

## **STONE IN AN URBAN SPACE – ITS POTENTIAL TO PROMOTE GEOTOURISM**

**Maria GÓRSKA-ZABIELSKA\***

Jan Kochanowski University, Institute of Geography, Chair of Geotourism and Environmental  
Geology, Świętokrzyska St 15, 25-401 Kielce, Poland, e-mail: maria.gorska-zabielska@ujk.edu.pl

**Ryszard ZABIELSKI**

Polish Geological Institute National Research Institute,  
Rakowiecka St 4, 00-975 Warszawa, Poland, e-mail: ryszard.zabielski@pgi.gov.pl

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**Abstract:** The geological heritage of Pruszków, although with an easy access, remains  
beyond the knowledge and consciousness of its inhabitants. Besides the short  
description of the area's geodiversity, the article presents ten large erratic boulders  
and other stone elements occurring in the town. It is indicated that they have high  
scientific, educational, cultural-historical, and – not less important – aesthetic values.  
The promotion of these values can stimulate the development of urban geotourism.  
Geoconservation activities can contribute to the creating the image of the town, in  
which the principles of sustainable development are taken into account.

**Key words:** geological heritage, geodiversity, georesources, erratic boulders, stone  
objects, geotourism, Pruszków, Mazovia region

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### **INTRODUCTION**

Stone elements in towns and the role they play have already been described many  
times, considering various aspects. These peculiar georesources are valuable examples of  
geological heritage (=geosites) occurring in towns (Rubinowski & Wójcik, 1978; Migoń,  
2012; Dowling, 2013; Del Monte et al., 2013; Lollino et al., 2015; Pica et al., 2015;  
Zagożdżon & Zagożdżon, 2016; Chylińska & Kołodziejczyk, 2018; Brocx & Semeniuk,  
2019; Pereira & Van den Eynde, 2019; da Silva, 2019). Palacio-Prieto (2015) defines  
urban geosites as the places representing geological or geomorphological values, formed  
as a result of geological processes or created by man but closely connected with geology.

According to him these can be, among others, buildings for the construction of  
which rocks were used. Rocks may also be geosites (Migoń, 2012), including erratic  
boulders (Reynard, 2008) incorporated into an architectonically developed urban space  
(e.g. Duraj et al., 2017; Keiter, 2017; Grimmberger, 2017; Köppe et al., 2018; Górską-

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\* Corresponding author

Zabielska & Zabielski, 2018). If they link geological aspect with mysterious myths, which is an example of cultural value of an erratic bolder, they attract mankind's attention in every epoch (Motta & Motta, 2007). The various use of stone in urban space in Poland has been recently described by Zagożdżon & Śpiewak (2011) and Zagożdżon & Zagożdżon (2015). The latter authors pointed out two main aspects connected with this fact, i.e. geotourist and petroarchitectural aspect. The present paper falls into the geotourist trend because its purpose is to document the stone resources in Pruszków in order to expand the tourist offer in the Warsaw agglomeration. Not less important aim of the paper is to indicate new chances of sustainable development of the district and town and to create the image of the town, which should adapt some elements of abiotic nature for tourist purposes, in accordance with the principles of environmental protection.

Georesources are the objects of interest in geotourism (among others Hose, 1995; Słomka & Kicińska-Świdorska, 2004; Newsome & Dowling, 2006, 2010; Migoń, 2012), including urban geotourism (among others Rodrigues et al., 2011; Del Monte et al., 2013; Del Lama et al., 2015; Lollino et al., 2015; Pica et al., 2015, 2016; Chylińska & Kołodziejczyk, 2018). Geotourism is a new branch of tourism, which appeared a few years ago, and combines sightseeing with qualified tourism. Geotourism is also a branch of cognitive tourism based on the exploration of geological objects and processes, which provides aesthetic experiences. Geotourism is also an economic activity. It offers geoproducts (e.g. Reynard et al., 2015; Farsani et al., 2011, 2017; Yuliawati et al., 2019), which are the solution for the local community empowerment bringing them real financial benefits (Xun & Ting 2003; Dowling, 2013).

