Mitigating pollution in Ancient Rome's green spaces

Mitigating Pollution in Ancient Rome's Green Spaces

Dr Andrew Fox - University of Nottingham

There has been a consistent engagement with the continued degradation of our environment over the past twenty years, and it was a concern among ancient authors. Columella, a Roman agronomist writing in the first century BC, identifies that one of his antecedents, the Greek Hipparchus, had commented on soil depletion in the second century AD.[1] However, sustained engagement with climate change and the environment was not typically practised outside of specialist texts, at least not in a fashion as closely analogous to our modern understanding. For example, Caesar did not elect to march his troops across Gaul in order to limit their carbon footprint, nor did he concern himself with deforestation as a climate issue when obtaining resources for the siege works at various towns.[2] Outside of specialist texts such as Columella's *Res Rusticae*, ancient engagement with the climate, and with air quality in particular, is primarily from a sensory basis.[3] Following Baker's sensory approach to ancient environmental pollution, it is perhaps best to understand discussions of the environment, and of the atmosphere in ancient Rome with a more fluid understanding of both terms. Pollution was not understood in the same quantitative fashion as it is today, and is conceived of in qualitative terms.[4] As an example, discussions about the import of foreign goods are limited to the damaging effects of *luxuria* on a Roman populace susceptible to the temptations of such immorality, and not about the effects of importing a product from such a great distance (although Wallace-Hadrill has argued that the further one has to go for a good in the Roman world, the more luxurious that good is).[5] Taking the same qualitative approach, it might be better to think of the 'atmosphere' of an ancient place as being more closely related to its ambience, and pollution of it as something that is not judged quantitatively, but in terms of its effect on the experience of visitors to it.

[1] Columella *Rust*. 1. *praef*. 1.
[2] Lucan offers an account of the type of concern that is more prevalent in Caesar's deforestations in Bellum civile 3.394-452. This is a well-known passage of Lucan's epic poem, and for discussion of it see, among others, Phillips (1968), Spencer (2005), Leigh (2010) and Hunt (2016: 121-72).
[3] Baker (2018).
[4] Hughes (2014) 50-2.
[5] See Pliny on *luxuria*, as well as Seneca the Younger, both of whom caution against its import on frequent occasions. Also see Fox (2019; 81-7), Lao (2011), and Wallace-Hadrill (1990).

Despite the dissonance between ancient and modern understandings of atmospheric pollution, there remains some continuity in ancient and modern approaches to limiting the impact of pollution in urban spaces. One way in which Roman architects controlled the experience of visitors was through the use of green spaces. These were common in ancient cities, and Vitruvius encourages their inclusion in public buildings. However, green spaces were not an exclusively Roman idea, and Roman interactions with nature in urban settings were influenced by the idea of the Greek *paradeisos* and the Persian *pairidaeza*, which has been explored in the context of conquest and gardens by Totelin.[6] In the first century BC, Rome's urban garden spaces began to become public spaces, and were designed, not as a private venue but as a performative public display: this was nowhere more prominent than in the Porticus of Pompey, which will form the primary focus of this article.[7] The end of the civil wars at the fall of the Republic and the relative stability of the principate also marked the beginning of sustained growth in the city of Rome's economy, and came in a period of climatic stability.[8]

Mitigating the effects of pollution in the ancient world did not stem from as scientifically rigorous a process as today, and judgements of air quality were primarily made from a sensory basis. This can make discussion of ancient approaches to environmental pollution challenging, since Roman accounts do not use the same frame of reference as modern approaches, which rely on scientific analyses. This paper will deploy these contemporary analyses to explore ancient practices as evidenced in literature and material evidence and will determine the extent to which Romans of the first centuries BC and AD understood the benefits of greenery, and of green spaces, on environmental pollution. It will also explore how effective ancient urban planting would have been in mitigating the presence of pollutants and the effects of pollution, using modern analysis of urban planting as a point of comparison.

Vitruvius and *viridia*

Vitruvius, a Roman architect of the late Republic and Augustan period, describes his ideal place, based on the Porticus of Pompey, in his architectural manual *De architectura*:

---

[6] Totelin (2012). Also see Moynihan (1979), and Farrar (1998: 9-10).
[7] For the Porticus of Pompey as a public space, see especially Gleason (1994).
[8] See Harper et al. (2018).

