Water Management during the Dacian Period in the Orăştie Mountains. Catchment and Storage of Water

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Abstract: The purpose of this article is to offer a general view over the different systems of catchment and storage of water used during the Dacian antiquity in the Orăştie Mountains area, Romania. The methodology will be based on a dichotomous approach, in an effort that tries to compare the hydrological situation (supported by GIS maps) with the known archaeological discoveries relevant for the subject.

Keywords: water, storage, catchment, cisterns, hydrography, GIS, Dacians.

Rezumat: Scopul articolului este de a oferi o imagine generală asupra diferitelor sisteme de captare şi depozitare a apei folosite de dacii care locuiau în antichitate zona munților Orăştiei. Metodologia se va baza pe o abordare în oglindă, anume interpretarea diferitelor descoperiri arheologice relevante în funcție de situația hidrografică specifică (pe baza unor hărți GIS).

Cuvinte-cheie: apă, captare, stocare, cisterne, hidrografie, GIS, daci.

The geographical aspects always intrigued the researchers of the Dacian civilization in the Orăştie Mountains area. The first extensive study regarding this area subsumed a topographical study made by Constantin Daicoviciu,[1] which focused on the localization of all the known archaeological discoveries. Subsequent articles, like the one by Hadrian Daicoviciu,[2] completed the image with new information and verifications of the previous data. But probably the most complete image was realized when another synthesis was published in 1989.[3] Ştefan Ferenczi, an archaeologist known especially for his field work, published as part of the already-mentioned book a thorough study about the geography of the same area.

[1] Constantin Daicoviciu – Alexandru Ferenczi, *Aşezările dacice din Munții Orăştiei* [Dacian Settlements in the Orăştie Mountains], (Bucureşti: Ed. Academiei R.P.R., 1951).

[2] Hadrian Daicoviciu, 'Addenda la "Aşezările dacice din Munții Orăştiei"' [Addenda to "Dacian Settlements in the Orăştie Mountains"], *Acta Musei Napocensis*, 1 (1964): 111–123.

[3] Hadrian Daicoviciu – Ioan Glodariu – Ştefan Ferenczi, *Cetăți şi aşezări dacice în Sud-Vestul Transilvaniei* [Dacian Fortresses and Settlements in South-Western Transylvania], (Bucureşti: Ed. Ştiințifică şi Enciclopedică, 1989).

Such previous efforts will provide the basis for the geographical aspects of my work (besides, of course, distinctive geographical studies). I will try to complete and verify some of the existing information by means of new techniques in archaeology, like the generation of maps through GIS (Geographic Information System) software.

Hydrography

The area of the Orăştie Mountains covers the north-westernmost part of the Parâng Mountains, which is the most extensive mountain group of the Meridional part of the Carpathians (Fig. 1).[4] This group has its highest peaks on its southern side (with the homonymous Parâng Peak), where the mountain ridge is oriented on an east-west axis.[5] The northern part of the Parâng Group has much lower altitudes, and its many ridges are oriented radially (Fig. 2a).[6] Thus, the more accessible northern part of this mountainous region has its hydrographic basin oriented towards the north (with its rivers draining into the Mureş Valley), while the more inaccessible southern part is drained by intra-mountainous rivers oriented east-west (which drain into the Olt and Jiu gorges, which limit this mountainous group as well).[7] As such, the hydrographic basin of the southern part of the central group of the Meridional Carpathians is divided between the Jiu in the west and the Lotru in the east (Fig.1), the watershed between these two basins being a narrow ridge which also provides the alpine passage towards the northern part of this mountain group.

The north-western part of this group, called the Şureanu Mountains, has a principal ridge, oriented towards the south-east, where we find its highest peaks and which provides the passage towards the Parâng Mountains (Fig. 2a). This ridge divides the principal water basins of the Şureanu Mountains, with the Jiu, Strei, Grădişte, Cugir and Sebeş hydrographic basins converging along this ridge (Fig. 2b). The flow direction of these valleys is different, although they all drain into the Mureş (except Jiu, which we already discussed - Fig. 2b). The Cugir and Sebeş Valleys have a straight-forward north direction of flow towards the Mureş (given the fact that they are situated north-east of the central ridge). But the same cannot be said about their western counterparts, the Strei and Grădişte Valleys. These two valleys have a parallel direction of flow, firstly in an east-west direction, only afterwards

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[4] Petre Coteţ, *Geomorfologia României* [Romania's Geomorphology], (Bucureşti: Ed. Tehnică, 1973], p. 222.

