

PARTE 3
RICOSTRUIRE IL PAESAGGIO

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THE DIGITAL *TOPIARIUS*: TOWARD A METHOD OF RECONSTRUCTING THE *VIRIDARIUM* OF THE GREAT PERISTYLE OF THE VILLA ARIANNA AT *STABIAE*

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INTRODUCTION

The garden within the Great Peristyle of the Villa Arianna at *Stabiae* mediates between architecture and nature, between notions of interior and exterior, between the views of the surrounding mountains and bay and – as this paper will explore – the painted worlds of elite gardening¹. The garden (*virid[i]arium*) with its apparently simple linear planting beds and water system was discovered with well-preserved, contoured surfaces in 2007² (fig. 1). One of the largest expanses of a luxurious Roman garden exposed archaeologically to date, its relatively clear state of preservation enables us to again stroll along the ancient walks in the sunshine and sea breezes, while viewing Mt. Vesuvius across the bay. The outlines of planting beds filled with root cavities of varied shapes and sizes enable us to imagine a rich horticultural experience for the viewers. In this project, we hope to be even more concrete, seeking evidence for the arrangement and shaping of the garden plants from wall paintings, then using digital technology to test that evidence in three dimensions against the existing archaeological evidence of root cavities, post holes, and planting contours. Building on prior publications, this project asserts that only 3D modeling enables us to recognize the wide range of experiences the designer and patron of the garden sought to create. The challenge of such modeling lies in the creation of the veg-

etation. The construction of digital plants for use in architectural models has two key issues which we addressed in this project. The first is that plants require a great deal of computer memory. The second, and more important, issue is that trees and shrubs available for use in digital architectural models are not in the preferred shapes seen in ancient paintings, so they do not provide the correct spatial and aesthetic experience. We have decided to publish our aspirations, methods, and results in hopes of working with our international colleagues to advance techniques for achieving a high scientific and design standard for digitally reconstructing Roman gardens. The linear design of ancient Roman gardens is very different from gardens of the Italian Renaissance and from those we design today. Advancing the technical issues in modeling is essential to an accurate understanding the complex experience of the people who enjoyed the work of the *topiarius*. Only then can interpretations of identity, meaning, narrative, and spectacle be staged.

ARCHAEOLOGICAL EVIDENCE FROM THE GREAT PERISTYLE OF THE VILLA ARIANNA AT *STABIAE*

The Villa Arianna is situated at the edge of the zone destroyed by the eruption of Mt. Vesuvius in 79 CE. First ex-

¹ The paper combines the contents of the talk and the poster presented at the conference. The authors would like to thank Riccardo Olivito, Anna Anguissola, and Marialaura Iadanza and the other organizers of this important publication. We are grateful to Massimo Osanna, General Director of the Parco Archeologico di Pompei, and Pietro Giovanni Guzzo and Teresa Elena Cinquantaquattro, former Superintendents of the Soprintendenza Speciale per i Beni Archeologici di Napoli e Pompei, and the Director of the *Stabiae* archaeological site, Dott.sa. Giovanna Bonifacio; also to Coordinator Director General Thomas Noble Howe and the Restoring Ancient *Stabiae* Foundation for inviting the authors to study the garden of the Great Peristyle with a team from the Cornell Institute for Archaeology and Material Studies (CIAMS), with support from the Hirsch fund. This project is also part of a study of the *Horti Stabiani* project to record in a database all of the known gardens at *Stabiae*, as well as a larger project, “Le jardin e son archeologie” with the CRNS/ENS through a PICS grant for international collaboration. We are grateful to Daniel Tal for his assistance with software and modeling issues, Nils Niemeier and Samuli Samelius for creating the root cavity database, to Kaja Tally-Schumacher, Amina-Aïcha Malek, and Ian Sutherland for foundational discussions on these garden beds. We especially thank the students of the Parks and Imperial Fora of Ancient Rome seminar in Spring 2017 for their contributions to the poster session: Yiyang Bao, Lauren Butts, Gabriel Curran, Blake Enos, Hong Gao, Norihisa Hatakeyama, Haruka Kido, Eric King, Luyao Kong, Yuchen Tong, Yimeng Zhu.

² The history of its discovery and the seasons of documentation from 2007-2012 are published in HOWE *et al.* 2016.

