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Archaeological revival of memory of the Great War.
The role of LiDAR in tracing the boundaries of the WWI Rawka Battlefield Cultural Park

Anna Zalewska[a, b], **Michał Jakubczak**[c] **and Jacek Czarnecki**[d]

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"When I saw it, I was amazed how complex it is". "It should be protected. It has survived for a hundred years". "I was not aware it is so extensive and uncluttered". "It is like a masterpiece, so impressive and so meaningful" — these are just a few of the many reactions noted when presenting a LiDAR visualisation of a World War One battlefield to the general public and to those, in whose power it is to protect it. In Masovia, central Poland, battlefields have not been treated so far — and hence conserved, as legacies of a painful history despite significant social potential (Zalewska 2013). In this context, archaeology can become socially important and causative also within the field of remembrance studies as an institution of cultural memory, forging an important return path from cultural forgetting to cultural memory by retrieving lost objects and defunct

[a] Institute of Archaeology, Maria Curie Sklodowska University, Lublin, Poland
[b] Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, Poland
[c] Independent researcher, Warsaw, Poland
[d] Collegium Civitas, Warsaw, Poland

Fig. 1. Archival photograph of the German trenches close to Bolimów, manned in 1915 by soldiers of the 61 (8 Pommeranian) Infantry Regiment v. d. Marwitz (Copyright by Rodside Lessons Foundation)

information from the past (Assmann 2008: 97–8). A reflection on the crucial role of Airborne Laser Scanning technology for the process of activating warscape memory gives the opportunity to recall the history of the Eastern Front during the Great War (Czarnecki 2014).

DEPOSITIONAL PROCESSES: THE GREAT WAR IN MASOVIA (POLAND)

In the autumn of 1914, the Russian Army established a defensive line in the foreground of Warsaw, based on the Rawka river, where the Russian Army took advantage of the steepness of the eastern bank. However, in the upper reaches of the Rawka this was not possible and in the vicinity of Bolimów the Russians were forced to situate their defensive line at a distance of 2–3 km from the river, turning a series of villages into fortresses. The position was crucial for protecting the road to nearby Warsaw (Fig. 1). For seven months of heavy fighting, the Ninth German Army tried to break through, using the most modern weapons of the time, including chemical warfare. In January 1915, Germans used artillery shells containing tear and irritating agents and then in May, June and July the severe chlorine gas attacks, took place. In mid-July 1915, when the area lost its strategic importance, the two armies retreated leaving behind ruins and ashes.

MATERIAL REMAINS OF A FORGOTTEN GREAT WAR AS SUBJECT OF STUDY

After 100 years the former battlefield became the subject of a transdisciplinary project "Archaeological revival of memory of the Great War. Material remains of life and death in trenches of the Eastern Front and the condition of the ever changing battlescape in the region of the Rawka and Bzura rivers (1914–2014)". The project is implemented by the Institute of Archaeology and Ethnology of the Polish Academy of Sciences and financed by the National