[5] Daicoviciu – Glodariu – Ferenczi, *Cetăţi şi aşezări,* p. 19.

[6] Valer Trufaş, *Hidrografia Munţilor Sebeş* [The Hydrography of the Sebeş Mountains]. PhD Dissertation, Manuscript, Cluj-Napoca, 1971, p. 1.

[7] Coteţ, *Geomorfologia,* p. 223.

reassessing towards the north (Fig. 2c). This peculiarity is given by the fact that they need to sidestep the north-western oriented ridges of the Şureanu Mountains. The difference between the Strei and the Grădişte Valleys is that the first one encloses the mountains on their external periphery, while the second one has an intra-mountainous passage, reorienting towards the north only once it exits the mountainous area, circumvallating the Prisaca Peak at Costeşti, the north-westernmost point of the Prisaca sculptural level (Fig. 2c).[8]

The main ridge of the Şureanu Mountains ends in its north-western part with the Godeanu Peak. This peak represents another focal point regarding the water basins of the Şureanu Mountains (Fig. 2b). On its western side we find the first sources of the Grădişte Valley (through Godeanu valley – which delimitates the hill called Piciorul Muncelului – where the remains of *Sarmizegetusa Regia* are located). On its north-western side we find the first sources of the Sibişel Valley (which will drain later into the Grădişte Valley), while on its eastern side we find the first sources of the Cugir Valley. On the southern side we find the Petros Valley, which will drain into the above-mentioned Strei River.

From now on we will focus on the Grădişte Valley, which has its sources right underneath the Godeanu Peak. The Grădişte Valley is delimitated at its sources by the Muncelului Ridge on its northern side, by Godeanu's main ridge on its eastern side and by the Luncani Plateau on its southern side (Fig. 3a). The first sources of the Grădişte Valley (the Godeanu, the Şesului and the Tâmpu Streams – Fig. 3b) created deep valleys which delimitate two specific mountain feet, the Şesului and the Muncelului. The Şesului is oriented east-west, having a higher altitude and a bigger level difference towards the valleys (Fig. 3d). The second one, the Muncelului mountain foot, protracts from the northern Muncelului Ridge towards the south and turns towards the west around its middle point. It is much more elongated, creating a passage way between the Muncelului Peak and the Grădişte Valley (Fig. 3c). It is delimitated by primary streams, such as Valea Albă, Godeanu and Strâmtosu (Fig. 3b), which form underneath the high ridges, in the forested area. On the Muncelului mountain foot a number of primary water sources appear, these being collected by the delimitating streams (Fig. 3b).

Moving towards the exit of the valley from the mountains, at Costeşti we are faced with a different situation. The northern Prisaca Ridge faces towards the south the Târsa Plateau (part of the Luncani Plateau – Fig. 3a). At this north-western extremity of the Târsa Plateau we find two Dacian citadels

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[8] Lucian Drăguţ, *Munţii Şureanu: studiu geomorfologic* [Şureanu Mountains: Geomorphological Study]. PhD Dissertation, Manuscript, Cluj-Napoca, 2003, p. 45.

watching over the Grădişte Valley, being placed near the confluence of the Faerag and the Grădişte Valleys (Costeşti-Cetățuie north of the confluence, Blidaru south of it – Fig. 4a). The hydrographical context for these two citadels is distinct. If Costeşti-Cetățuie is more or less an isolated hill, with sources of water present only at its lower level (Fig. 4a), the case of Blidaru is much different. This citadel is placed on the limits of the Târsa Plateau, on the passageway between the plateau and the Grădişte Valley (Fig. 4a). If on the plateau the water sources are scarce, the situation differs on the limits of the plateau, where, as the maps show, many streams appear. And although the citadel itself is situated on a spur, having no direct water sources, there are plenty around it.

The situation regarding the citadel at Piatra Roşie also differs, as it is located on an isolated hilltop, with no direct water resources available (Fig. 4b).

