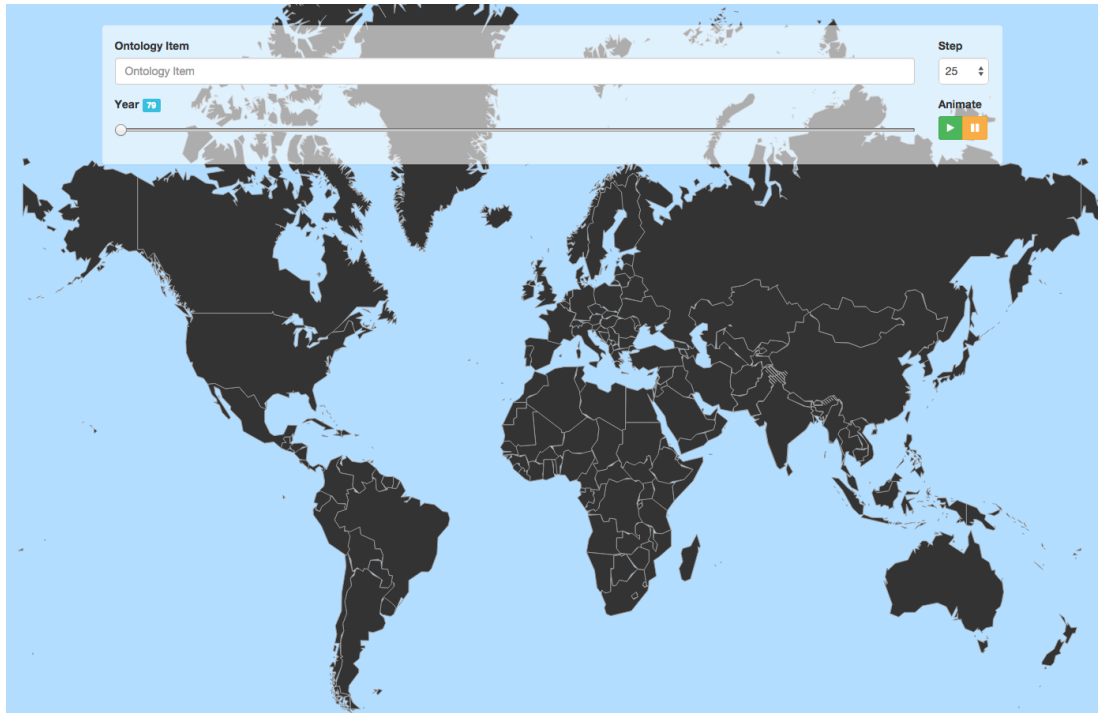
Fig. 3.8   The Geochart of the Poporowapa web application.

Step 1 (1-23 occurrences per marker)   *Step 25 (1-42 occurrences per marker)*

Step 50   (1-140 occurrences per marker)   *Step 100 (1-178 occurrences per marker)*

Fig. 3.9   The occurrences of the ontology root node *Objects*, according to
                    steps 1 and 25 (above), 50 and 100 (below), for the year AD 225.

Occurences of objects and themes on wallpaintings
Between 79 and 395 AD
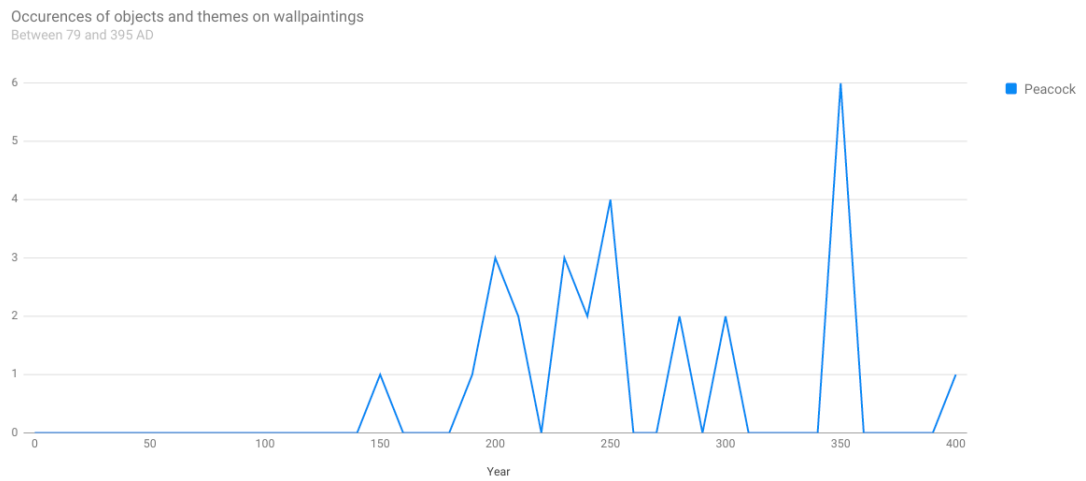
Fig. 3.10   The occurrences of the ontology node *Peacock* (step 10).
