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RICHARD KUBIŠTA*, DENISA HALAJOVA*

GEORADAR RESEARCH IN HISTORIC GREENERY

METODA BADAŃ GEORADAREM NA TERENACH ZIELENI HISTORYCZNEJ

Abstract

New methods of non-invasive research in historic greenery offer a relatively quick capability to identify, localize, or just disprove the existence of underground features like paths, flowerbeds, parterres, landscaping remains, or even some larger plants. We have made several case studies in historic parks in the region of south-western Slovakia with a georadar X3M equipped with 500 MHz antenna using several scanning methods (including planar). Interpretation has shown not just modern features like engineering networks, but also historic elements (like pathways) which can be now easily approved by an invasive archaeological survey

Keywords: *georadar research*, *historic greenery*

Streszczenie

Nowe metody nieinwazyjnych badań terenów zieleni historycznej oferują relatywnie szybką możliwość identyfikacji lokalizacji, występujących pod powierzchnią ziemi dawnych elementów kompozycji, takich jak ścieżki, rabaty kwiatowe, partery, mała architektura, a także większe okazy roślin. Wykonane zostały analiz studialne w parkach regionu południowo-zachodniej Słowacji georadarem X3M, wyposażonym w 500 MHz antenę, z użyciem kilku metod skanowania (w tym jednej płaskiej). Ich interpretacja zezwala na identyfikację nie tylko współczesnych sieci inżynieryjnych, ale również elementów historycznych (takich jak ścieżki), których obecność potwierdzona być może już inwazyjnymi badaniami archeologicznymi.

Słowa kluczowe: *badania georadarem*, *roślinność historyczna*

* PhD Eng. Richard Kubišta, PhD Eng. Denisa Halajová, Department of Garden and Landscape Architecture, Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra.

1. INTRODUCTION

Historic greenery represents the most complex part of the cultural heritage of every nation. It is very specific because it consists of living elements which create together a monument of human knowledge, finesse and imagination of beauty usually changing over the centuries. This attribute causes an overlay of compositions following the evolution of period styles. Gardens or parks underlie fashion like all kinds of art; however, it takes much longer because of the natural characteristics of biological elements. They are different thanks to constructed items like buildings, garden pavilions, bridges, statues or even paths, which are easily substituted. There is one thing that biological and non-biological elements have in common, they both leave more or less visible marks, traces in the terrain of historic greenery complexes. This could be the foundation of a building covered by a lawn, a lost path in the wood, or just the root systems of hedges planted in a formal composition in a French parterre or just one huge solitary tree stump somewhere in the meadow of an English landscape park.

Every serious study of historic greenery has to be based on a very detailed inventory of living and non-living elements. If we had such inventories from the times when the site was founded, it would be much easier to follow the evolution of each particular historic green site. The only relevant information we usually have about them is a historic cadastral map, perhaps some lists of plants bought, or just literal descriptions, paintings or lithography. None of these offer sufficient information about the greenery which could be comparable with the present situation. In the recent past there was only on way to acquire more detail – by archaeological research. The present offers more opportunities: first of all aerial satellite or aeroplane screening of the landscape surface; secondly non-invasive terrain surface scanning by georadar. While the first is more suitable for larger parts of landscape like fields; the second can be used on smaller areas like parks, gardens, parterres etc. Georadar scanning was chosen for our terrain surface research.

2. THE AIM OF THE RESEARCH

As model sites, three historic parks were chosen in two different localities; the first was the historic park in Santovka, the second a historic village promenade in Santovka, and the third the historic park in Palarikovo. This choice was made at the request of the local authorities in the two cases in Santovka and in Palarikovo the research was made at our own decision, as there was a scientific need to prove the existence of the parterre. During recent archival research, two plans of garden parterre were found dated to the end of the 19th century. In the present there is no evidence of the existence of the formal parterre as the park was redesigned in an English landscape style at approximately the same time. The question is whether these plans were only a proposal which was never realized, or they were realized and then replaced by lawn. In the case of Santovka's historic village promenade there was assumption concerning the former existence of a chapel, and in the historic park was an assumption concerning the existence of a park promenade. We have tried to answer all these questions.

3. THE PRESENT STATE OF RESEARCH

Clark (2008) made a similar georadar research in Amache in the Granada Relocation Centre, located in south-eastern Colorado, USA. The investigations were designed to further assess the archaeological resources of the site, especially the gardens documented by historic photographs and site survey. These locations were subjected to a ground penetrating radar (GPR) survey, which confirmed the presence of features with ornamental and vegetable gardens. The GPR results in the vegetable garden were inconclusive.