> The central areas, bounded by porticoes, should be decorated with greenery (*viridia*). This is because walking in the open air is very healthy, especially for the eyes, because from the plantations, a fresh and rarefied air flows into the moving body, sharpens the vision, and thus clears the eyes of the thick humour, and leaves the gaze clear and acute. Moreover, since the moving body heats up by walking, the air extracts the humours from the limbs and diminishes their repletion, dissipating what the body has, more than it can carry. (5.9.5)

Vitruvius links walks in the 'clean and rarefied air' provided by greenery within a large architectural space. By necessity, this space has to be 'in the open air', and the element that promotes the health (*salubritas*) of the visitors to the space is the rarification of the air. Davies has identified that air quality was a concern for a number of Roman authors, that Horace encourages visitors to the city to put the smoke and din to one side, and to focus on other aspects.[9] The smoke was likely a result of the chief fuel of the city, wood, and the creation of open public spaces in the first century BC such as the Porticus of Pompey and the Horti formerly owned by Caesar in Transtiberim will have created zones which might have provided some separation from the smells and sounds of the city.

Vitruvius' concern in the creation of the *viridia* is not, like his account of the lead workers' struggles with air quality, concerned with the creation of impurities of the blood in visitors, but instead presents a green space in a complex as a place for cleansing 'the thick humour' from the eyes of the visitor. Whether this 'humour' (*umor*) corresponds to a humour in the Hippocratic (or later Galenic) sense is unclear, and Vitruivius could have been using *umor* to refer to a 'liquid'. In this instance, it could be taken that the 'thick humour' (*crassus umor*) that greenery cleanses are reflex tears, created in response to a foreign irritant.[10] It would then be reasonable to assume that the foreign irritants are elements such as the smoke generated by Rome's fuel and other particulates that would be carried in the air in an urban space.

The cleansing nature of green spaces is not unique to Vitruvius' writing in the ancient world. Herodian reports that the emperor Commodus was, in the late second century CE, sent by his physicians to Laurentum, to walk among the laurel groves. Herodian further tells us that Commodus was expected to benefit from the refreshing shade of the trees, and the purifying scent of the laurel trees themselves (Hdn. 1.12.2). Conversely, too much shade could be understood as a negative thing for a tree, and Pliny tells us that

---

[9] Davies (2012) 74, citing Hor. *Carm.* 3.29.11-12. Davies also cites Strabo's observation that tall chimneys distance harmful gases from the population (3.2.8), and Vitruvius observing that lead workers suffer as a result of the air impurities essential to their profession (*De arch.* 8.6.11).

[10] For more on the three varieties of tears, see Murube (2009).

the fir tree (*abies*) drips poison from its branches, preventing any growth beneath them (Plin. *HN*. 17.91). Vitruvius concludes that the porticoed space is beneficial to the health of visitors in peace time (*De arch*. 5.9.9).[11]

Green Spaces: A Modern Approach

Figure 1: The Green Wall at Edgware Road. Map Data: 2020 Google.

The health of urban citizens in the modern city has become a key issue in the past decade. In 2011, funded by (then Mayor of London) Boris Johnson's Clean Air Fund, a 180 square metre green wall was constructed on the side of Edgware Road tube station (see Figure 1). It was designed, manufactured, and installed by the firm Biotecture Ltd and was commissioned with the explicit intent of reducing the effect of particulate matter

[11] Other ancient authors, such as Celsus and Pliny the Younger, discuss the benefits of walking in the open air, with Celsus explicitly advising walks outside of porticoed spaces, directly contrary to the typical urban experience. O'Sullivan (2011: 80-3) offers some discussion on this, and the emasculation that they believe to be present in Roman thought about walking vs living a sedentary life.

produced at a busy junction.[12] The particulate matter that the green wall is designed to reduce the effect of is PM_{10}, particulate matter of 10 micrometers across.[13]

Similarly, the Green Areas Inner-City Agreement (or GAIA project) in Italy planted 3000 trees in the city of Bologna from 2010-15, with the specific aim of reducing air pollution from CO_2 and PM_{10} (for an example, see Figure 2).[14] To do this, they analysed the filtration quality of different species, and identified twenty four tree types best suited to reduce the targeted pollutants, with the added benefit of reducing urban temperature by 4.5°C.[15] The tree types selected can be characterised as being either broad- or small-leaved, and/or aesthetically pleasing, and this is in line with the requirements of the Bologna Council, who only partially relied on the evidence presented by estimates of the capacity of trees to decrease fine dust, volatile organic compounds and gaseous pollutants, as well as their capacity to reduce temperature.