As such, the hydrographical context of these three specific areas crucially differs. At the Piciorul Muncelului – *Sarmizegetusa Regia* we are facing an area rich in water, located near the sources of the valley (it must be also stressed that the Grădişte Valley has, as opposed to most of the other rivers of the Şureanu Mountains, the main area of water-collection in its upper part of flow).[9] At Costeşti there are still plenty of resources (especially at Blidaru), while at Piatra Roşie the resources are scarce.

Archaeological discoveries

Probably the most important water source attested as used in antiquity is the spring in the sanctuary of *Sarmizegetusa Regia* (Fig. 4c). During archaeological excavations, a terracotta conduit, probably leading to the source of this stream, was uncovered (Fig. 4d).[10] But despite this, the actual information regarding the tapping of this spring, as well as its exact position are scarce. It is mentioned in a later report about the excavations from the year 1980 that the 'elements of the water-tapping system of the spring on the 11th terrace had been uncovered'.[11] In a later publication it is added that this catchment system was mostly destroyed during the nineteenth century excavations and that only two andesite stone blocks with carved gutters were recovered,[12] which are still visible today at the site. The intervention in this

[9] Trufaş, *Hidrografia,* p. 39.

[10] Constantin Daicoviciu *et al*., 'Şantierul arheologic Grădiştea Muncelului Costeşti' [Grădiştea Muncelului Costeşti Archaeological Site], *Materiale şi Cercetări Arheologice*, 6 (1959): 331–358, p. 340.

[11] Daicoviciu – Glodariu – Ferenczi, *Cetăți şi aşezări,* p. 168.

[12] Ioan Glodariu – Adriana Rusu-Pescaru – Eugen Iaroslavschi – Florin Stănescu, *Sarmizegetusa Regia. Capitala Daciei preromane* [Sarmizegetusa Regia. Preroman Dacia's Capital], (Deva: Acta Musei Devensis, 1996), p. 107.

area during the restoration project that took place in 1980–1982 (when a new modern catchment system was constructed) complicated furthermore the possibility of new verifications. As such, we have no information regarding the kind of tapping system used in antiquity for this spring.

A much better documented case of water-catchment is attested in the civilian area of the settlement, in the place called Tău, which to this day consists of a marshy area (Fig. 4c, 4e). Here, a complex water-catchment system was found. The water from two springs was collected and transported through terracotta pipes to a central wooden barrel, and then transported further down (Fig. 5).[13] The two springs were collected differently, the first through a small wooden barrel, while the second through a cavity carved in the local rock, with the lower level walled with fragments of local rock, upon which the upper part of a ceramic vessel was placed, which was then covered by a Roman type tile. Both of the basins were connected to the terracotta pipes through a lead pipe, whose ends were bent in order to be attached to the basins (they had, apparently, sieves attached as well).[14] On the way to the main wooden barrel the terracotta pipes had terracotta vents attached (as well as a wooden vent discovered near the terracotta vent on one of the conduits).[15] Both pipes converged in the central wooden barrel from which a third terracotta pipe emerged and transported the water further down.[16] This pipe had a terracotta vent attached to it as well, and was additionally protected by a wooden gutter.

As such, we have attested a complex water catchment system in a marshy area, and the attention given to water purification is to be expected.[17] The sieves and the vents found on the way to the main central basin have as main function a preliminary purification of the water. In the central barrel the necessary volume of water was collected and purified before redistribution.

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[13] Constantin Daicoviciu *et al.*, 'Studiul traiului dacilor în munții Orăştiei (şantierul arheologic de la Grădiştea Muncelului)' [The Study of the Dacian Living in the Orăştie Mountains (Grădiştea Muncelului Archaeological Site)], *Studii şi Cercetări de Istorie Veche*, 2/1 (1951): 95–127; Constaintin Daicoviciu *et al.*, 'Studiul traiului dacilor în munții Orăştiei (şantierul arheologic de la Grădiştea Muncelului)' [The Study of Dacian Living in the Orăştie Mountains (Grădiştea Muncelului Archaeological Site)], *Studii şi Cercetări de Istorie Veche*, 3 (1952): 281–307; the information from the publications is completed with information gathered from the excavation records and with observations made on the material artefacts kept in the deposits of the National Museum of Transylvania's History.

[14] Daicoviciu *et al.*, 'Studiul traiului' (1952), p. 296.

[15] Ibid., p. 297.