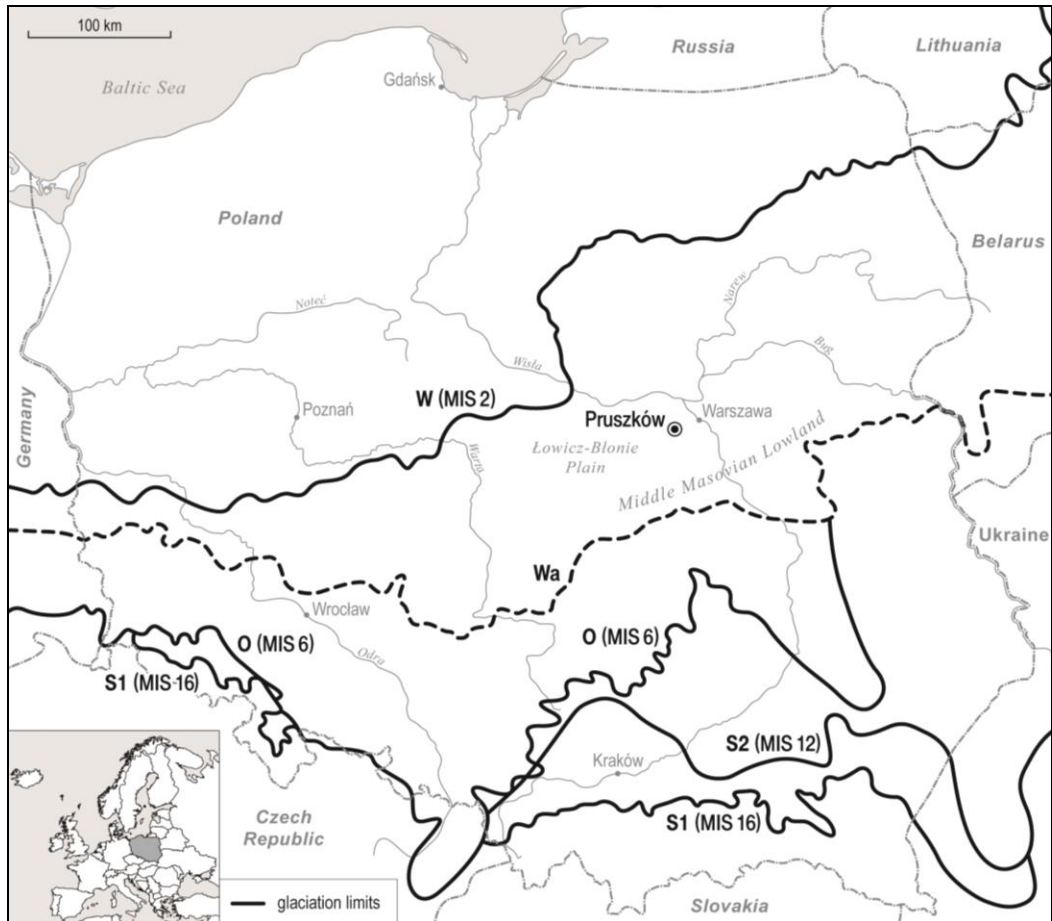
## **GEODIVERSITY OF THE STUDY AREA**

Pruszków is a district town in south-western Mazovia, which has had the town charter for 100 years. In 2018 the number of its inhabitants was approximately 60,000. The geological past, recorded in landforms and deposits, resulted in the great geodiversity (Gray, 2004; Zwoliński, 2004; Brilha, 2016) of this area. This geodiversity manifests itself mainly in the relief of the Łowicz-Błonie Plain, which is built of ground moraine, composed of till left by the Scandinavian ice-sheet during the recessional Wartanian Stage of the Odranian Glaciations (=MIS [marine isotope stage] 6; cf. Lindner & Marks, 2012; Marks et al., 2018, 2019) (Figure 1). The brown soils, which developed on till, are used in agriculture, also within the limits of Pruszków, in the historical Production Complex of Horticulture, which was established by Piotr Ferdynand Hoser around 1898 (Municipal Records of Monuments). The vast open areas of the Łowicz-Błonie Plain, used as meadows and arable fields, are a forefield for palace and park complexes (e.g. in Pruszków, Helenówek, Pęcice) exposing their architectural and composition values (Lewin & Korzeń, 2008). The glacitectonically squeezed Pliocene clays (Kowalczyk & Nowicki, 2007) were exploited in a brickyard at the turn of the 19th and 20th centuries, and consequently housing construction developed (Kaleta, 2010).