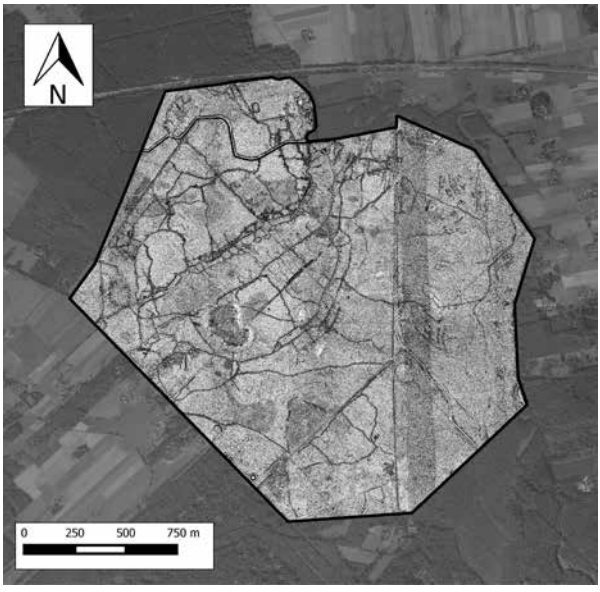

Fig. 2. Zones of WW1 material remains for potential protection in 2014–2018, marked on a visualization of the investigated area. Zone A: area of the best-preserved remains of positional warfare of the Great War, including 'No Man's Land'; zone B: relatively well preserved remains of the former battlefield, including the rear positions; zone C: strongly transformed area of the former WW1 battlefield (archaeological research planned for 2016) (Copyright by APP)

Science Centre in Poland. The scientific team (10 members) has been appointed by Anna Zalewska, the originator and principal investigator of the project. Its objectives of activating the persuasive and causative forces of 'material memory' (landscape memory) are being accomplished by a review of different archival sources on WW1 in Masovia, interviews and discussions, and an archaeological survey of the region.

ARCHAEOLOGICAL STUDIES IN THE PROTECTION OF VESTIGES OF POSITIONAL WARFARE

Non-invasive and invasive archaeological methods have revealed an extraordinary preservation of the ground scarred by war (Fig. 2). By adopting the multidisciplinary approach of "modern conflict archaeology" (after Saunders 2007), a study of written and iconographic sources was combined with fieldwalking, geophysical surveys and test excavation The new concept of the Polish Archaeological Record 2 (AZP2) project proved inspiring (for details, see: Rączkowski 2011: 154; Jakubczak 2014), comprising: a) fieldwalking, b) aerial reconnaissance (here LiDAR) and mapping of archaeological features, c) geophysical surveying and d) test trenches placed wherever current threats to preservation were identified or the cognitive potential for reconstructing life and death in the Great War trenches was recognized. The geophysical prospection is still in progress, GPR