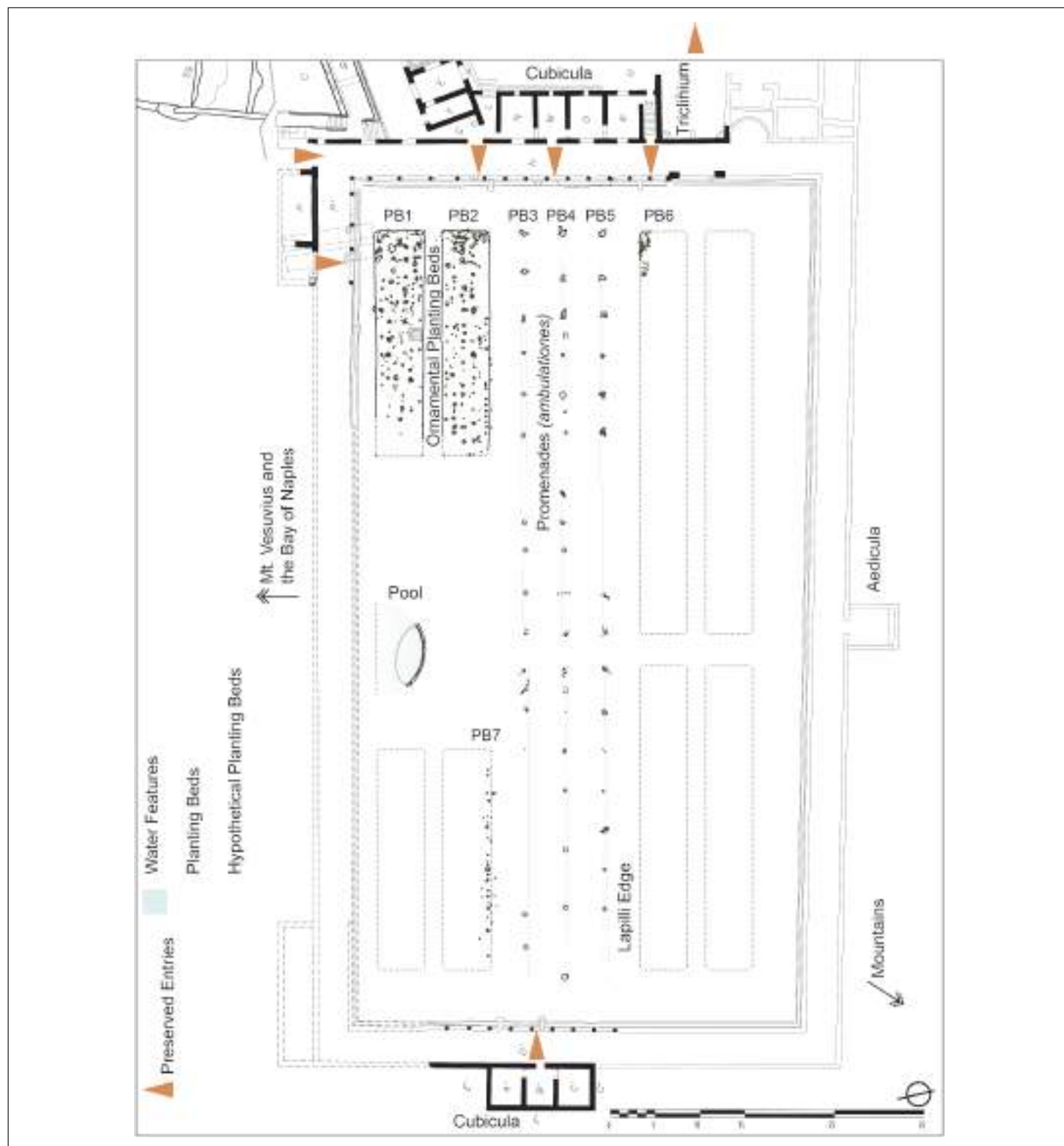


Fig. 1. Plan of the Great Peristyle of the Villa Arianna (Michele Palmer after a site plan by RAS/UMd). Permission of the Parco Archeologico Pompei.

cavated by Francisco La Vega in 1777-78, then by local archaeologist Libero d'Orsi in the 1950s³, the villa offered luxurious facilities in a series of architectural complexes arranged along the edge of the cliff above modern Castellammare di Stabia, with approaches from inland and along a road up the cliff from the sea. Several garden spaces have been identified throughout the villa, the largest of which is the Great Peristyle at the west end of the villa⁴. This garden, noted by La Vega in 1777, was not exposed until 2007 during an operation to lighten the load on the slope to avoid a landslide⁵ (fig. 2). Approximately one third of the area was revealed at this time. A large area to the north has been destroyed by erosion along the cliff and approximately one third remains to be excavated. The initial documentation was carried out by a team of University of Maryland architects working for the Restoring Ancient *Stabiae* Foundation (RAS). In 2008, a garden archaeology team from Cornell University was invited to join the project to record the garden features: compacted paths, soil contours, root cavities, and evidence for the water supply.

The arrangement of soil contours and compacted paths showed that the large peristyle courtyard featured at least two kinds of gardens: 1) a central strolling area comprising four parallel walks separated by narrow planting beds, and 2) flanking that area, pairs of wider planting beds (PB), also linear in nature (fig. 1). The wider beds PB1 and PB2 noted on the plan are best preserved and thus the focus of the work discussed in this paper⁶. These planting beds are characterized by the exceptionally high density of root cavities relative to other ornamental garden beds discovered in the Vesuvian region⁷. The cavities are organized in a linear arrangement but with such variety in the forms of the cavities that hedges must be ruled out (fig. 3). However, along the east ends of the two beds, the arrangement of post holes for a low fence and the associated clusters of various sizes of root cavities behind the fence line strongly evoked the layout of garden paintings⁸.



Fig. 2. View of the root cavities in Planting Beds 1 and 2 during excavations. Original levels visible in background. (Photo courtesy of RAS). Permission of the Parco Archeologico Pompei.

RELATIONSHIP OF ARCHAEOLOGICAL FINDINGS TO GARDEN PAINTINGS

A close inspection of garden paintings has revealed principles of design and arboriculture that add new knowledge to the important current scholarship on the plants of Roman gardens and their painted representations. The pioneering works of Wilhelmina Jashemski, Anna Maria Ciarallo, Massimo Ricciardi and others, well summarized and continued by Marina Ciaraldi, Mark Robinson, and others have brought to light the identifications of Roman garden plants, their uses in daily life, their varied meanings, and the inter-relationship between the evidence of paintings, texts, and archaeological remains at Pompeii and the surrounding areas. This scholarship forms the foundation of this study⁹.

³ Paolo Gardelli in HOWE *et al.* 2016, pp. 18-19.

⁴ JASHEMSKI 1983, pp. 308-310. The current *Horti Stabiani Project* has updated Jashemski's catalogue with additional gardens and updates based on recent work by the PAP and RAS teams.

⁵ Gardelli and Howe in HOWE *et al.* 2016, p. 21. See also BONIFACIO 2008, pp. 155-157. The supervisor of the operation, Vincenzo Sabini, had worked with Wilhelmina Jashemski on the gardens at *Oplontis*, and removed the last meter manually.

⁶ For full details see Gleason in HOWE *et al.* 2016, pp. 67-89.

⁷ The permit for the study was surface documentation, rather than excavation, so environmental remains were retrieved through a program of surface collection and sampling: plant macro-remains (only charcoal and carbonized plants were detected); phytoliths from the garden beds and walks; and pollen from the soils and the plasters; and land snails. The environmental evidence has provided a sketch of the dry vs irrigated areas, as well as the possible presence of turf paths, palms, and a range of woody and herbaceous plants we are still analyzing.

⁸ GLEASON 2010.