[16] Orjan Wikander (ed.), *Handbook of Ancient Water Technology* (Leiden – Boston – Koln: Brill, 2000), p. 30. It is well attested that in Northern Europe wooden barrels were often reused as water catchment basins or reservoirs.

[17] Ibid., p. 10. The author mentions the fact that swampy areas were used as last resort by the Romans.

The role of the vents along the pipes is ambivalent. They could serve as valves attached to the pipes, in case of overflowing with water. But they had, at the same time, the role of chambers of inspection (given their large diameter), as starting points for the periodical inspection and cleaning of the system. The attention given to the purification of the water suggests human consumption. Other pipe fragments (of different diameters) found next to the intact conduit suggests a number of interventions made upon the system. The Roman type tile covering one of the catchment basins could suggest, as Constantin Daicoviciu assessed since the initial discovery,[18] a later Roman intervention and use of this system of catchment, purification and redistribution of water.

This dual tapping system is well suited for this marshy area. We find at Vitruvius specific instructions about this. He mentions that where one cannot find running water, one should look for underground sources and collect them.[19] Then, when a source of water is found, more should be searched for in the neighbouring area and, through subterranean channels, gathered to a single place.[20]

The effort of constructing such a complex and lengthy system of water catchment, purification and distribution (the conduits heading towards the catchment basins have around 26 m in length each, while the one emerging from the central basin was followed for more than 30 m – Fig. 5) in such a water-resourceful area suggests the high demand of water by the ancient community at *Sarmizegetusa Regia*.

Another archaeological discovery regarding water management at Piciorul Muncelului – *Sarmizegetusa Regia* takes us to the second interest of this article, the storage of water. A cistern had been found inside the fortification (Fig. 6a), on the fourth terrace, having the dimensions of 9.6 × 6.2 m and 1.15 – 1.3 m depth.[21] It was cut into the local bedrock and had a well-conserved wooden floor (which was multilayered, with a clay, wood, clay and gravel layers from up to bottom) and presumably had wooden planking on its walls

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[18] Daicoviciu *et al*., 'Studiul traiului' (1952), p. 296.

[19] '*Earum autem erit facilior, si erunt fontes aperti et fluentes. Sin autem non profluent, quaerenda ubi terra sunt capita et colligenda*'. Vitruvius, *De Architectura*, Liber 8, Caput 1.1. (http://penelope.uchicago.edu/Thayer/L/Roman/Texts/Vitruvius/), accessed on 1 May, 2018.

[20] '*… tum deprimendus est puteus in eo loco et si erit caput aquae inventum, plures ca sunt fodiendi et per specus in unum locum omnes conducendi*'. Vitruvius, *De Architectura*, Liber 8, Caput 1.6. (http://penelope.uchicago.edu/Thayer/L/Roman/Texts/Vitruvius/), accessed on 1 May, 2018.

[21] Gabriela Gheorghiu, 'Cisterne descoperite în zona capitalei regatului dac' [Cisterns Discovered in the Area of the Dacian Kingdom's Capital], *Sargetia,* 27/1 (1997–1998): 177–189, p. 180.

and a roofed structure as well (Fig. 6b).[22] On the western side of the cistern, a channel cut in the wall, tapering from the surface until 0.2 m under the level of the floor, was interpreted as a drainage channel, while on the same side of the cistern a gutter made of local rock probably protected the supply pipe of the cistern.[23]

This cistern had mainly a military role, given its location (underneath the higher plateau on which the Dacian citadel is supposed to have been located), as well as its technique of construction which focuses on watertight measures in order to store water for as long as possible. But there is a problem regarding its source of water. Inside the fortification there is no spring, given the higher level. The only possibilities are either the collection of rain water from the upper plateau nearby, or its transport through a long roundabout, which would have taken the water from the north-western ridge, the only upper level area around where there seems to be a spring (Fig. 6a).[24]

But this is not the only cistern discovered around the Orăştie Mountains area. At Piatra Roşie, the remote calcareous hilltop, during archaeological excavation, a pit carved in the rock of the highest plateau was found (having around 2 m in diameter – Fig. 6c).[25] It is placed inside the main precinct of the fortress, and when it was dug, it still preserved water and, on its bottom, archaeological remains were found. It was probably used for collecting rain water. Another big pit, this time natural, is to be found inside the bigger precinct of the fortress (Fig. 6c).[26] Although it is natural, and the discussions regarding it focused more on the interesting archaeological material found inside, I see no reason why one should not consider a possible utilization of this pit as a storage basin. Last but not least, a series of information from the nineteenth century and the local oral tradition suggests the presence of a water pipe on the ridge that connects the hilltop with the rest of the area.[27] If this is the case, probably this pipe would have supplied a cistern at the base of the hilltop, most probably near the tower that overlooks the pathway towards the fortress.