This stage of town development left the so-called „quarter of millionaires” (inhabited by the prosperous inhabitants of Pruszków, among others by the members of the "Association of Polish Mechanics from America" returning from the United States, as well as by the workers of the Rail Rolling Stock Repair Workshops and the "St. Majewski and Co." Pencil Factory; Krzyczkowski, 2009; Kaleta, 2010), several street names (e.g. Ceramic Street or Brick Street), and also the so-called „count's clay pit ponds” (belonging to Antoni Potulicki, the last owner of Pruszków; Bielawski, 2009).

Bog iron ore (e.g. Kholodov et al., 2012; Fomenko & Sokolov, 2019) was another raw material exploited near Pruszków and Brwinów (Ruszkowski, 2019). In the period from 2<sup>nd</sup> century BC to 4<sup>th</sup> century AD the resources of this natural raw material

became the basis for the development of a large centre of production and processing of iron (Woyda, 2002, 2006; Tomczak, 2007). The objects from this period, discovered during archaeological excavations, are exhibited in the recently renovated Museum of Ancient Mazovian Metallurgy (<http://msh.m.pl/wp/>).



**Figure 1.** Location of Pruszków in relation to the extents of the Scandinavian ice-sheets according to Marks et al. (2018, 2019). S1 (MIS 16) – Saanian 1, S2 (MIS 12) – Saanian 2, O (MIS 6) – Odranian, Wa – Wartanian, W (MIS 2) – Weichselian

Water is a natural resource that should be protected but unfortunately the inhabitants of the Mazovia region rarely care about it. In the Łowicz-Blonie Plain water occurs mainly in numerous rivers and streams. The described area is drained by the Utrata River and its tributaries (Żbikówka, Regulka, Raszynka, Zimna Woda). The inhabitants of Pruszków appreciate only the recreational value of water (bathing, fishing, walking along the banks). They gladly visit the vicinity of the storage reservoir on the Utrata River in the nearby village of Komorów, the large exploitation pit (now filled with water) of the former brickyard of the Hoser brothers in the northern part of Pruszków, and the fishponds (former "count's clay pit ponds") in the Potulicki Park in the town centre (Skwara, 2002; Lewin & Korzeń, 2008; Jakubowski, 2009). All these objects were created due to favourable natural relief and the adaptation of the Utrata River oxbows and

old exploitation pits of the brickyard (Bielawski, 2009). The inhabitants of Pruszków use also the groundwater resources that are exploited for their needs (Kowalczyk & Nowicki, 2007). Three water intakes exploit the Oligocene aquifer (groundwater is drawn from a depth of 238-244 m below ground surface), and one intake draws water from the Quaternary aquifer from a depth of 29.5 m below ground surface.