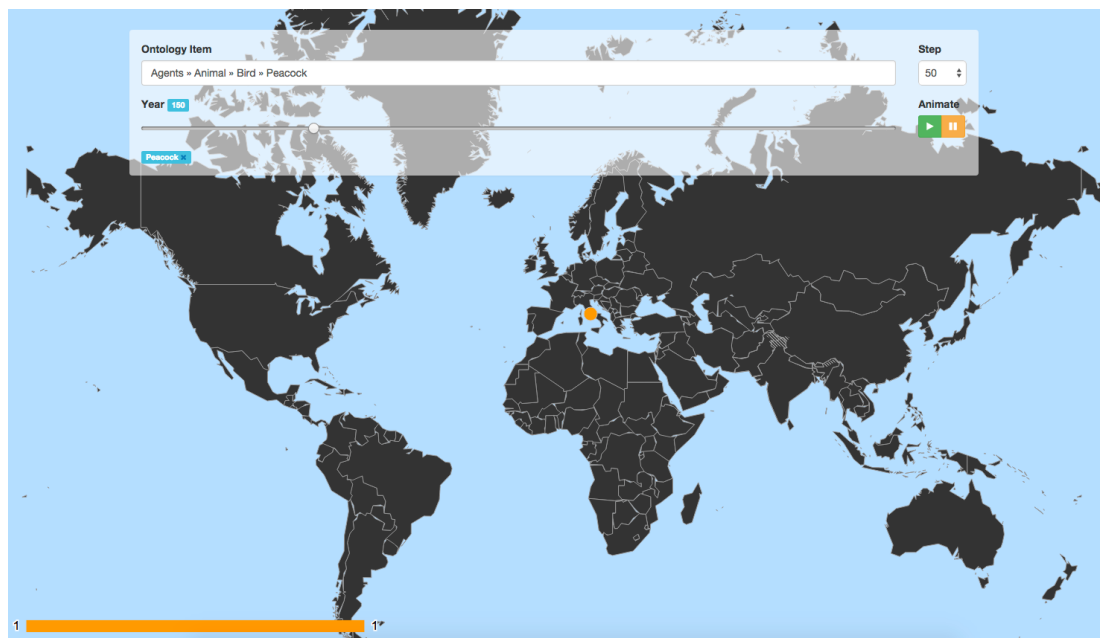
AD 150 (1 occurrence per marker)
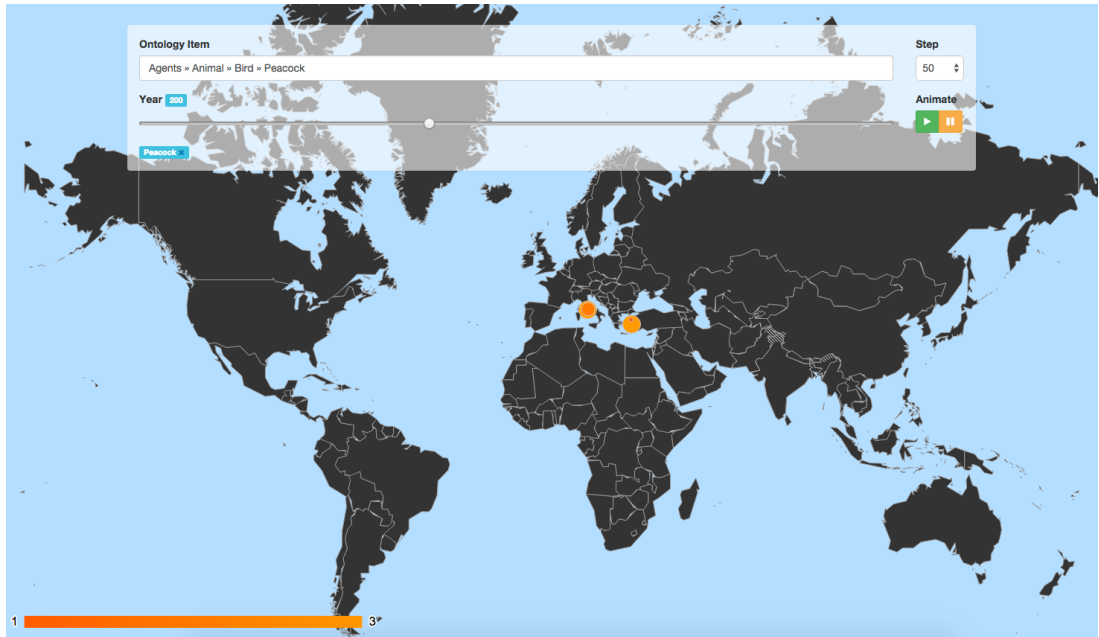
AD 200 (1-3 occurrences per marker)
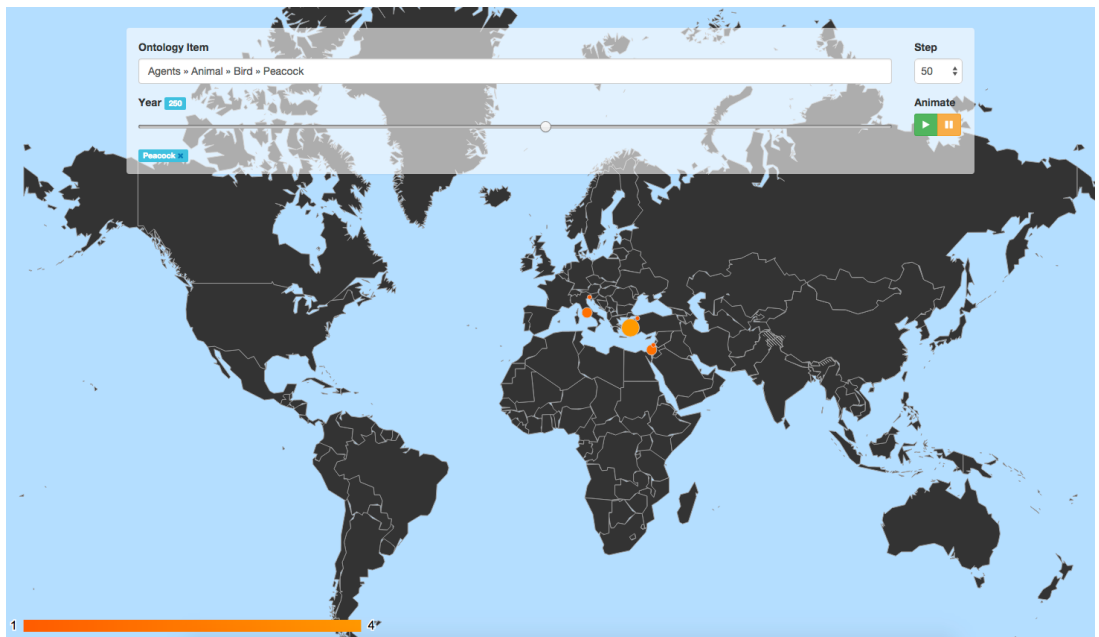
AD 250 (1-4 occurrences per marker)
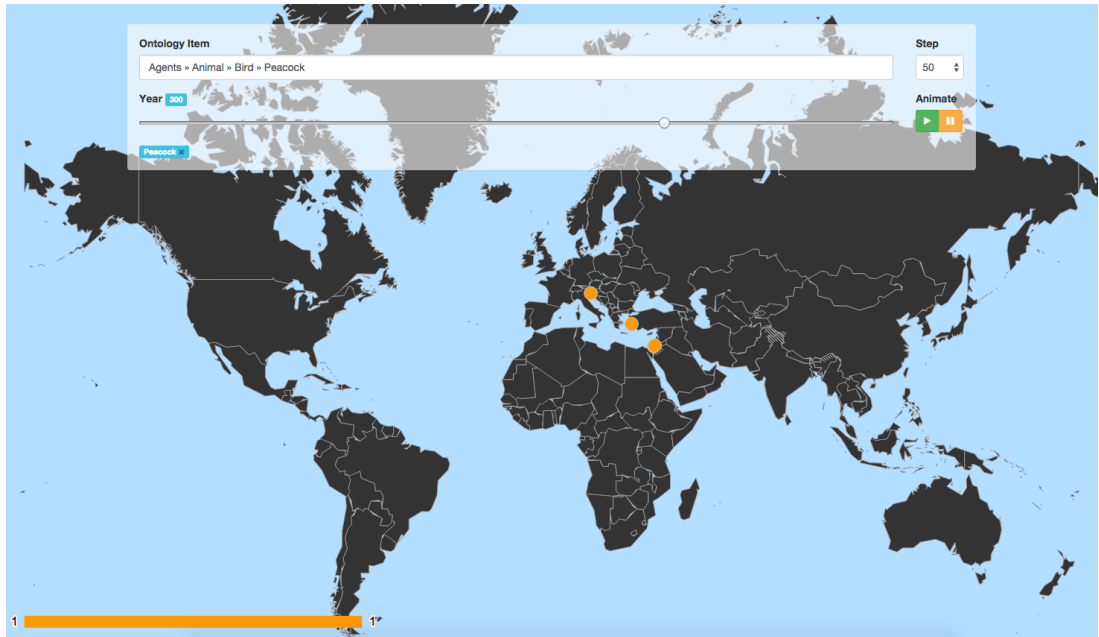