Watters (2012) made a GPR study in the residence of poet Henry W. Longfellow in Cambridge in Massachusetts, USA. This was a part of a wider study using not just GPR but also other techniques such as magnetometry, resistance and conductivity/ magnetic susceptibility. At the front parterre, he came to the conclusion that resistance data suggest there may be compacted surfaces between these 'garden beds', based upon the higher resistance value along that appears to be a central pathway in the GPR data. GPR data, however, shows the garden 'beds' as a stronger anomaly than the 'pathways'. If the 'pathways' were a compacted surface, in theory, they should show as a strong anomaly in the GPR data. Different geophysical survey methods provide detailed information as to what is buried beneath the ground. We are able to integrate this information for a more insightful interpretation of the buried features, but to truly know what remains archaeologists must ground truth these features through auguring or excavation. These result shows that even a flower bed can be easily recognizable in GPR research thanks to the long lasting change in the soil structure compared to neighbouring parts of the surface.

4. THE DESCRIPTION OF THE RESEARCH

At our first location in Santovka village promenade close to the famous local mineral water spring (geographical position 48.15345, 18.7653) we selected linear scanning of the terrain as the probable position of the chapel was approximately sure on the top of the terrain elevation behind the wooden garden pavilion. As the ground surface was almost completely covered by the scrub the only possible line for radar penetration was on a narrow trodden path leading across the top of a small hill. As the route crossed the probable position of the chapel the situation was suitable.

For the second location in Santovka in historic park with a manor house today used as a home for the elderly (geographical position 48.14700, 18.7783) we also selected linear scanning in two directions perpendicular and parallel with the assumed position of the park promenade. The parallel scan was to show possible binding paths between the two main paths. The terrain was cleared of scrub but was rough and covered by organic material (tree leaves and grass).

Both locations in Santovka were surveyed on a day with sunny weather during summer 2012. The surface was dry and the temperature reached approximately 25°C. These parameters gave successful scanning with an X3M georadar equipped with 500 MHz antenna with a scope up to 6 m into the terrain depth.

The third location in the historic park in Palarikovo at the garden parterre next to the garden façade of the manor house oriented to the park (geographical position 48.03857, 18.06899) was suitable for planar scanning as the area was only covered by lawn. Planar ground penetration is a set of parallel scans at a distance

of 50 cm (width of the georadar trolley) made in the area of the south-eastern half of the parterre in range 30 × 50 m. This decision was taken due to an expectation of symmetry in the composition of a classicist parterre. A set of 100 scans were made in a perpendicular direction to the main parterre axis (each 25 to 30 m long). As controls, 5 scans were made parallel to the main parterre axis (each 50 m long repeated only each 5 m).

During wider research, two diagrams of garden parterre plans in a formal baroque style were found in the Archive of The Monuments Board of the Slovak Republic. Both were simple geometric compositions of several rectangles circumscribed by hedges probably of boxwood (*Buxus sempervirens* L.) with an incorporated tennis court and peach orchard (*Persica vulgaris* Mill.). Today the parterre is non-formal with a poor quality lawn but with still readable marks of formal design from the turn of the 20th century. These are the aforementioned fountain and 4 not very visible roundish terrain elevations (approximately 15 cm high and 4 m in diameter) positioned around the fountain in the corners of a square. These elevations are identifiable with a high level of probability as the original positions of 4 cone cut yew trees (*Taxus baccata* L.) from historical photos. Another 8 yew trees still exist on the opposite parterre in front of the manor house at the court d'honour.

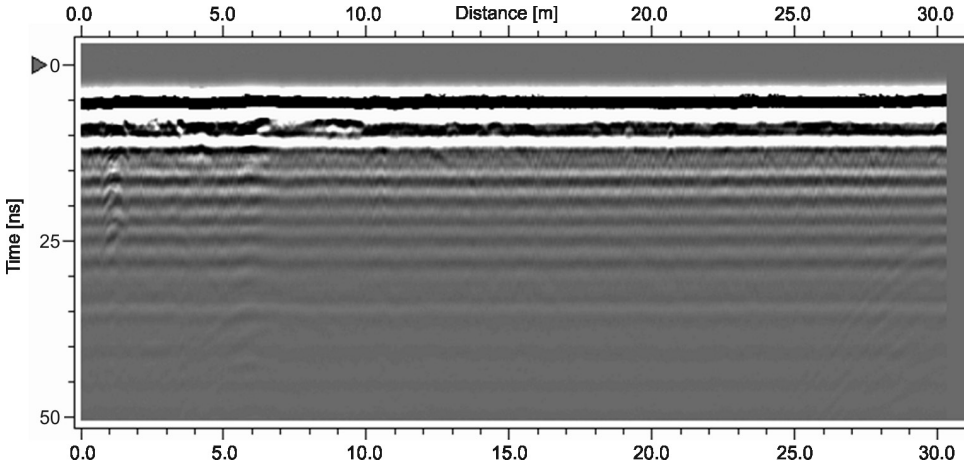
According to photos from the beginning of 20th century the parterre was a symmetric composition with four cone shaped yew trees (*Taxus baccata* L.) with a low cut octagonal hedge made of boxwood (*Buxus sempervirens* L.) with an octagonal pink marble fountain in the middle. This fountain is the only element surviving to this day; the design of the garden parterre was very similar to the existing one on the opposite side of the manor at the court d'honour. This survey was also made in sunny weather during 2 days in summer 2012 on dry terrain with cut lawn.