Figure 2: Parco Aquile Randagie, from Via Genova, Bologna. The new trees are planted in the foreground, alongside more mature trees lining the footpath on the left. Map Data: 2019 Google.

[12] Biotecture were also commissioned by Transport for London to design, plant, and maintain a green wall at Elephant and Castle tube station in 2016. However, this wall has not been the subject of the same analysis as the Edgware Road green wall.

[13] A human hair is 100 micrometers in diameter.

[14] I had intended to include an image of these trees as they are today, but my trip to Italy was cancelled on account of COVID-19. For the locations of the trees planted under the GAIA project, see http://www.arcgis.com/apps/OnePane/basicviewer/index.html?appid=d79f04fa28f144aa9c95987eb438d17e. In the absence of photos taken on site, I have included a Google Maps Street View image of one of the parks planted in the GAIA project, and of the green wall at Edgware Road, which I was similarly unable to visit on account of the national lockdown at the time of writing.

[15] This is according to the case study published by The European Climate Adaptation Platform Climate-ADAPT (2016, https://climate-adapt.eea.europa.eu/metadata/case-studies/gaia-green-area-inner-city-agreement-to-finance-tree-planting-in-bologna).

While the GAIA project rapidly became self-sustainable (it was projected to run from 2010-13, and is still having an effect on the city) and is now a stable part of the city's municipality, the Edgware Road green wall requires frequent maintenance, and was the subject of a study by Imperial College London. This study assessed the efficacy of greenery in reducing PM_{10}, and concluded that 'plants with small leaves with a high density of hairs were most efficient at intercepting $PM_{2.5\text{-}10}$, but during sustained periods of dry weather plants may reach a saturation point, after which particulate capture is less efficient.'[16] The recommendation of the report were that, while green walls and planting did counter PM_{10} to some extent, they should only be employed as a supplementary method to more stringent approaches. A 2018 report on the impact of vegetation on urban air pollution by the Air Quality Expert Group, prepared for the UK Department for Environment, Food and Rural Affairs; Scottish and Welsh Governments, and the Department of the Environment in Northern Ireland takes a similar approach, identifies that while vegetation is beneficial, it is not capable of combating urban pollution on its own.[17] The report is also very clear that the planting of trees did not eliminate pollution, and in several instances only redistributes it. Planting positions of trees also affect the efficacy of trees in combating the dispersion of pollutants, as well as the deposition of particulate matter onto the ground.

Propertius and the Porticus of Pompey

The observations of the Air Quality Expert Group can only be applied in a hypothetical hindsight to discussions of the efficacy of tree planting in the ancient world, and their effect on pollutants there. But ancient pollution can be, and has been, measured. Recent examinations of Greenland ice cores have indicated that the first century BC was a period of fluctuation for Rome's emissions, dropping in correspondence with sustained periods of warfare until 61 BC before a brief recovery until Caesar's Spanish campaigns, and increasing again when Octavian assumed control in 31 BC. Emissions continued to escalate throughout the Roman principate, and the substantial drop.[18] Meanwhile, our evidence for the planting within the city of Rome typically comes from written accounts and (in rare instances) archaeological evidence.[19]

---

[16] Shackleton et al. (2012) 2.
[17] Air Quality Expert Group (2018) 28.
[18] McConnell et al. (2018).
[19] While trees are archaeologically fugitive, we are sometimes fortunate to find the traces of their existence, as is the case in the example used in this section.

A classic example of this is the Porticus of Pompey, the building Vitruvius employed as his example of an ideal building in the passage of *De achitectura* quoted above. Here, a range of evidence types come together to inform our understanding of the building, which is found in poetry, archaeological evidence, and the *Forma Urbis*.[20] The trees of the Porticus are found across this evidence, and are most clearly referred to in ancient literature. Martial, in his *Epigrams*, briefly refers to the 'double grove' (*nemus duplex*) of the complex, and its shade.[21] Almost a century earlier, Propertius was more extensive in his description of the grove:

> Pompey's Porticus, its shady
> columns draped in Attalid fabrics,
> and plane trees growing in neat rows (*Elegies*, 2.32.11-13).[22]

These plane trees are unlikely to have been planted with any environmental benefit in mind, and were possibly an attempt to echo Pompey's triumphal import of the ebony tree.[23] There are additional benefits to the plane tree in the place, and these are identified by Martial and Propertius, the former highlighting the shade cast by the plane tree,[24] and the latter its architectural qualities: the trees are planted in strict rows while the columns are shady, and the natural element is juxtaposed with the artificial. An additional factor in planting plane trees could have been that they are reasonably well-equipped to withstand urban planting, although their shallow root spread does pose some risk to paving.[25]