AD 300 (1 occurrence per marker)
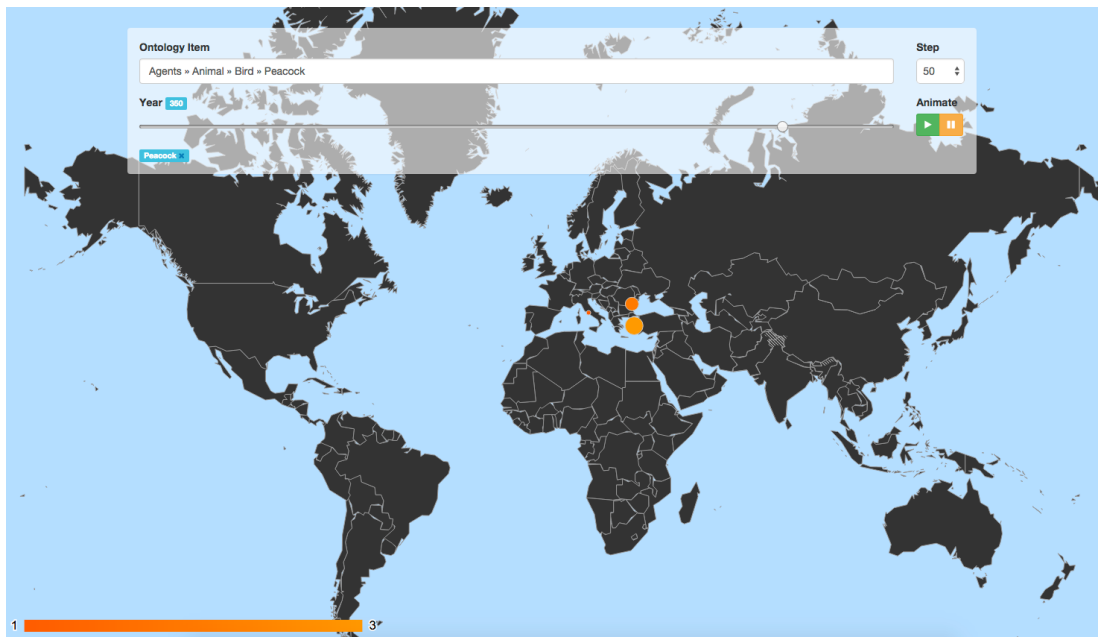
AD 350 (1-3 occurrences per marker)

Fig. 3.11   The occurrences of the ontology leaf node *Peacock*, for the years AD 150, 200, 250, 300, and 350 (step 50).