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[22] Gabriela Gheorghiu, 'Cisterna dacică de la Grădiştea de Munte' [The Dacian Cistern from Grădiştea de Munte], *Acta Musei Napocensis*, 33/1 (1996): 375–386, p. 376.

[23] Ibid., p. 375.

[24] Eugen Iaroslavschi, 'Conduits et citernes d'eau chez le daces des Monts d'Orăştie' [Water pipes and cisterns of the Dacians in the Orăştie Mountains], *Acta Musei Napocensis,* 32/1 (1995): 135-143, p. 140. The author mentions as well the possible collection of rain water from the upper plateau or the usage of ground water, unfortunately without developing the latter possibility.

[25] Constantin Daicoviciu, *Cetatea dacică de la Piatra Roşie. Monografie arheologică* [The Dacian Fortress at Piatra Roşie. Archaeological Monography] (Bucureşti: Ed. Academiei R.P.R., 1954), p. 55.

[26] Ibid., p. 66.

[27] Ibid., p. 33.

Returning to the Grădişte Valley, we find the defensive system comprised of the two citadels at Costeşti-Cetățuie and Costeşti-Blidaru, as well as a number of towers, which are overlooking the entrance in the mountainous valley.

The earlier citadel at Costeşti-Cetățuie is situated, as we have already mentioned, on a more or less isolated hill, with sources of water appearing at its lower levels (Fig. 4a). Here, during archaeological excavations, two cisterns were discovered. The first and more important one is situated underneath the highest plateau, inside the main rampart of the fortress, near the tower no. 4 (Fig 7a.). It is mentioned that this cistern had wooden planking.[28] The lower level on which this cistern was placed compared to the higher plateau (where smaller pits carved in the local rock were found – probably with the purpose of collecting rain water)[29] could suggest that its supply was determined by a particular source that appeared underneath the highest plateau. Given the level curves that appear on the plan, a stream seems to drain from the area around the cistern. Of course, the cistern could be supplied by rain water as well (or both), although further verifications could prove useful.

The second cistern, placed on the outskirts of the hill, on a lower level, near the tower no. 4,[30] was supplied, most probably, by one of the many springs that are available at this level.

A more impressive situation regarding water management is to be found at and around the Costeşti-Blidaru fortress. Close to the fortress, on the north-western side (Fig. 7b), a cistern was uncovered (with the dimensions of 8 × 6.2 m, 4 m depth),[31] bearing another technique of construction, in the sense that it was built in stone (Fig. 7c), with multiple layers of mortar and other waterproof materials (Fig. 7d), having a stone arch as well (Fig. 7e), considered to be built by either a Greek[32] or a Roman[33] engineer. I will not focus on the details regarding the building technique of this cistern, as it is not the primary aim of this article. Given its character and proximity to the fortress, this cistern had unquestionably a military function (an aspect that has been already assessed before).[34] Its placement underneath the higher plateau of the fortress suggests that it was supplied by a nearby spring, thus the placement of this cistern is, once again, determined by the location of the first accessible water

[28] Gheorghiu, 'Cisterne', p.178.
[29] Ibid., p. 178.
[30] Ibid., p. 178.
[31] Daicoviciu et al., 'Şantierul arheologic Grădiştea Muncelului' [Grădiştea Muncelului Archaeological Site], *Studii şi Cercetări de Istorie Veche,* 5/1–2 (1954): 123–155, p. 141.
[32] Ibid., p. 142.
[33] Ioan Glodariu, *Arhitectura dacilor. Civilă şi militară (sec. II î.e.n. – I e.n.)* [Dacian Architecture. Civilian and Military (2nd century BC – 1st century AD)] (Cluj-Napoca: Dacia, 1983), p. 38.
[34] Ibid., p. 39.