## METHODS

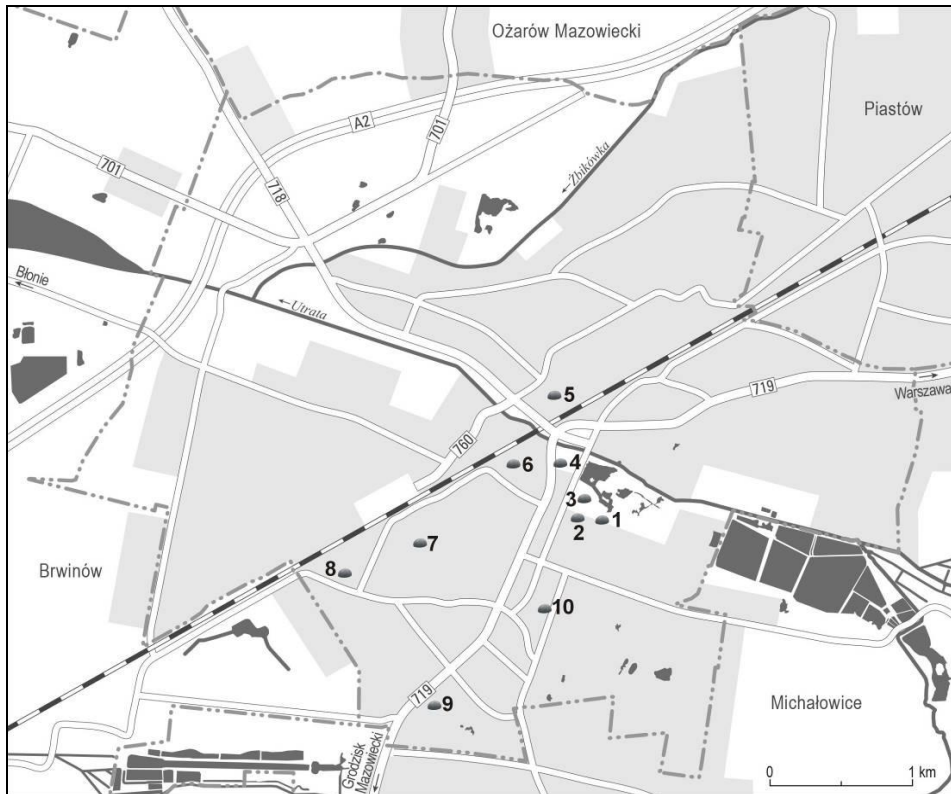
The course of the research in the field covered an inventory of stony elements within the urban area. This procedure consists of measuring the basic dimensions of the boulders (Table 1). In turn, each boulder was considered for its Scandinavian provenance. Attention was paid to whether there is indicator erratic.

**Table 1.** List of the ten largest erratic boulders in Pruszków

<b>Petrographic type, provenance, age</b>	<b>Length [m]</b>	<b>Width [m]</b>	<b>Height [m]</b>	<b>Diameter [m]</b>	<b>Volume [m<sup>3</sup>]</b>	<b>Weight [m]</b>	<b>Location in the town</b>
1. Småland granite SE Sweden; 1.75-1.5 bn years	3.1	2.3	1.3	8.0	4.64	12.8	Museum of the Ancient Mazovian Metallurgy 52°09'52"N 20°48'32"E
2. Scandinavian sandstone, probably of Cambrian age; 541-485 m. years	2.65	0.55	1.85	5.85	1.4	3.9	John Paul II' Square 52°09'52"N 20°48'30"E
3. Rapakivi granite from the Åland Islands; 1.7-1.54 bn years	1.25	0.7	0.8	3.4	0.37	1.01	John Paul II' Square 52°09'54"N 20°48'28"E
4. Gneiss from the Baltic Shield; 1.96-1.75 bn years	1.0	0.65	1.1	3.15	0.37	1.03	Centre of the town 52°10'06"N 20°48'25"E
5. Quartzitic porphyry from the Åland Islands; 1.7-1.54 bn years	1.4	1.1	0.9	3.8	0.72	1.99	In front of the Museum DULAG 121 52°10'23"N 20°48'27"E
6. Småland granite, SE Sweden; 1.75-1.5 bn years	1.2	0.8	1.08	3.45	0.54	1.49	Bersohn' Square 52°10'06"N 20°48'02"E
7. Gaize from the bedrock of the Botnian Gulf or from the Lower Vistula Valley; 145-66 m. years	2.05	1.7	1.15	6.0	2.1	4.19	In front of the Social Insurance Institution building 52°09'51"N 20°47'38"E
8. Granite-gneiss from the Baltic Shield; 1.96-1.75 bn years	1.85	1.95	0.95	6.0	1.79	4.93	In front of the Sport School Complex 52°09'39"N 20°47'04"E
9. Småland granite, SE Sweden; 1.75-1.5 bn years	2.15	1.3	1.0	5.6	1.46	4.0	Southern part of the town 52°09'14"N 20°47'37"E
10. Karlshamn granite from Blekinge	2.6	1.7	1.3	6.45	3.0	8.26	Lipowa Street 52°09'21"N 20°48'39"E