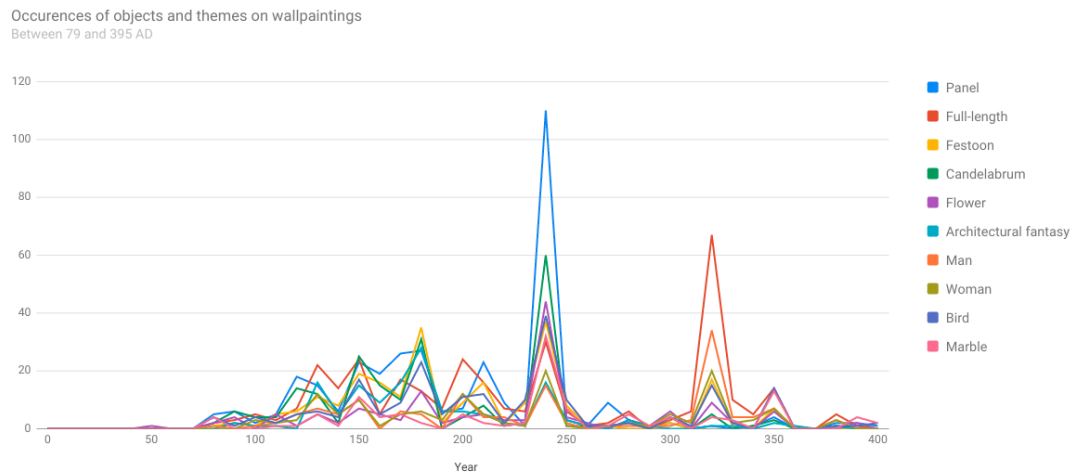
Fig. 3.12   The occurrences of the top ten most popular ontology nodes linked to the option *Visual features* (step 10).

Fig. 3.13   Example of the *Architectural fantasy*. Rome, AD 185-211.

Occurences of objects and themes on wallpaintings
Between 79 and 395 AD
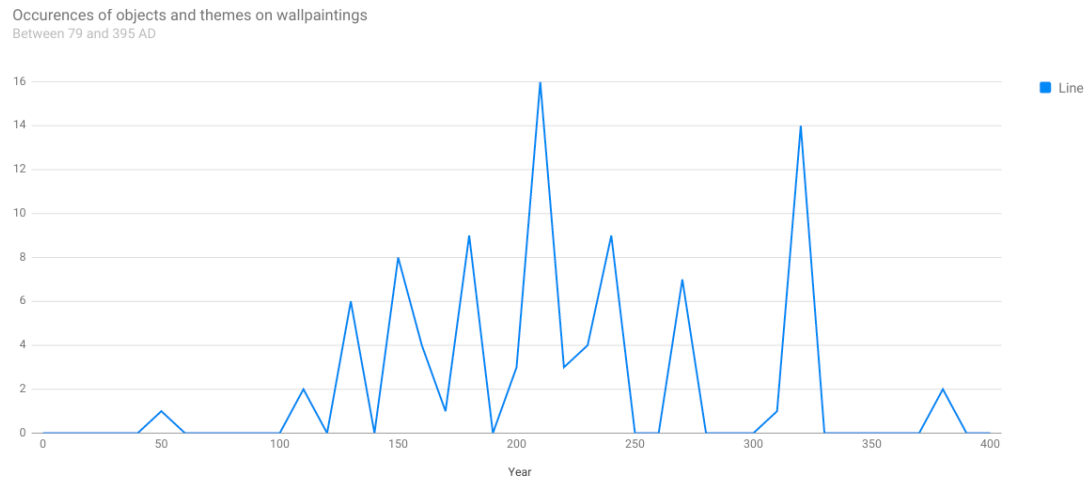
Fig. 3.14   The occurrences of the ontology node *Line* (step 10).

Fig. 3.15   Example of an item annotated with *Line*. Rome, AD 190-230.