⁹ JASHEMSKI 1979 and 1983, CIARALLO, MARIOTTI LIPPI 1993; CIARALLO 1991a-b, 1992, 2001, among many publications; Massimo Ricciardi in CLARKE, MUNTASSER 2014, pp. 1096-1142; CIARALDI 2007; ROBINSON 2002 and 2006-2007.

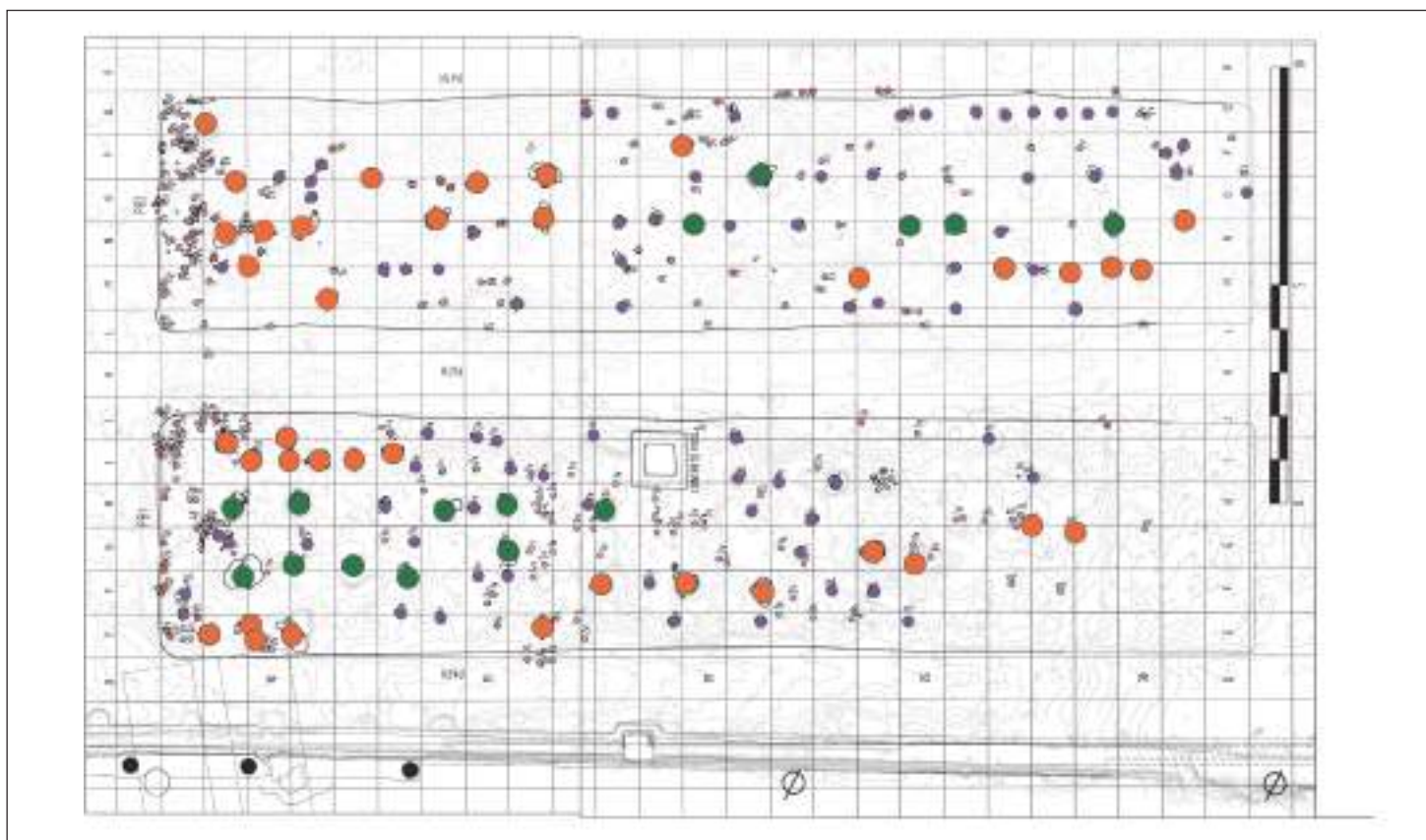


Fig. 3. Plan of root cavities in Planting Beds 1 and 2, color coded by general type.

To date, we have looked most closely at the garden room of the Villa of Livia *ad gallinas* at Prima Porta¹⁰ and *oecus* 32 of the House of the Golden Bracelet in the *Insula Occidentalis* (VI 17, 42), particularly the north wall but with similar principles seen on the other walls and in *oecus* 31 (fig. 4)¹¹. These paintings were chosen because of the exceptionally fine detailing of the plants. The many other fine garden scenes in the corpus of Roman garden paintings offer potential for future study as well, but feature more stylized representation of the plants.

In examining the garden paintings, first we have documented compositional principles that may be applied to the garden

beds¹². Garden paintings have distinct foreground, middle ground, and background zones, each of which feature symmetrical arrangements of plants and/or art. The compression of each plane into a single scene allows the flowering and fruiting plants to be displayed against darker green backgrounds and for single specimen plants to be highlighted, often behind small fountains or statues. We have seen this relationship with single statues set off by single plants in both the garden paintings and the actual gardens of Villa A (of *Poppaea*) at Oplontis¹³. A far more complex arrangement is seen in garden paintings of long, densely planted beds and the archaeological remains of long linear beds, such as

¹⁰ The bibliography on Augustan representation at Prima Porta and Rome is extensive, but for this study the works of KELLUM 1994, CANEVA, BOHUNY 2003, CANEVA 2010, ZARMAKOUPI 2008, KUTTNER 1999 have been influential, leading to publications by members of this seminar: TALLY-SCHUMACHER, NEIMEIER 2016 and NEIMEIER, TALLY-SCHUMACHER 2017.

¹¹ AOYAGI, PAPPALARDO 2006, STEFANI, BORGONCINO 2006; S. Settis (SETTIS 2002) has provided valuable reproductions of these paintings for our studies.

¹² Gleason in HOWE *et al* 2016, pp. 73-77; GLEASON 2019.