**Explanation:** boulder volume was calculated using the formula:  $0.523 \times \text{length} \times \text{width} \times \text{height}$  (Schulz, 1964; Speetzen, 1998); boulder weight was calculated on the assumption that  $1\text{m}^3 = 2.75$  tons

For this purpose, available atlases of such rocks as eg. Meyer (1983), Zandstra (1999), Smed & Ehlers (2002) and Rudolph (2012, 2017) have been used. The provenance of some erratic boulders have been indicated by the boulder size (Table 1), which is mainly an effect of bedrock joint in source area (eg., Gorbatshev, 1980; Gaál & Gorbatshev 1987; Johansson, 1988; Rodhe, 1992; Berglund et al., 1992; Lindh, 2002; Scholz & Obst 2004). Also other specific features have been taken into consideration, like e.g. presence of crystals of blue quartz in Småland granites (Bartholomäus & Solcher, 2002) or large round potassium feldspars surrounded by a border of soda-calcium feldspars in Åland granites (Meyer, 1983). The next stage of research has been a recognition of the role of erratic boulders in the city. The following values have been considered: cognitive, scientific, educational, culture-forming, aesthetic and geoconservation. All of them cocreate the geotourist value of stony objects within the city limits.



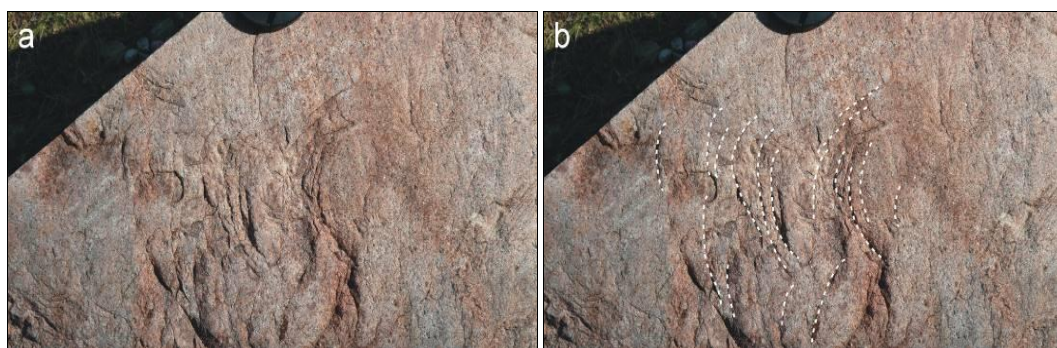
**Figure 2.** Location of ten largest erratic boulders in Pruszków (compare Table 1)

### STONY OBJECTS IN PRUSZKÓW

Stone in Pruszków is present in natural and cultural heritage objects.

The first group includes erratic boulders, which were deposited in the Mazovia region during the recessional Wartanian Stage of the Odranian Glaciations (=MIS 6; cf. Lindner & Marks, 2012; Marks et al., 2018, 2019). The authors of the paper know ten large erratic boulders occurring within the limits of Pruszków (Figure 2). These boulders are characterized in the Table 1. All erratic boulders in Pruszków, although they occur *ex situ*, i.e. not in the places of their original glacial deposition, belong to the local geological heritage of this part of the Mazovia region, which is their **cognitive** and even **scientific**