Occurences of objects and themes on wallpaintings
Between 79 and 395 AD
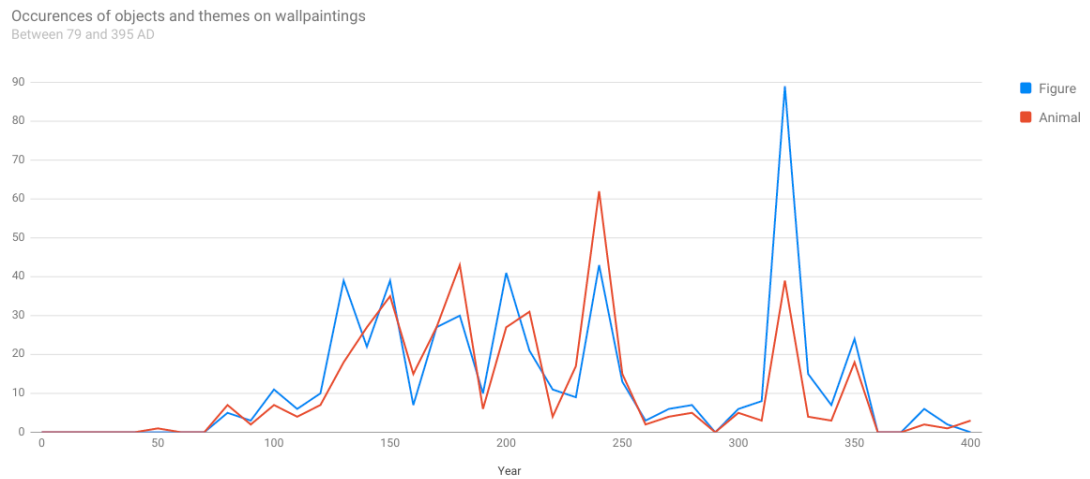
Fig. 3.16 The occurrences of the ontology nodes *Figure* and *Animal* (step 10).
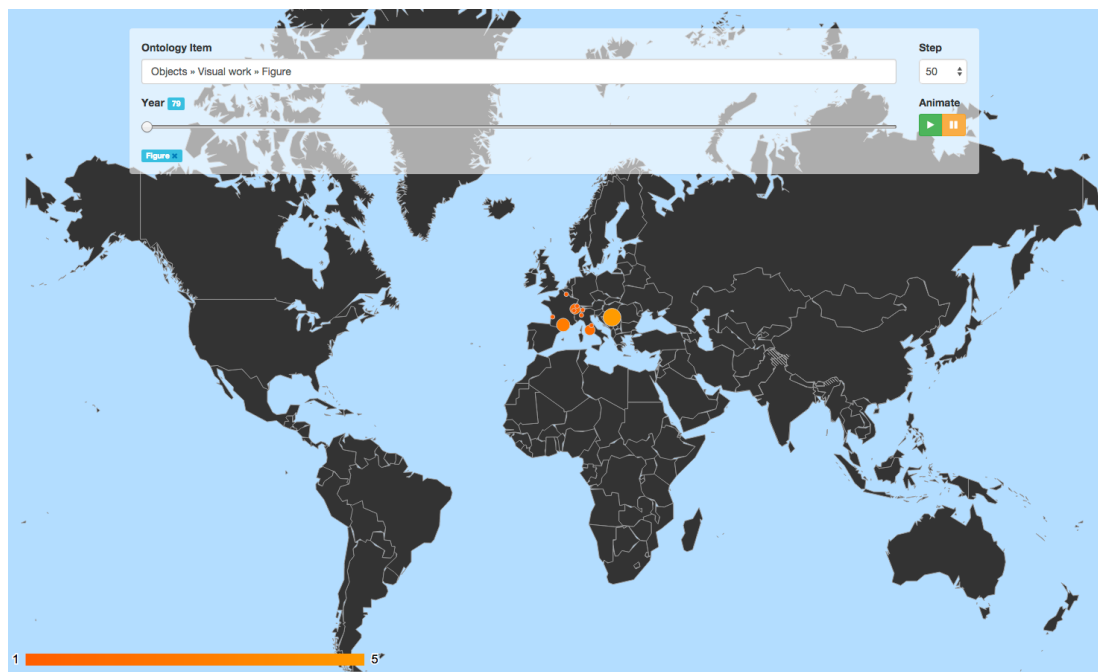
AD 79 (1-5 occurrences per marker)
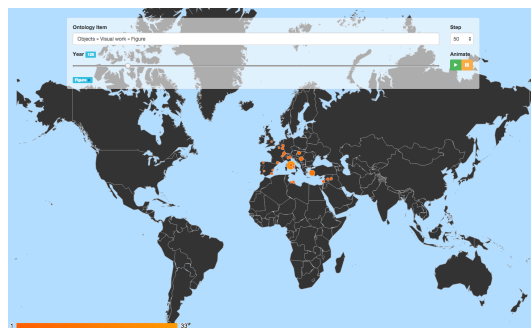
AD 125 (1-33 occurrences per marker)
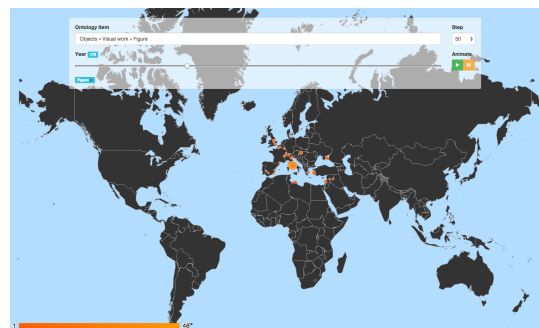
AD 175 (1-48 occurrences per marker)
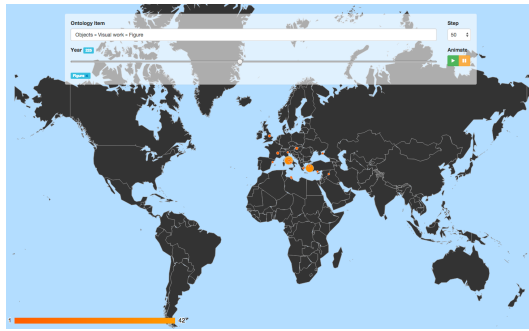
AD 225 (1-42 occurrences per marker)
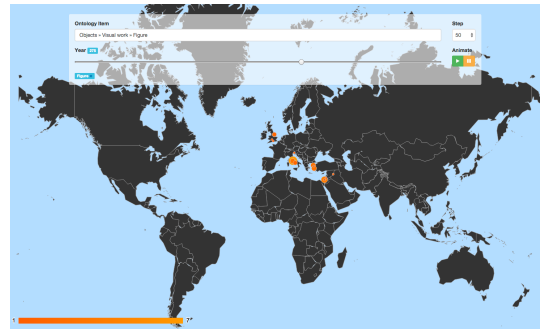