¹³ JASHEMSKI 1979, pp. 289-328; see also GLEASON 2013 pp. 929-1095 in CLARK, MUNTASSER 2014, and BERGMANN 2019.



Fig. 4. Garden painting from the North wall of *oecus* no. 32, House of the Golden Bracelet (Pompeii, VI.17.42) (Credit: Museo Archeologico Nazionale, Naples, Campania, Italy/ De Agostini Picture Library / L. Pedicini/ Bridgeman Images.) Insert photo: Author from the original painting.

PB1 and PB2 at the Villa Arianna. The wide beds discovered at *Oplontis* and the Villa San Marco apparently did not feature the density of root cavities seen at the Villa Arianna, so this is the first time such a density of diverse types of root cavities has been noted in a large garden. The closest archaeological parallel is the precinct of the Temple of Elagabalus on the Palatine Hill in Rome, where linear beds separating strolling walks displayed diverse plantings, as evidenced by planting pits and pots found in the beds¹⁴. Many principles noted below are also rendered in mosaic of the 22.4 m. long nymphaeum at Massa Lubrese¹⁵.

The variety of plants seen in garden paintings is achieved through the careful shaping of the plants through pruning, dwarfing (and probably grafting, although this is not represented explicitly). Using the birds for scale, we see that the trees and shrubs depicted in garden paintings are much smaller than the natural size of the species. One might argue that this is simply artistic license. However, the second important aspect of the paintings chosen for this study is that these plants are depicted as vigorously pruned, with clearly represented cuts on the branches. As these are paintings, not photographs, the artist is clearly intending the viewer to see these cuts as part of the realism of the representation. Our studies suggest that the *topiarius* maintained plants at the scale of the viewer's eye level, rather than in proportion to the architecture. Excavators of the planted

walks of the Temple of Elagabalus came to a similar conclusion, again based on the use of relatively small amphora and planting pots within that monumental space¹⁶.

Although the painter enjoys the freedom to avoid problems of seasonality and gravity, this question of artistic imagination should not discourage us from discussing whether the paintings depict the practice of *ars topiaria*, the elite form of gardening we would expect to see in the Villa Arianna garden. Parallels in the relationship between gardens and painting are attested throughout garden history in both European and Asian art¹⁷. Bergmann has most recently tackled this question directly, noting that “the desire to bring the outdoors inside” was shared earlier in Egyptian, Minoan, Akkadian, and Etruscan art. Her work addresses lush garden paintings, but also gardens with minimal, also miniaturized, plantings within reed fencing, exploring the interactive experience between painted and real gardens¹⁸.

Scholars have noted the absence of any portrayal of *nemora tonsilia* and other shaped plants, such as those described by Pliny the Younger in his gardens¹⁹. Literary evidence for gardens provides key terminology and descriptions of experience that cannot be gained in other ways; however, verbal descriptions lack precision about form and design, enabling readers to imagine these characteristics within the limits of historical or preserved knowledge²⁰. After closely examining the scale and shaping, we have suggested that the plants depicted in the garden

¹⁴ VILLEDIEU, 2001, pp. 94-100.

¹⁵ BUDETTA 2006b, 25.

¹⁶ VILLEDIEU 2001, Fig. 75

¹⁷ This diachronic relationship is clearly presented in the recent survey of garden history edited by M. Leslie and J.D. Hunt (LESLIE, HUNT 2013).

¹⁸ BERGMANN 2014, 2018.

¹⁹ For example, CIARALLO, MARIOTTI LIPPI 1993, p. 116 see topiary as clipped hedges and see no evidence in the paintings, and LANDGREN 2004, p. 105, who also regards topiary work as meaning hedges or shaped figures and scenes, argues for not judging from the absence of evidence in the paintings.

²⁰ Many modern interpretations of Roman gardens are based on Renaissance interpretations of Pliny's letters (BEK 1994) which, in turn, shaped later interpretation (DU PREY 1994). Recent scholarship on the villas is summarized by ANGISSOLA 2007; see also BERGMANN 1995 and MYERS 2018, pp. 258-277.

paintings are, in fact, the highly skilled efforts of the *topiarius*²¹. The fashion of cutting of plants into playful shapes, as described by Pliny the Younger²², is perhaps a slightly later trend than the pruning effects seen in garden paintings of the late first century BCE and early first century CE. The absence of figural shapes or scenes should not, however, minimize appreciation for the virtuoso skill required in shaping and miniaturization, as can be seen in the East Asian arts of *bonzai* and *niwaki* today²³. In sum, while the ancient term, *ars topiaria*, gives us our word for topiary, the effects desired by the Romans of the first centuries BCE and CE appear to differ from the shaping of plants into animals, scenes and geometric forms popularly imagined today. The garden room at Prima Porta is the finest early representation of this elite practice, while in Pompeii, the garden paintings of the House of the Golden Bracelet offers a clear representation of the techniques involved.

COMPOSITION

The method of analysis used in this interpretation began by seeking a compositional order to the planting arrangements in the painting. We determined that it is possible to divide all garden paintings studied to date into foreground, middle ground, and background planes. Each plane has a clear function in the composition. For example, in the scene from the House of the Golden Bracelet (fig. 4), the foreground is symmetrically arranged with a herm statue bearing a pinnake, or painting, to each side of a central fountain. The plantings of palm, rose, oleander and arbutus appear random. In the middle ground, by contrast, the vegetation is symmetrical: a plane tree (*Platanus orientalis*) provides a focal point behind the fountain, with a single viburnum (*Viburnum tinus*) flanked by a pair of laurels (*Laurus nobilis*) to each side. The background is minimal, providing a green backdrop and just a hint of greater depth to the scene.

Making a conjectural plan of the painting, we could see that it had the potential to inform us about the garden beds at the Villa Arianna. In PB1 and PB2, the beds feature clear rows of plants, which could now be understood as foreground, middle ground and background planes²⁴ (fig. 5).