However, there may have been an additional effect on the reduction of air pollutants within the complex. This is not necessarily a benefit that was planned by the original architects of the Porticus of Pompey, which pre-dates Vitruvius' observations in the *De*

---

[20] See Davies (2017: 229-32) for a summary of the evidence, and for analysis of Pompey's theatre complex in the context of the political upheaval of the close of the first century BCE. For the archaeological evidence (soundings under the Teatro Argentina), see Coarelli (2007: 285).
[21] Double grove: Mart. *Ep*. 2.14.10. Shade: Mart. *Ep*. 5.10.5. Martial does not mention the type of tree that offers this shade.
[22] These three lines feature prominently in discussions around the Porticus. Among others, see Russell (2016: 153-86); Gleason (1994); Spencer (2010: 167-70); Kuttner (1999). For the planting of trees in porticoes, and the archaeological evidence for it, see Gleason and Palmer (2018).
[23] I examined these trees in my PhD thesis (see esp. Chapter 4.1) and concluded that the plane tree had been planted as an alternative to the ebony, which was imported and displayed by Pompey in his Pontic triumph (Plin. *HN* 12.20; 12.111-12. See also Solin. 52.52). Since the ebony would not be able to grow in Rome's temperate climate, the plane would be a suitable substitute, since it would emulate the shade of the ebony tree (Plin. *HN* 2.32.11-13; Luc. *Bell. Civ*. 10.304) and its origin, being "quintessentially Asian", Totelin (2012: 134); see also Kuttner (1999: 347).
[24] Pliny the Elder reminds us that the plane tree was only imported for the sake of its shade (*HN* 12.6).
[25] Morgenroth (2011). The risk is due to a particularly dense root network at 20cm down. Romans were aware of the destructive power of trees (see Prop. 4.5.75-6; Pers. 1.25; Mart. 10.2.9; Juv. 10.142-6), and of a plane tree's root spread (see Varr. *Rust*. 1.37.5), so would have considered this when planting these trees.

architectura by between thirty and fifty years. The effect on smaller particulate matter such as PM_{10} is not likely to have been as substantial as, for example, the Green Wall at Edgware Road: Shackleton et al. identify that small-leaved trees are the most efficient at gathering PM_{10}, and the plane tree is not identified by GAIA as one of the 24 tree species best-suited to the prevention of PM_{10} spread. When Vitruvius made his observations regarding *viridia* and the rarification of the air in the late first century BCE, he was doing so without the same rigorous scientific analysis as has been afforded to modern planting, in the examples of the GAIA project and the Edgware Road green wall. However, this analysis goes some way to indicate that the trees planted in the Porticus would have had a mitigating effect on the air pollutants described by Horace,[26] and the observations of Vitruvius suggest that at least some visitors to the Porticus noticed, and were thankful for, the rarified air afforded by these trees.

Summary

This paper set out with two clear objectives: to establish if trees were included in Roman public places for environmental purposes, and to examine if they would have been effective in fulfilling this role. Trees were included as an element of *viridia*, which Vitruvius advocated as being beneficial for health. This was not the only reason that trees were planted, and other compelling reasons, such as as the spoils of war, did exist. In the context of the Porticus of Pompey, the trees functioned as a part of the building itself, and may have provided the predicted benefits for the health of a visitor, although the plane tree is not the ideal tree for capturing air pollutants, per modern analyses of trees in urban settings of the twenty-first century. While the language that Vitruvius uses may not be the same as the language of modern scientists, we can see that the use of trees and other *viridia* to filter out small particulate matter for the benefit of the general population is not a new concept, and has been practised since the first century BC. The methodology employed in this paper, comparing ancient and modern approaches to mitigating the effects of pollution, can be applied throughout the ancient world and to different forms of pollution. My next project will do just that and will take a similar approach to four forms of pollution, air, noise, and water pollution, and land contamination.

[26] Hor. *Carm.* 3.29.11-12.

References

Air Quality Expert Group (2018) *Effects of Vegetation on Urban Air Pollution*, Department for Environment, Food and Rural Affairs.

Baker, P. (2018) 'Identifying the connection between Roman conceptions of 'Pure Air' and physical and mental health in Pompeian gardens (c.150 BC–AD 79): a multi-sensory approach to ancient medicine', *World Archaeology*, 50(3): 404–417.