AD 275 (1-7 occurrences per marker)
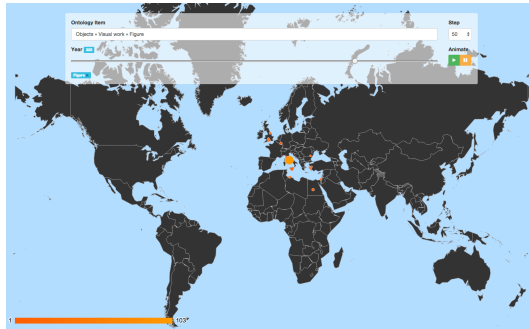
AD 325 (1-103 occurrences per marker)
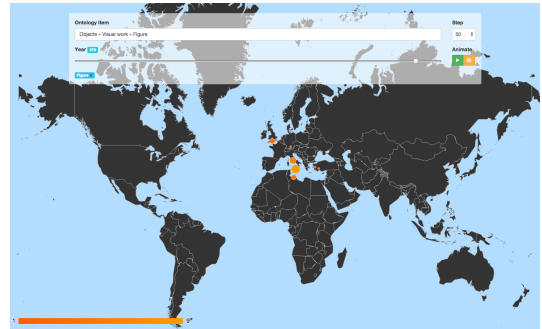
AD 375 (1-9 occurrences per marker)

Fig. 3.17   The occurrences of the ontology node *Figure*, for the years AD 79, 125, 175, 225, 275, 325, and 375 (step 50).
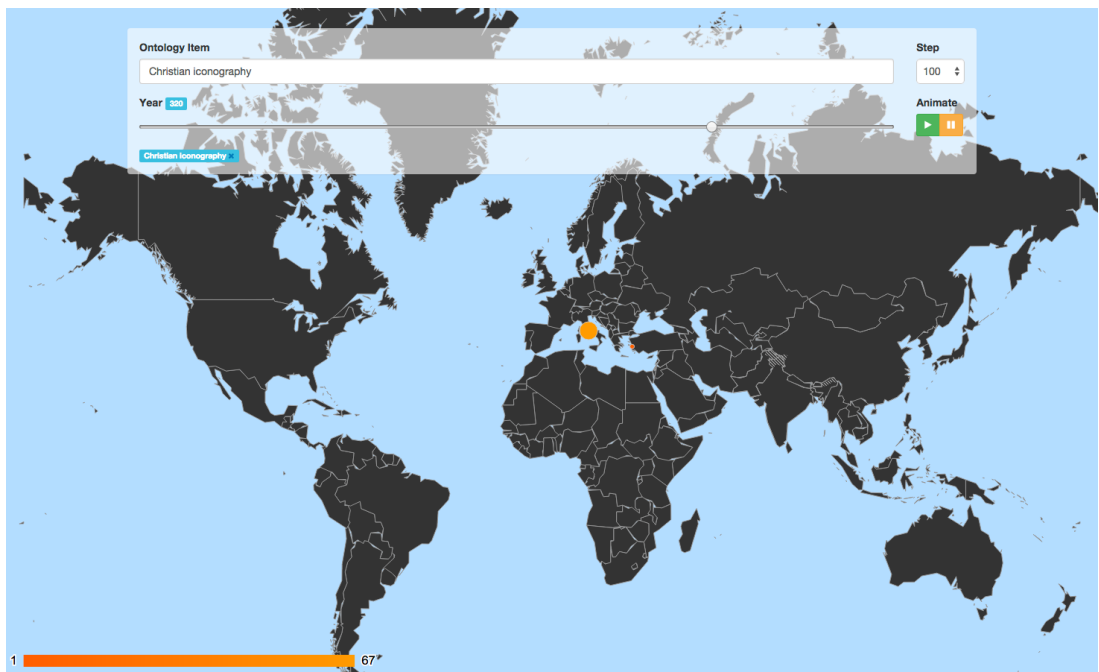
AD 320 (1-67 occurrences per marker)

Fig. 3.18   The occurrences of the ontology root node *Christian iconography*, for the year AD 320 (step 100).