With this understanding of the plantings, the next critical point of comparison between the wall paintings and the root cavities at the Villa Arianna is the handling of their shape²⁵. In

this short summary, we might look at three specific ways the paintings convey the work of the *topiarius*: pruning dead and extraneous branches to emphasize a natural characteristic of a tree; hard pruning of shrubs and trees to manage shape and size; miniaturization of large trees. Each of these techniques is visible in fig. 2. These three methods were integrated to produce an assemblage of plants choreographed for viewers strolling through the garden, placing the most interesting features of the plants within their cone of vision in a verdant setting with seasonal displays, aromas, and cultural associations.

The first method is removal of all dead and aging elements of the plants. While this is true of all the plants of a garden, removal of the lower branches gives the palm and umbrella pines their characteristic forms in these paintings. Note in fig. 2 that the palms are not only pruned of dead foliage, but also their arching fronds showing an aesthetic preference for a vertical form of the palm. While umbrella pines (*Pinus pinea*) are not depicted here, seaside villa scenes show a preference for silhouettes much as we appreciate them today.

The second technique is a variation on coppicing in which the shrub is cut to the ground to encourage the growth of a single straight branch, giving the shrub layer the appearance of carefully arranged boughs. Shrubs such as laurel, viburnum, oleander, and arbutus are, in nature, small trees or thick multi-stemmed bushes with a robust appearance, but in these paintings only single branches or stems are delicately arranged into the scene. The House of the Golden Bracelet, as well as the garden painting of Livia at Prima Porta, feature shrubs such as the strawberry tree (*Arbutus unedo*), oleander (*Nerium oleander*), viburnum (*Viburnum tinus*) and laurel (*Laurus nobilis*) that are portrayed as single branches, mixed and tightly spaced in the composition. Myrtle and naturally coppicing trees, such as hazel, noted in the pollen record, may also have been handled in this way.

Fruit trees are handled in various ways. In the Prima Porta painting, they are shown in small tree form, with the interior branches removed to create clusters of fruit and leaves at the ends of the branches, in a style reminiscent of cloud pruning. Pomegranates, apples, citron, and other fruit trees are displayed in this form, with the pruning cuts depicted. In the House of the Fruit Orchard, a very different, vase-shaped presentation is offered to the viewer. In all cases, the trees are also kept low so that the beauty of the fruit and flowers are at the eye level of the viewer, rather than above it, as would be the case in an or-

²¹ GLEASON 2019.

²² PLIN., *Epist.*, 2, 17, 14; 5, 6, 17.

²³ See GLEASON 2019.

²⁴ See Gleason in HOWE *et al.* 2016, pp. 73-79.

²⁵ For a fuller discussion see GLEASON 2019.

chard. Clearly, in wall paintings the size of the plants must fit the frame of the wall, which is inherently human-scaled; but we need to consider how the scale worked in the garden as well. Fruit and nut trees were admired for their fine characteristics, their prestige as an import, or the skill of the gardener in grafting or shaping them. It was important to make that work visible within the gaze of the garden's visitor.

Finally, we see large trees pruned, almost as in the Japanese art of *bonsai* (miniaturized plants in pots) or *niwaki* (garden trees). The specimens in Roman painting are frequently seen as focal points behind statuary or fountains in the paintings and are of many species. The finest example is the plane tree (*Platanus orientalis*) in the House of the Golden Bracelet. It is so visibly pruned and so small in size that it can be none other than the *chamaeplatanus*, or dwarfed plane, described by Pliny the Elder (*Nat.* 12, 3) and recently discussed by Landgren²⁶. Dwarfing, like *bonsai*, is carried out entirely by the skillful clipping of the branches, pruning the roots to confine them to a container or space and to prevent young water shoots from growing vigorously into the carefully sculpted form²⁷.

APPLYING THE PRINCIPLES TO THE VILLA ARIANNA

This analysis of dwarfed trees and pruned shrubs brings us back to their arrangement in the overall composition in the beds of the Great Peristyle garden. An early reconstruction of PB1 and PB2 using plants at their characteristic sizes and natural shape produced a crowded, disproportionate effect (fig. 6a). The paintings suggest a low, layered arrangement of carefully shaped plants composed to be experienced within the cone of vision of strollers in the garden, as well as for stationary viewing from nearby rooms (fig. 6b). Computer modeling, in principle, offers the best way to understand the dynamics of these arrangements. For excavated gardens, modeling can offer a means of assessing the root cavities and layout, in tandem with principles from the garden paintings.

THE DIGITAL TOPIARIUS PROJECT

Despite the rich potential of digital methodologies, reconstructions of Roman villas often omit the gardens and plantings due to technical and evidentiary limitations. Within an architectural model, rendering digital vegetation requires both a great deal of computer memory and hours of labor by skilled