source. As Ioan Glodariu rightly pointed out, probably the spring used was the one that appears underneath the ridge that connects the fortress to the rest of the hill, and the water was transported through a terracotta pipe along the western side of the plateau.[35] The discovery of the remains of a terracotta pipe on the western side of the cistern seems to suggest the same.[36]

The Blidaru fortress is placed on the hill slope that provides the passage from the Târsa Plateau to the Grădişte Valley. Besides the fortress, on this hill slope (and along the attested ancient road), a number of towers were uncovered, forming a complex system of defense (Fig. 7b).[37] Around these towers new data regarding water management were identified. A terracotta pipe was found on the ridge that goes to Faeragului Plateau, in the place called Curmătura Faeragului, which probably supplied with water the towers on the plateau (Fig. 7b, Fig. 8a).[38] More recently, a pit identified underneath the plateau may suggest the presence of a cistern that could receive this water (Fig. 8b).[39]

Another discovery was made on the Pârâul Chişetoarei, about 80-100 m uphill from the Grădişte Valley (Fig. 7b).[40] Here, a well conserved cistern made of wood was uncovered. The wooden structure had an almost square form of 2.95 × 3.05 m and over 3 m depth, with the sessile planks that formed the walls having 10 cm thickness and around 30-42 cm width (Fig. 8c).[41] The planks were attached onto corner posts that were provided with gutters for receiving the planks and were stuck 40-50 cm in the rock beneath the cistern floor.[42] The walls were reinforced with two posts on the exterior of each wall (that followed the entire height of the walls) and two on the interior of each wall (that had different sizes though, on the north and south 1.04 m height and 0.24 m width, on the western and eastern walls 1.44 m height, 0.44 m width). These interior posts supported the lower part of the walls, as well as a set of four beams (two longitudinal and two transversal) that supported in turn the walls, being fixed to the exterior posts (Fig. 8c).[43] On the bottom of the

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[35] Ibid., p. 39.
[36] C. Daicoviciu *et al*., 'Şantierul arheologic Grădiştea Muncelului' (1954), p. 141.
[37] Adriana Pescaru - Gelu Florea - Răzvan Mateescu - Paul Pupeză - Cătălin Cristescu - Cristina Bodo - Eugen Pescaru, 'The Dacian Fortress from Costeşti-Blidaru – Recent Archaeological Research.The Towers from La Vămi, Poiana lui Mihu, Platoul Faeragului (I)', *Journal of Ancient History and Archaeology*, 1 (2014): 1-28, p. 10.
[38] Daicoviciu – Ferenczi, *Aşezările dacice,* p. 24.
[39] Adriana Pescaru- Gelu Florea - Răzvan Mateescu - Paul Pupeză - Cătălin Cristescu - Cristina Bodo - Eugen Pescaru, 'The Dacian Fortress', p. 5.
[40] Daicoviciu – Ferenczi, *Aşezările dacice,* p. 24.
[41] Gheorghiu, 'Cisterne', p. 179.
[42] Ibid., p. 179.
[43] Ibid., p. 180.

cistern only a layer of fine bluish muddy clay was found,[44] that was probably a result of the action of the humidity upon the local rock.[45] Although Gabriela Gheorghiu supposes the existence of a wooden floor which had been destroyed by the action of the water,[46] I tend to disagree with this opinion, as the whole wooden structure had been preserved so well without presenting any traces of extra watertight measures. The cistern had an opening in the wooden wall on the western side and a stone block was found underneath the opening at about 1 m depth from the top of the wooden structure.[47] Between the wooden structure of the cistern and the walls of the carved pit there was a space of about 25 cm left, which was filled with local stone fragments (Fig. 8d).[48] Remains of wooden shingles were found inside the cistern, proving that it was a roofed structure.[49] In the immediate vicinity of the cistern one terracotta tube was found, suggesting that the cistern was supplied by a nearby spring. The cistern was located on the left side of the Chişătoarei Stream, on a small terrace.[50] This stream eroded the terrace, uncovering the cistern and drawing the attention of the archaeologists.[51] Most probably the cistern was supplied by this very stream, the water being diverted with the help of the pipe. The chosen location, aside the streams flowing through, provided better access to the cistern and a more stable ground given the declivity of the terrain (this concern is evidenced by the strengthening efforts visible in the building technique as well).