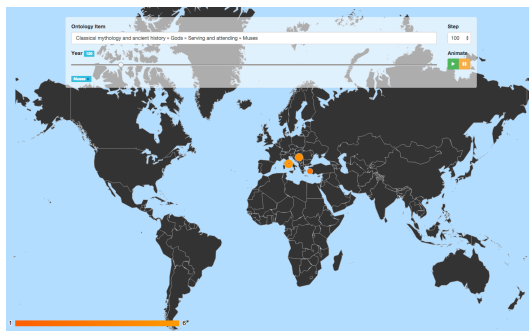
AD 120 (1-6 occurrences per marker)   *AD 220 (1 occurrence per marker)*
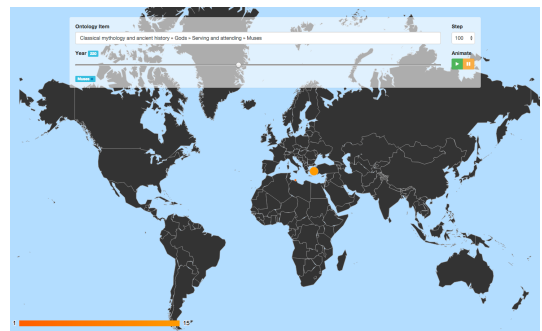
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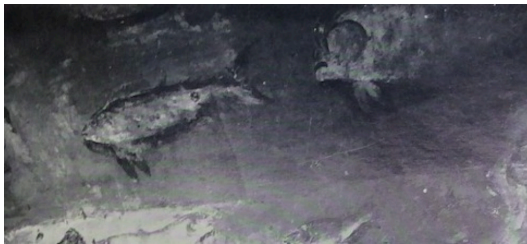
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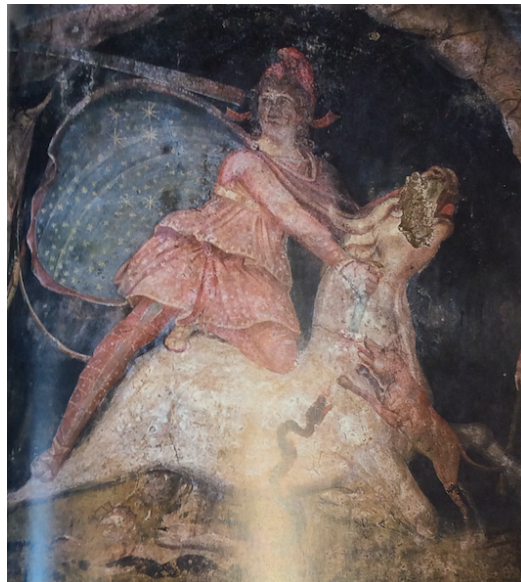