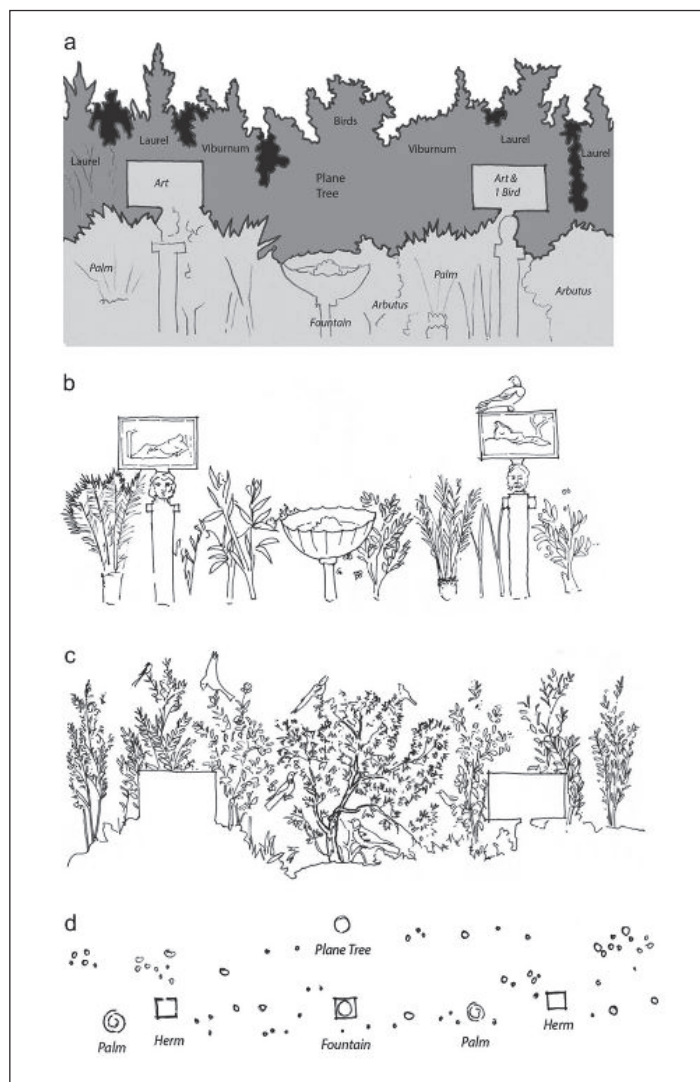


Fig. 5. Foreground, middle ground and background planes of House of the Golden Bracelet with conjectural plan of the painting. Compare with root cavity plan (photo by K. Gleason).

technicians (see Pietroni, Pagano in this volume). Furthermore, modeling ancient gardens is confounded by the problem that modern digital plants available do not share the appearance or experiential character of the plants represented in ancient Roman art. While umbrella pines are similar, even palms were pruned vertically rather than with arched fronds in Roman times. There-

²⁶ Landgren in GLEASON 2013, pp. 90-93.

²⁷ BRICKNELL, JOYCE 1996; RIVERS 1891.

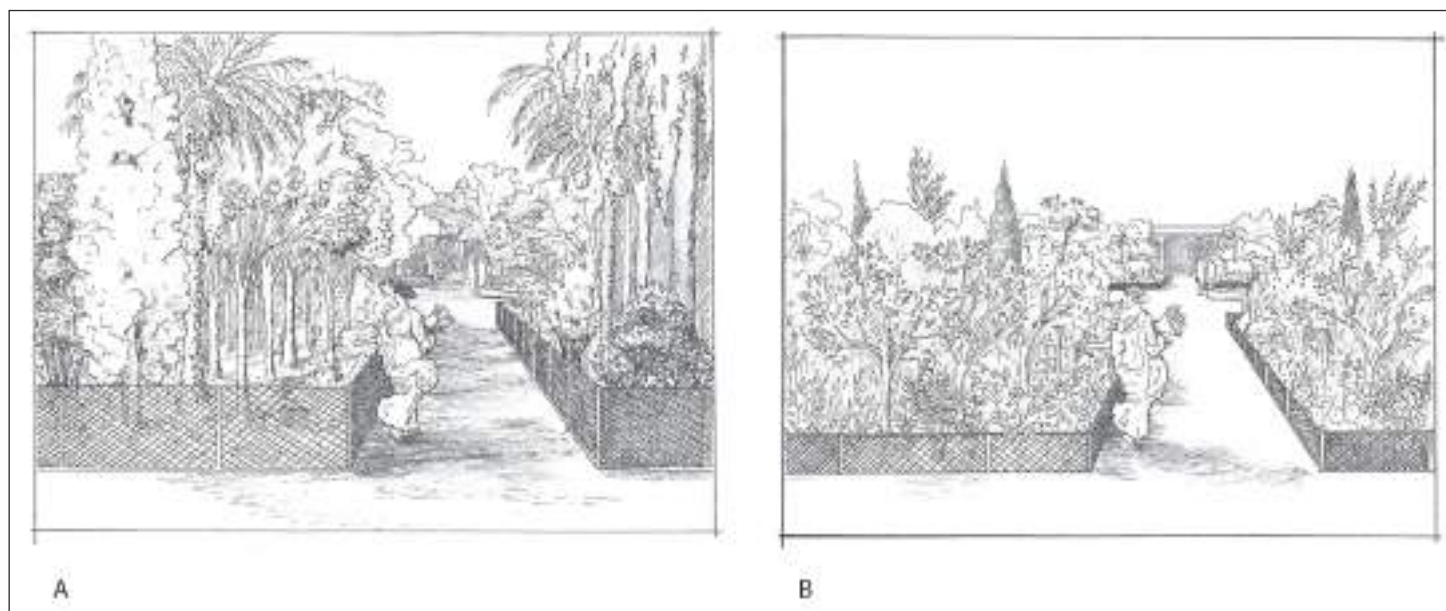


Fig. 6. Perspective study sketches of Planting Bed 2 reconstructed with a) vegetation in natural growth habit and b) with plants pruned in proportion to human eye level (Y. Korman after H. Zhong and K. Gleason).

fore, our modeling project was conceived as an interdisciplinary project to create individual plants, chosen from the archaeobotanical remains where possible and modeled on the plants of the garden paintings. The rooms and colonnades that framed the garden were also reconstructed using available evidence, allowing us to embed the garden within its architectural environment. In this model the plants could then be arranged and rearranged digitally, much as the *topiarius* might do, to achieve aesthetic qualities such as excellent proportion, beauty of the plant in bloom, fruit and foliage, and cultural qualities, such as exotic origins, religious or political associations, or other significance to the viewers.

The team began with modeling the ground surface of walks and garden beds, based upon a LIDAR scan, interpreted into an idealized form²⁸. At the same time, the surrounding rooms and colonnades of the Great Peristyle were constructed using survey and CAD plans created by the Restoring Ancient *Stabiae* (RAS) architects in the field²⁹.

As this was the first time the peristyle had been interpretatively modeled, a number of key issues arose that had to be addressed in the field after the class ended. Michele Palmer,

one of the mentors of the student team, visited the site in June 2017 to resolve architectural issues noted by the student team with RAS colleagues and Director General, Thomas Howe. She began a new SketchUp model with a different construction method in order to more accurately portray the architecture that surrounded the garden and to solve issues of how the garden's topography fit into the peristyle's frame. Palmer had noted in the excavation report for the RAS garden project that the floors of the rooms of the villa surrounding the garden and the peristyle itself are not level, as would be the case in contemporary building methods, but instead followed the slope of the garden³⁰. This is actually important to understanding the site. While the garden surface appears level from East to West, in fact it actually slopes a meter over that distance. Most architectural modeling software is built around the assumptions of level floors in buildings and presents difficulties in reconstructing non-level building planes, such as terrace and gardens. Palmer's model, derived from careful reevaluations and measurements of the surviving roofed and open air surfaces has painstakingly worked out the interface of flat and sloping planes and is thus as accurate as possible.