5. THE RESULTS OF RESEARCH

In the case of Santovka's village promenade one measurement was made across the top of the small hill behind the garden pavilion. Unfortunately just one possible path was possible as the rest of the site was completely covered by scrub. Interpretation of the only radargram shows no building remaining in the selected area. This survey is considered insufficient as the local people still remember the existence of the chapel.

Following the presumptions about the position of the promenade in Santovka's historic park and the existence of a formal parterre in front of the manor house, 12 directions of georadar scanning were set. Each was 20-75 m long and always parallel or perpendicular to the main axis of the park or the parterre. Afterwards, each measurement was processed in software and visually evaluated. There were recognizable tree root systems, engineering grids (water pipes) and significant layers with different density compared to the surrounding soil structure. These layers were on the assumed position of the promenade at a width width of 3-4 m and a depth of approximately 30-40 cm (Ill. 1). Material composition is probably sand, gravel or maul as it has a different structure and density from the soil. The promenade is completely covered by soil and other organic materials as the park was not maintained for 20 or more years. Recent cleaning out in the park offers the possibility to realize archaeological probes at the sites identified by geaoradar.

A separate 6 radargrams were made perpendicular to the main axis of the park, so they crossed the assumed position of the promenade from the beginning next to the manor house to the end at the park border. One radargram was made parallel to the axis and unfortunately did not cross the promenade. Another 5 radargrams were made at the parterre; short (approximately 20 m) were perpendicular to the main axis and long (approximately 75 m) parallel to the main axis of the parterre.



Ill. 1. Radargram made in the historic park in Santovka made perpendicular to the probable main axis of the assumed park promenade showing different material structure between the 6th and 10th m (source: authors archive 2012)

Il. 1. Radargram dla historycznego parku w Santovka, wykonany prostopadle do prawdopodobnej osi głównej zakładanej promenady parkowej, ukazujący różne struktury materiału między szóstym a dziesiątym metrem (R. Kubista, 2012)

In the case of Palarikovo, according to the assumed arrangement of the axial symmetric design of the historic parterre, planar scanning was chosen on one side of the parterre; it was not necessary to scan both sides of the parterre as they should be symmetrical. As it is still time-consuming to scan large areas, although much faster than invasive methods, just one half of the parterre was chosen as study material. In an effort to capture any fragments of historic structures lost in the sediments of the time planar scanning was needed. This type of scanning allows any remains of former linear elements like paths, hedges or others to be captured. Readable marks also arise after long lasting use of separate areas in the same way (lawn cutting, maintenance of paths, flower beds and so on); the soil in these areas rises up or is always kept at the same level and just the terrain around changes the height. Even out planting of linear hedges leaves marks readable at a particular time by geoscanning; this is due to the changes in soil layers.

After the software processing of 105 terrain profile scans made by the georadar, these were interpreted. Several types of underground features were detected; first of all tree root systems creating shallow concave changes in the radargrams; secondly, engineering grids producing deep concave changes; thirdly, any other underground features produced flat changes in radargrams.

6. CONCLUSION

In Santovka's village promenade, according to the visual evaluation of radargrams the hypothesis of existence of a chapel was not accepted. Maybe the assumed position on the top of the hill was not correct. Other measurements were not realisable due to the existence of overgrown scrub on the site. Only after removal of the shrub vegetation would it be possible to make a new terrain scan.

In Santovka's historic park, according to the visual evaluation of radargrams, the hypothesis of promenade existence was accepted. The existence of formal parterre was also probably approved as there were visible significant changes in the radargrams taken in front of the manor house. All these results have to be confirmed by invasive research methods.

In the third case in Palarikovo, a non-invasive planar research of the garden parterre was made using an X3M georadar equipped with 500 MHz shielded antenna manufactured by the Swedish company MALÅ. We have assumed the existence of baroque features remaining only under the soil surface as the parterre was restored at the turn of the 20th century. These assumptions were conditioned by the existence of historic planting plans for the garden parterre in two variants dated 1794. 105 scans were made; these were processed using Rad Explorer 1.41 software, a GroundVision 2 compatible with the georadar. In separate radargrams tree root systems were readable, as were engineering grids expressed by graphic change of fluent radargram flow. According to the interpretation of radargrams, it is possible to come to the conclusion that neither of the historic garden parterre proposals were ever realised on the site.

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