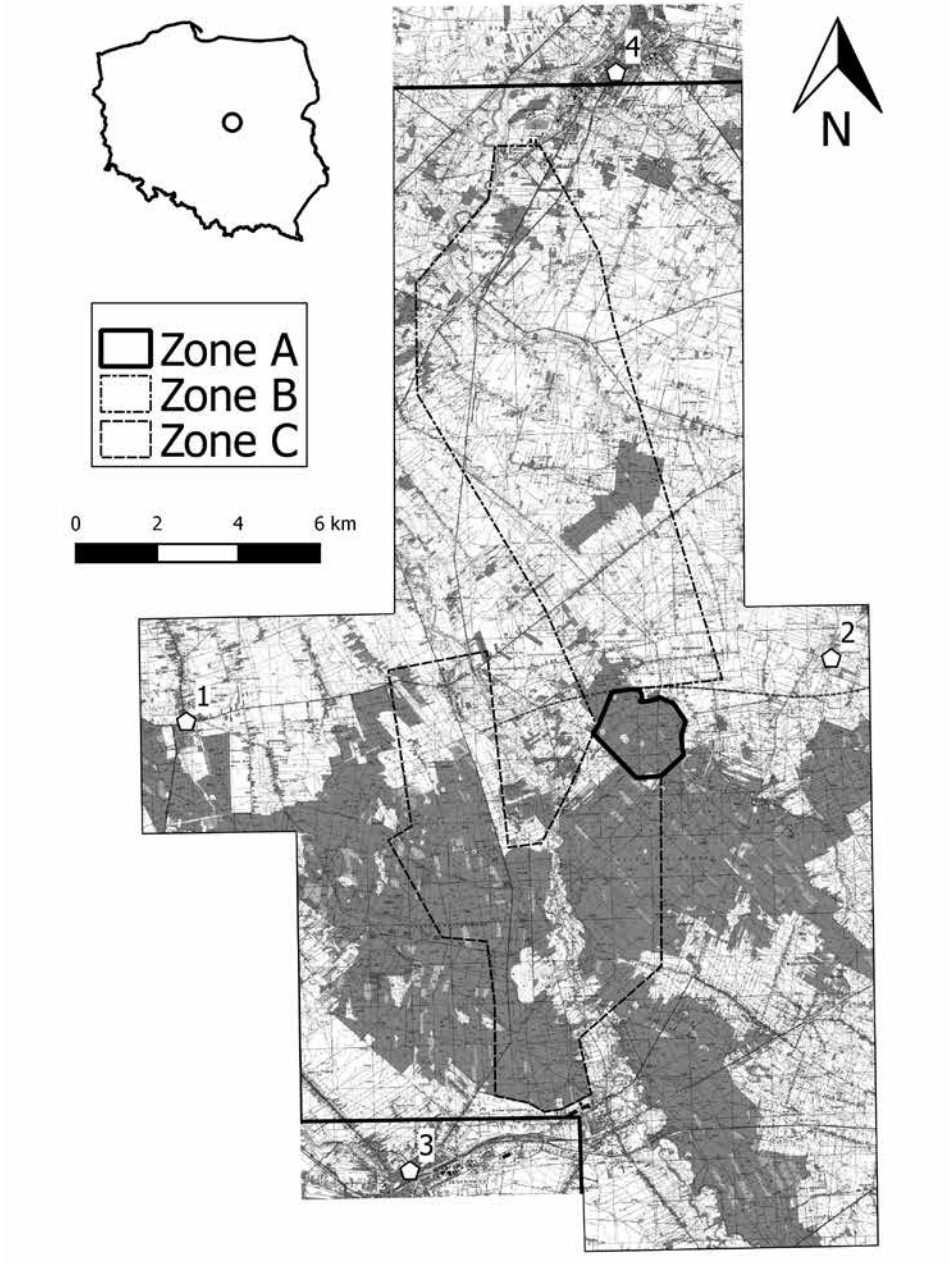

Fig. 3. Zone A as shown with ALS is a piece of the Great War stuck in time: diverse features from 1915, like artillery emplacements, dugouts, weapons stores, field hospitals etc., best preserved in the field but also the most heavily damaged by illicit search for metal finds (Copyright by APP)

proving to be the biggest challenge, electro-resistance and magnetometry already yielding relevant outcomes, and LiDAR turning out to be a crucial tool in recognizing the postwar landscape.

LIDAR TECHNOLOGY IN THE CONTEXT OF SENSITIVE GAS-SCAPES

In the process of activating memory of a place where poisonous gasses were used, airborne laser scanning, which passes also through forest cover, appeared invaluable (Fig. 3). The results of the ISOK Project (IT system of the country's protection against extreme hazards) were employed and clouds of points were reclassified by archaeologists using Lastools software. Visualizations prepared in Global Mapper, RVT and LiVT software were verified for credibility, improving significantly DTM (digital terrain model) quality. The best results were obtained with the use of a SVF (anisotropic sky-view factor), which did not exclude the effectiveness of other visualizations. Analysis of the intensity of laser reflection for plowed fields did not bring the expected results.

Field verification of the LiDAR results augmented the project's QGIS database and facilitated choice of areas for detailed study. These were then implemented to a GPS device as raster images, allowing for very accurate recording in the field of specific landforms. One of the most important results of the archaeological survey was the demarcation of three zones in the studied area: A, 3,5 km^2; B, 55 km^2 and C, 42 km^2.

CONCLUSIONS

The LiDAR visualization was chosen as the core presentation method for the research (Zalewska, Kiarszys 2014) and geophysical methods as a significant element of AZP2 implementation because of a limited range of alternatives (archival aerial photographs from 1915 have still to be found). However, the "more visual approach" to the presentation of the results of archaeological analysis offered by LiDAR, assuming field verification, proved highly persuasive (see Rączkowski 2011: 155). Suffice it to recall the response, mentioned in the opening lines of this abstract, of people living in the neighborhood when they first saw the results and who are responsible for the preservation of these remains for the future.

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