²⁸ Palmer in HOWE *et al.* 2016, p. 61.

²⁹ Sutherland in HOWE *et al.* 2016, pp. 41-53

³⁰ HOWE *et al.* 2016, p. 62.

Next, using the garden paintings from Pompeii and Rome as well as the first results of the archaeobotanical studies as a reference³¹, the student team created digital models of the individual painted plants and assembled them into categories derived from careful analysis of the surviving root cavities (fig. 7). The design of the planting arrangement was determined by the location of individual cavities within the garden beds (PB1 and PB2) as recorded in the RAS database³². The team analyzed and designated these cavities according to five categories based on the descriptions, CAD plans, sections and photographs recorded in the database: 1) herbaceous, 2) small shrub, 3) small tree, 4) multi-stemmed shrub, and 5) large tree. These types were color-coded onto a plan of the root cavities. Importantly, the translation of the two-dimensional data derived from the root cavity plans and wall paintings into virtual three-dimensional models allowed for the team to experiment with and explore different arrangements, juxtapositions and perspectives of plants (fig. 8 and fig. 9a).

The team encountered two specific issues in modeling the plants of the garden paintings. Firstly, without extensive modeling experience, it was found to be very difficult to “prune” or alter 3D stock plants used in contemporary modeling. Students had even more difficulty creating new plant models in Rhino or other 3D programs. 2D plants were less complicated to create, had better character and are satisfactory for creating static views but they fail to meet the goal of creating plants that can be manipulated three-dimensionally to design the garden to be seen from many angles while strolling. Ultimately, we were forced to conclude that exploring the work of the *topiarius* in the Great Peristyle could not be successfully modeled without the assistance of a computer programmer with skills in creating vegetation.

Secondly, the above-mentioned hardware limitations for rendering 3D plants became acute when assembling the component elements into an overall model³³. Different software exhibit considerable variety in handling complex geometry and in generating finished renderings. Rhino proved more efficient for these tasks but not all team members had access to the software. SketchUp is free so became the common denominator for the team but proved to require more capability from computers. Standard computers available to the team were incapable of handling the complex geometry of 3D trees when we arranged the plants to correspond with the cavities in the garden beds. Palmer encountered the same issues in the new model and used 2D plants. More high-end computers built specifically for ani-

mation and rendering will be needed to achieve an accurate representation of the density of the root cavities. Palmer’s model is now the base for continued modeling efforts with a professional programmer to build the plants of the garden paintings (fig. 9b).

Despite technical difficulties, our planned process is a promising one. Both models resist a fanciful artistic reconstruction. Rather, by creating movable and removable parts that can be assembled in various artistic combinations, we can test the best archaeological evidence we have to date against emerging scholarship on principles of *ars topiaria*. The picture that is emerging from our work reveals a form of garden art unique in the history of gardens, a practice of topiary work that would evolve over centuries to become the beloved Renaissance Roman garden, yet wholly different from it. Only by designing accurate representations of ancient Roman plants can we advance our knowledge of this new form and truly understand the multisensory experience of the Great Peristyle at the Villa Arianna and other Roman gardens.

CONCLUSION

Roman garden paintings contain important evidence for the arrangement and shaping of plants. In the finer paintings the artist carefully depicts highly refined pruning practices that may be linked to texts describing the work of the *topiarius*, but of dwarfed and rescaled plants, not shapes of animals or scenes. These would come later. Plants are arranged in the gardens paintings in overlapping planes that create a rich sense of display against a verdant backdrop. Applying this evidence to the Great Peristyle at the Villa Arianna, we see in the layout of root cavities a strategic juxtaposition of planes of plants, seen by strollers to have a lush effect, one where important specimen plants are displayed to best effect against a dark, vegetative backdrop. The composite renderings and studies of root cavities push against views of overly disciplined gardens that operated on symmetry and regularity, such as the hedges and parterres of Renaissance Rome. Here in the garden, variation in composition, paired with an itinerant viewer, helped to produce an environment that was constantly transforming. While the painted garden captured an idealized garden at a fictional apex of each plant’s beauty, the living garden greeted the stroller with new views every day: a bud, a blossom, an emerging fruit, a fruit nearly perfect, eaten the next day by an early bird.

³¹ The first results of the archaeobotanical studies include Cypress (*Cupressus sempervirens*), maple (*Acer sp.*), strawberry tree (*Arbutus unedo*), hazel (*Corylus avellana*), beech (*Fagus sylvatica*), ash (*Fraxinus sp.*), Walnut (*Juglans regia*), olive (*Olea europea*) and (evergreen) oak (*Quercus sp.*).

³² The software utilized to create the model included AutoCAD, Rhino, SketchUp, and 3DS MAX.

³³ At the time of the poster session for the conference, the model was assembled for the first time.