Climate Adapt (2016) *GAIA - Green Area Inner-city Agreement to finance tree planting in Bologna*, https://climate-adapt.eea.europa.eu/metadata/case-studies/gaia-green-area-inner-city-agreement-to-finance-tree-planting-in-bologna, accessed 19-Mar-2020.

Coarelli, F. (2007) *Rome and its Environs* (trans. J. Clauss & D. Harmon). University of California Press: Berkeley.

Davies, P. (2012) 'Pollution, propriety and urbanism in Republican Rome' in M. Bradley (ed.) *Rome, Pollution and Propriety*, Cambridge University Press: Cambridge, 67-80.

Davies, P. (2017) *Architecture and Politics in Republican Rome*, Cambridge University Press: Cambridge.

Farrar, L. (1998) *Ancient Roman Gardens*, The History Press: Stroud.

Fox, A. (2019) *Living Trophies: Trees, Triumphs and the Subjugation of Nature in Early Imperial Rome*, PhD thesis, University of Nottingham.

Gleason, K. (1994) 'Porticus Pompeiana: A New Perspective on the First Public Park of Ancient Rome', *The Journal of Garden History* 14: 13-27.

Gleason, K. and Palmer, M. (2018) 'Constructing the ancient Roman garden' in W. Jashemski, K Gleason, K. Hartswick, and A-A Malek (eds) *Gardens of the Roman Empire*, Cambridge University Press: Cambridge.

Harper, K. and McCormick, M. (2018) 'Reconstructing the Roman climate', in Scheidel, W. (ed.) *The Science of Roman History: Biology, Climate, and the Future of the Past*, Princeton University Press: Princeton.

Hughes, J. D. (2014) *Environmental Problems of the Greeks and Romans: Ecology in the Ancient Mediterranean*, John Hopkins University Press: Maryland.

Hunt, A. (2016), *Reviving Roman Religion: Sacred Trees in the Roman World*, Cambridge University Press: Cambridge.

Kuttner, A.L. (1999) 'Culture and history at Pompey's museum', *TAPA* 129: 343-73.

Lao, E. (2011) 'Luxury and the creation of a good consumer' in R. Gibson & R. Morello (eds), *Pliny the Elder: Themes and Contexts*. Brill: Leiden, 35-56.

Leigh, M. (2010) 'Lucan's Caesar and the sacred grove: deforestation and enlightenment in antiquity' in C. Tesoriero, F. Muecke, and T. Neal (eds), *Lucan: Oxford Readings in Classical Studies*, Oxford University Press: Oxford, 201-38.

McConnell, J. R., Wilson, A.I., Stohl, A., Arienzo, M. M., Chellman, N. J., Eckhardt, S., Thompson, E. M., Pollard, A. M., and Steffensen, J. P. (2018) 'Lead pollution recorded in Greenland ice indicates European emissions tracked plagues, wars, and imperial expansion during antiquity', *PNAS* 115(22): 5726-5731.

Morgenroth, J. (2011) 'Root growth response of *Platanus orientalis* to porous pavements', *Arboriculture and Urban Forestry* 37(2):45-50.

Moynihan, E. (1979) *Paradise as a Garden in Persia and Mughal India*, George Braziller: New York.

Murube, J. (2009) 'Basal, reflex, and psycho-emotional tears', *The Ocular Surface* 7(2):60-6.

O'Sullivan, T. (2011) *Walking in Roman Culture*, Cambridge University Press: Cambridge.

Phillips, O.C. (1968) 'Lucan's grove', *CPh* 63: 296-300.

Russell, A. (2016) *The Politics of Public Space in Republican Rome*. Cambridge University Press: Cambridge.

Shackleton, K. Bell, N., Smith, H., and Davies, L. (2012) *The role of shrubs and perennials in the capture and mitigation of particulate air pollution in London*, Centre for Environmental Policy, Imperial College London.

Spencer, D. (2005) 'Lucan's follies: memory and ruin in a civil-war landscape' *G&R* 52:46-69.

Spencer, D. (2010) *Roman Landscape: Culture and Identity*. Cambridge University Press: Cambridge.

Totelin, L. (2012) 'Botanizing rulers and their herbal subjects: plants and political Power in Greek and Roman literature', *Phoenix* 66: 122-44.

Wallace-Hadrill, A. (1990) 'Pliny the Elder and man's unnatural history', *G&R* 37(1):80-96.