**value.** Closer observation of a boulder allows identifying its mineral composition and petrographic type, and thus the geological processes that affected it from the time of crystallization during diastrophic processes ended with orogenesis, which formed the bedrock of the present-day Scandinavia, through the transport in an ice-sheet, to the glacial deposition in the European lowlands. Based on the origin of a boulder from a particular outcrop in Scandinavia, it can be described as an indicator erratic (Korn, 1927; Lüttig, 1958; Meyer & Lüttig, 2007). The analyses of statistically representative indicator erratics allow to indicate with high probability their source areas and to determine the directions of long-distance transport to the places where the erratics were left by an ice-sheet. These features create the **educational value** of an erratic boulder. This value is increased by some morphological features of boulder surface (formed during glacial transport) such as roundness, glacial polish and striae, crescent chatter marks (Figure 3a, b, No. 8 in Figure 2 and in Table 1) as well as the traces of abrasion in the form of microribs (Figure 4, No. 6 in Figure 2 and in Table 1). The latter are a record of morphogenetic processes that have continually modified the surface of a boulder since the time when it was left in dry and cold periglacial environment in the foreland of a retreating ice-sheet.



**Figure 3a.** Fragment of an erratic boulder – gneiss; **3b.** Visible crescent chatter marks formed by the scratching of the rock surface by the sharp edges of the crumbs carried in the ice-sheet sole. Occurring in front of the Sport School Complex, the boulder may play an educational role

The aesthetic value of boulders is created by their size and attractive appearance. For this reason some of the boulders were set in good locations in the town or in private gardens. The boulders, objects commonly found as indestructible, resistant to the passage of time (in the scale of human life), are used as monuments or pedestals of monuments, with commemorative plaques fixed to them (Figure 5, No. 5 in Figure 2 and in Table 1; also Nos. 3, 6, 10 in Figure 2 and in Table 1). In such situations the erratic boulders play both the **culture-forming** and **aesthetic** role. The largest erratic boulder in Pruszków (No. 1 in Figure 2 and in Table 1), due to its size, is protected by law as a monument of inanimate nature (the only one of this kind in the Pruszków district). As the object of protection it has **geoconservation value**. Unfortunately, none of the erratic boulders in Pruszków has its own name or legend. Therefore, these boulders have no historical value and their cultural significance is small. The erratic boulders in the urban space of Pruszków are also present in the Falcon Park (Figure 6), on the lawns along the streets (e.g. ventifacts with visible abrasion microrelief, Figure 7), and also – sliced up – as the windowsills of shops (Figure 8a, b). It is worth mentioning that the number of erratic boulders in Pruszków is constantly increasing because more and more new buildings are built and their foundations reach deep into the glacial deposits so new erratic boulders are dug up. Several of the cultural heritage objects in Pruszków are connected with geology.





**Figure 4.** Fragment of an erratic boulder – granite (No. 6 in Table 1). Visible parallel microribs, which are the result of abrasion – destructive aeolian process affecting the boulder in dry and cold periglacial environment in the foreland of the shrinking ice-sheet



**Figure 5.** Commemorative plaque on an erratic boulder in front of the Museum DULAG 121. The rock plays here the culture-forming and aesthetic role



**Figure 6.** Three abraded erratic boulders in the Falcon Park, centre of Pruszków, play aesthetic role



**Figure 7.** A model example of ventifact might have played an educational role in the town



Stones, though not necessarily Scandinavian erratics, are also present in gabions (Italian *Gabbione* – cage), i.e. steel cages filled with the coarse-gravel fraction. They have, besides aesthetic and decorative, also a practical function, e.g. they stabilize slopes, for example in the Żwirowisko Park (former gravel pit, Figure 9). Gabions are also the original fences of private properties (Figure 10). Stone objects are commonly found in the Pruszków cemeteries and in the historic Jewish cemetery (Figure 11). Most of the matzhevas in the Jewish cemetery were made of the so-called Kunów sandstone (Lower Jurassic), exploited in the vicinity of Kunów near Ostrowiec Świętokrzyski (eastern part of the Świętokrzyskie Province). This sandstone has been commonly used as the material for architectural details and sculptures. That is why it is found in many cemeteries in the Mazovia region.