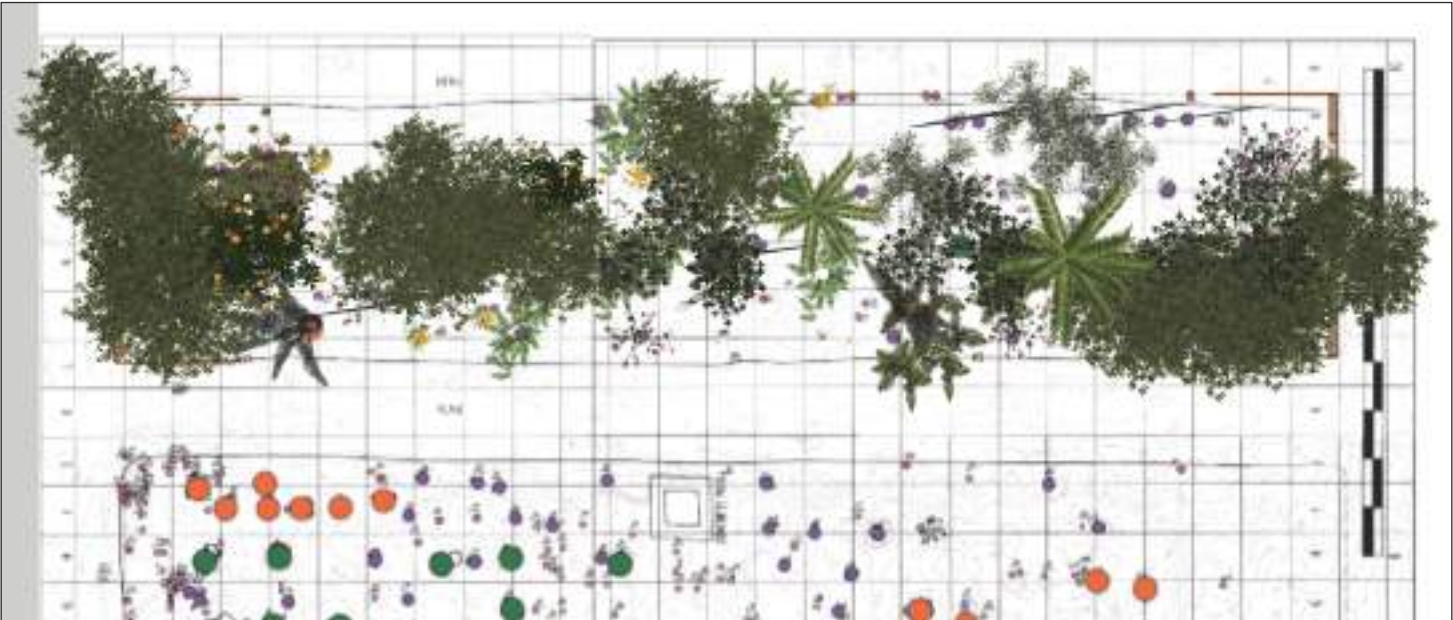



Fig. 8. Inserting plants into the root cavity locations by type (Hong Gao).



Fig. 9. a) The first arrangement of the plants by the students; b) revised model after the field season (Michele Palmer).

THE DIGITAL TOPIARIUS

Modeling Vesuvian garden rooms real and imagined



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Overview and Goals:
Virtual reconstructions of Roman villas often seek the gardens and plantings due to the poorly surviving archaeological evidence, limitations in digital modeling software, and the visual memory required to construct digital vegetation. This poster reflects from an interdisciplinary team of archaeologists, landscape architects, and archaeobotanists as they work together by using the well-preserved Linear Peristyle gardens of the Villa Arianna at Stabiae as a methodological case study in virtual reconstruction.







Methodology:
The collaborative nature of this project allowed for the designers and archaeologists to be divided into five teams, each taking on a specific aspect of the model: Site Topography, Architecture, Planting Bed Analysis, and Plant Modeling. Each group worked with the specific primary evidence that was relevant to their component of the model, using software such as SketchUp Pro, Blender, AutoCAD, and Lumion in order to study, construct, and visualize the Great Peristyle gardens at the Villa Arianna. Overall, the modeling process was built on prior scholarship on the forms of evidence we have for the ancient Roman garden: archaeological evidence, ancient paintings, texts, and studies of movement. The processes described below reflect small team collaborations that, in turn, collectively synthesized the interdisciplinary effort of investigating and visualizing the work of the digital topoius.

Process I: Site Topography
The reconstructed surface model of the garden's topography was created from a LIDAR scan of the surviving archaeological site. These contours were imported into a two-dimensional AutoCAD file where the grade of the slope could be determined. A refined contour reading plane allowed the designers to accurately depict the unique form of this garden through a three-dimensional mesh form (above).

Process II: Architecture
The surviving architectural remains of the colonnade, peristyle, and porticoes of the Villa Arianna served as the primary material for the digital architectural reconstruction. Architects used plans, elevations, and photographs to model the architectural enclosure that formed and created rooms of the garden from within the villa. In instances where architectural material from Stabiae was absent (e.g. the roof line and roof structure), studies of villa architecture and garden-form throughout the Vesuvius region supported the hypothetical reconstruction of the Villa Arianna's portico.

Process III: Planting Bed Analysis
The garden's design and contents can be best illustrated through the layout of surviving rock columns, port holes, and planting columns. Care was made of the site plan found within the two well-preserved planting beds (PIB 1 and 2) as well as the three linear planting beds extending along the corner of the garden (PIB 3, 4, and 5). From these notes and careful study of the garden's remains, topography, landscape architects developed a digital map (left) that articulated a color-coded analysis of the general types of plants that could be identified from the rock sections.

Process IV: Plant Modeling and Composite Views
Working with garden packages from Pompeii and Herculaneum, landscape architects created models of plants in each category explored by the Planting Bed Analysis team. Custom plants are especially challenging to produce digitally and presented unique methodological opportunities to study Roman garden planting practices as depicted in paintings. By isolating individual plants to the settings of Roman gardens and comparing them with examples of the same plants in their natural environment today, this team was able to design and build digital models of Roman garden plants. Individual renderings of plants were then integrated into the color-coded maps of the planting beds according to plant taxonomic established earlier. These composite renderings are shown below and left.

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Fig. 10. Digital Topoius poster (Designed by Evan Allen).

We argue that digital modeling should draw upon this evidence to enable the modern viewer to more fully engage in the multisensory experiences of these gardens, drawing rigorously upon the archaeological evidence. Once modeled, the attribution and arrangement of hypothetical plants to surviving root cavities remains open (productively) to contestation, demanding greater scrutiny of the aesthetic choices made in ancient paintings of gardens vis-à-vis archaeologically substantiated data. Indeed, a compelling virtual garden derived from these bodies of evidence can elucidate what a compelling garden was in antiquity, how these spaces interacted with natural and built environments in ways previously not hypothesized, what kinds of demands these landscapes placed on household resources, and what experiential data can yet be resuscitated from the gardens of the Roman empire, real or imagined.

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