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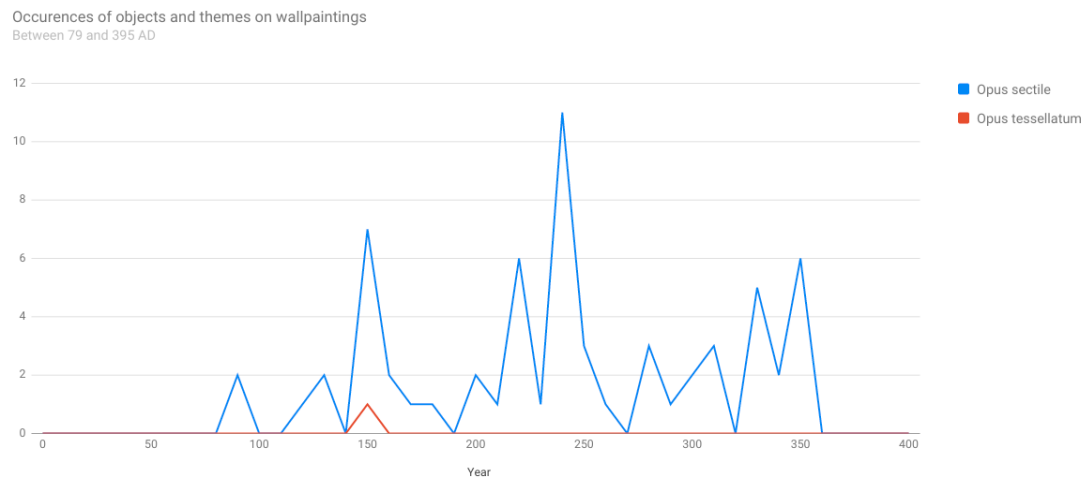
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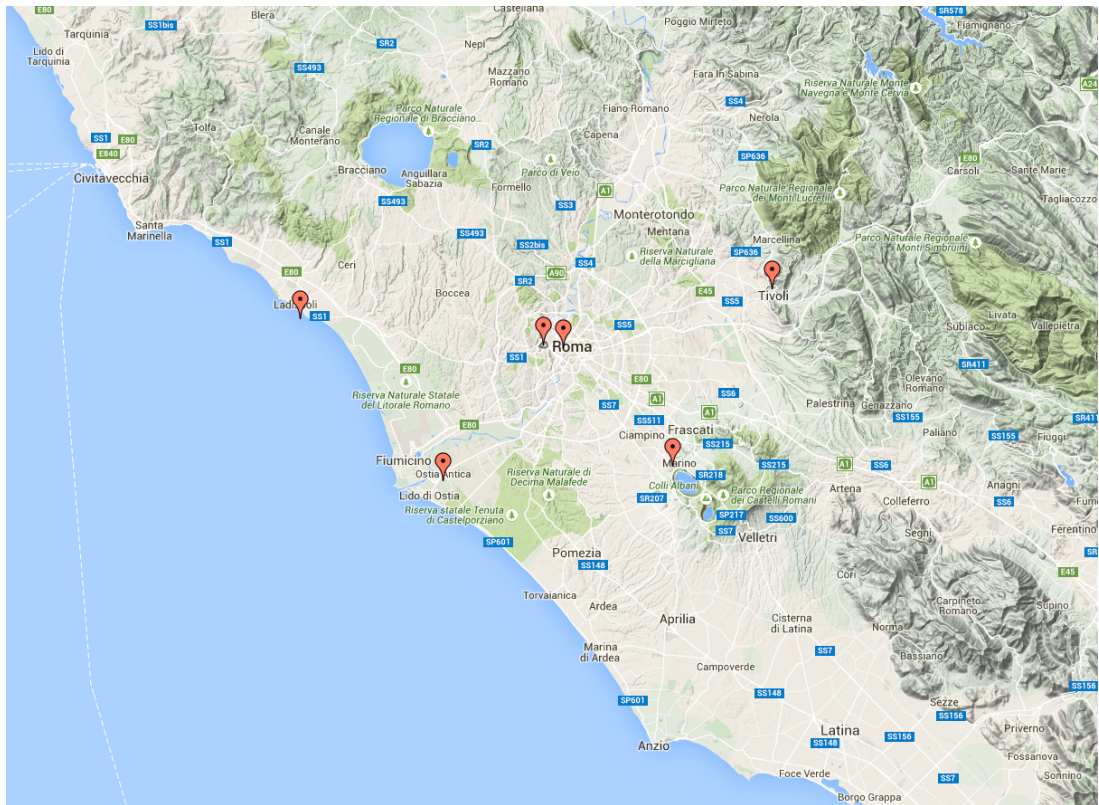
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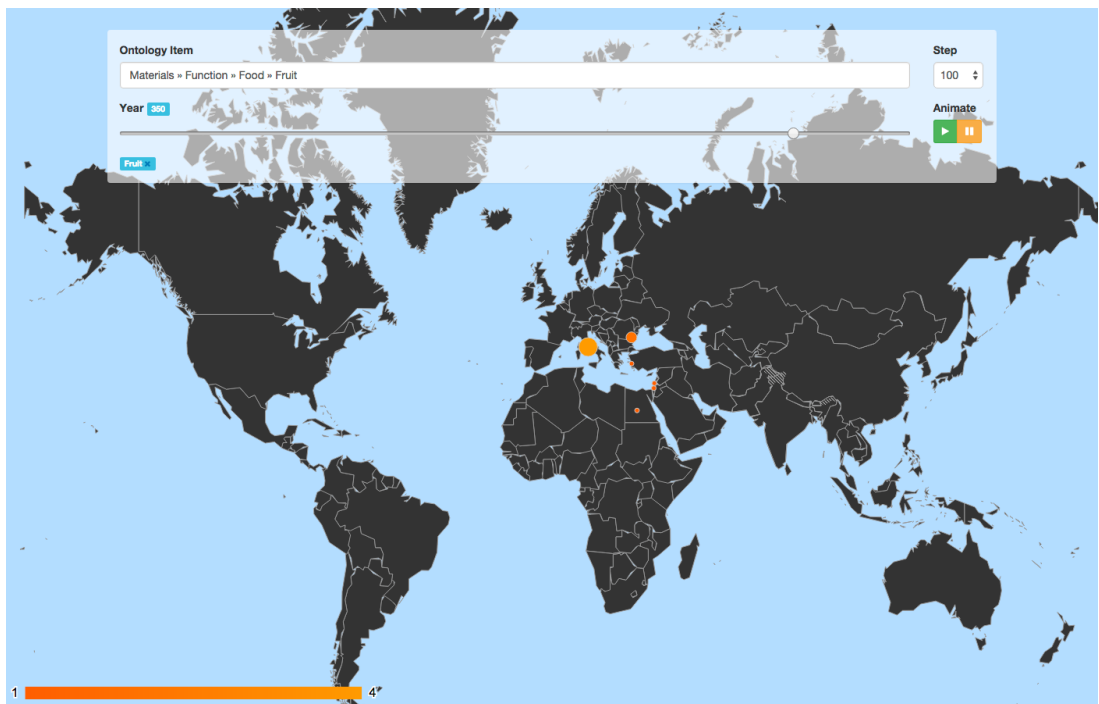
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