**Figures 8a & 8b.** The windowsills of a toy shop were made of rapakivi granite, the outcrops of which occur on the Åland Islands



**Figure 9.** Gabions in the Żwirowisko Park stabilize the slopes of the former gravel pit and have aesthetic and decorative function



**Figure 10.** Gabions are the original fences of private properties in Pruszków





**Figure 11.** Stone is present in the town, among others, in the historic Jewish cemetery

The outer walls of the building of District Authority Office are covered with the Novabrik elevation brick. It is made of the mixture of natural aggregates: granite, marble and mica (Figure 12). Plasticizers, binders and colorants were added to the mixture to improve the visual and technical characteristics of brick.



**Figure 12.** The outer walls of the building of District Authority Office are covered with the elevation brick made of the mixture of natural aggregates: granite, marble and mica

## DISCUSSION

The stony objects of Pruszków are not present in the awareness of inhabitants. The initial survey conducted among the inhabitants of Pruszków does not arouse optimism. Though stone material has been present in the town for a long time and within reach, few people notice it, let alone exploit its educational or cognitive values. In some cases the aesthetic values of boulders were taken into account so they were set in good locations in order to commemorate an important person or event. Consequently, such boulders play a historical-cultural role. And in all, erratic boulders have potential to promote urban geotourism. Based on them, an educational or even geotourist path could be marked out taking into account the assumptions of the strategy of hands-on activities (Brzezińska-

Wójcik, 2015), which consist in the active and emotional commitment of tourists or pupils, and thus making their education more effective. Therefore, the educational values of erratic boulders should be noticed by the Pruszków teachers who complain about difficult contact with geological exhibits (the closest collection of rocks is in the Geological Museum of the Polish Geological Institute in Warsaw).

Geotourists who will see new attractive objects on the map of Pruszków, will decide to come to the town to get to know their history. It is therefore necessary for the municipal authorities to have (even temporarily) a specialized geo-storyteller (Wolniewicz 2019) or a guide who will impart the necessary knowledge in a professional way. It depends on his/her qualifications whether the persons interested (geotourists) notice the value of the object that affects the overall assessment of the geodiversity of the region. The transfer of knowledge should be accompanied by a leaflet or folder, and preferably a chapter in the monograph/tourist guide to Pruszków or Warsaw surroundings. Publications should be printed in a local printing house and available in the Pruszków bookshops, kiosks, coffee houses, and similar institutions. It is worth adding that the authors of this paper tried to disseminate knowledge among the inhabitants of Pruszków publishing every month a geological column in a local journal and organizing educational walks through the town. Not less interesting are innovative field games, like geocaching (<https://www.geocaching.com/play> access on 11.06.2019) or Tourist and Recreation Orienteering Games (<http://trino.pttk.pl/> in Polish access on 11.06.2019).

Tourists, staying in the town, will make use of the gastronomic offer and will be interested in buying souvenirs. It is in the interest of the municipal authorities to meet the needs of tourists by the development of the appropriate paratourist infrastructure.

The inhabitants will profit from the development of (geo) tourism because it will result in the job creation. Expanding the urban tourist offer is urgent because – according to the results of the research commissioned by the Pruszków Municipal Council (Pruszków Stop, 2007) – as much as 75% of the surveyed inhabitants (from the group of 450 people aged 25-60) do not see the tourist values of their town.

## **CONCLUSION**

The authors hope that the implementation of the above-mentioned ideas will increase the Pruszków inhabitants' knowledge of the geological past of the town's immediate surroundings, of the recent history of the town experiencing a building boom or, finally, of the plans of Pruszków development founded on urban geotourism.

Properly exposed objects of inanimate nature will sustain and strengthen the ties of inhabitants with their town through the environment, culture, aesthetics, and heritage (cf. National Geographic, 2005; Reynard, 2008). Their role in the sustainable development of the district and town cannot be overestimated. They contribute to creating the image of the town, in which the elements of abiotic nature are adapted for tourist purposes, in accordance with the principles of environmental protection.

Finally, it should be noted that local initiatives, increasing awareness among the inhabitants, and the promotion of all the geotourist values will certainly help to draw attention to the need for stronger protection of the inanimate resources of the Earth.

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