Although this cistern most probably supplied the needs of the towers nearby, its character reveals, I think, a different aspect regarding the management of water in this area in the Late Iron Age. The cisterns found on the upper plateaus of the fortresses or right underneath them (with different character though – from rudimentary pits carved in the rock on the plateaus, used only for rain water collection, to complex cisterns supplied by spring water located on the terraces underneath the upper plateaus – with the best examples from Costeşti-Blidaru and *Sarmizegetusa Regia)* had as main focus water preservation for a military purpose (with the efforts visible in the watertight measures applied to them). But the case of the latter cistern at Muchia Chişetoarei is quite different. It is placed on a lower level, where perennial springs are plentiful. With such a context, there is no need for

[44] Ibid., p. 180.
[45] Daicoviciu – Ferenczi, *Aşezările dacice,* p. 25.
[46] Gheorghiu, 'Cisterne', p. 180.
[47] Ibid., p. 180.
[48] Ibid., p. 179.
[49] Daicoviciu – Ferenczi, *Aşezările dacice,* pp. 25–26.
[50] Ibid., p. 24.
[51] Ibid.

building a costly watertight cistern. Simpler, more traditional approaches are far more effective, in the sense that the construction of a sufficiently big reservoir in which the water from the spring can be effectively used is far more appropriate when the resources are this rich. Besides, the construction technique (based on a wooden structure surrounded by a rock layer), which avoids watertight measures, gives this cistern a purification function as well (it is more similar in this way to the function of the wooden barrel at Tău). Although I believe that this cistern serves mainly a military purpose of use, I suppose at the same time that it is an example of the more usual water tapping method employed in this mountainous area, that is still employed to this day (Fig. 8e), as I fortunately stumbled upon a more modest modern example located on one of the valleys of these mountains (it was placed on the first terrace above the valley). These kinds of cisterns probably fulfilled the role of "wells" and were used for tapping the clean water of the mountain springs from the hill slopes, as typical wells with a deep shaft are not needed and hard to obtain given the superficial level of the local rock. The Greek term *φρέαρ* (frear) means artificial well and is used for both wells and cisterns,[52] although the technical differences in the Greek world were quite clear (while the cisterns were mainly used for surface water tapping, the wells were used for ground water tapping).[53] But probably a more appropriate Greek term for the structure at Muchia Chişetoarei is the *κρήνη* (krene) – a fountain house, which usually consisted in a roofed structure where the water from a nearby spring was tapped in a basin from which it was accessible for use, either directly from the basin or through a waterspout [54] – later these structures were moved towards the central parts of the cities, with aqueducts supplying them.[55] A couple of archaeological observations suggest a similar interpretation – such as the location, the roofed structure, the presence of a pipe and the upper wooden enclosure, as well as by the opening and stone block on the western side – which served as an entrance. As such, the structure at Muchia Chişetoarei could be associated in some aspects with the archaic Greek "fountain house", although other aspects tend to suggest a local tradition more appropriate for the climate and resources of this mountainous area. Even so, I would not argue against the use of the term "cistern" for this construction, as it is already well-known as such in the archaeological literature, although the non-watertight

[52] Greek Dictionary Headword. Caput φρέαρ. (http://www.perseus.tufts.edu/hopper/resolveform?type=start&lookup=frear&lang=greek),
accessed on 9 May, 2018.
[53] Wikander, *Handbook,* pp. 21 – 29.
[54] Ibid., pp. 105 – 110.
[55] Ibid., p. 25.

characteristic of this cistern should be kept in mind. The disproportionate number of watertight type cisterns discovered in the area compared to the non-watertight singular example is probably due to the disproportionate level of research which focused more on the fortresses, while the latter type of cistern seems to be located more remotely.

In conclusion, the situation regarding water catchment and storage in the Orăştie Mountains seems to be modelled after the specific necessities and geographical layouts. As such, we have attested three manners in which water was tapped and deposited. The first belongs only to the military sphere, focusing on collecting rain water (in simpler carved cisterns) and nearby springs (in watertight cisterns placed on the outskirts of the fortresses). The second belongs both to the military and civilian spheres, and uses the rich mountain springs by means of non-watertight cisterns. The third one, found only at Tău – *Sarmizegetusa Regia*, taps the water from an indirect source, by means of intense purification, suggesting the high needs of the community that occupied that water-resourceful area.

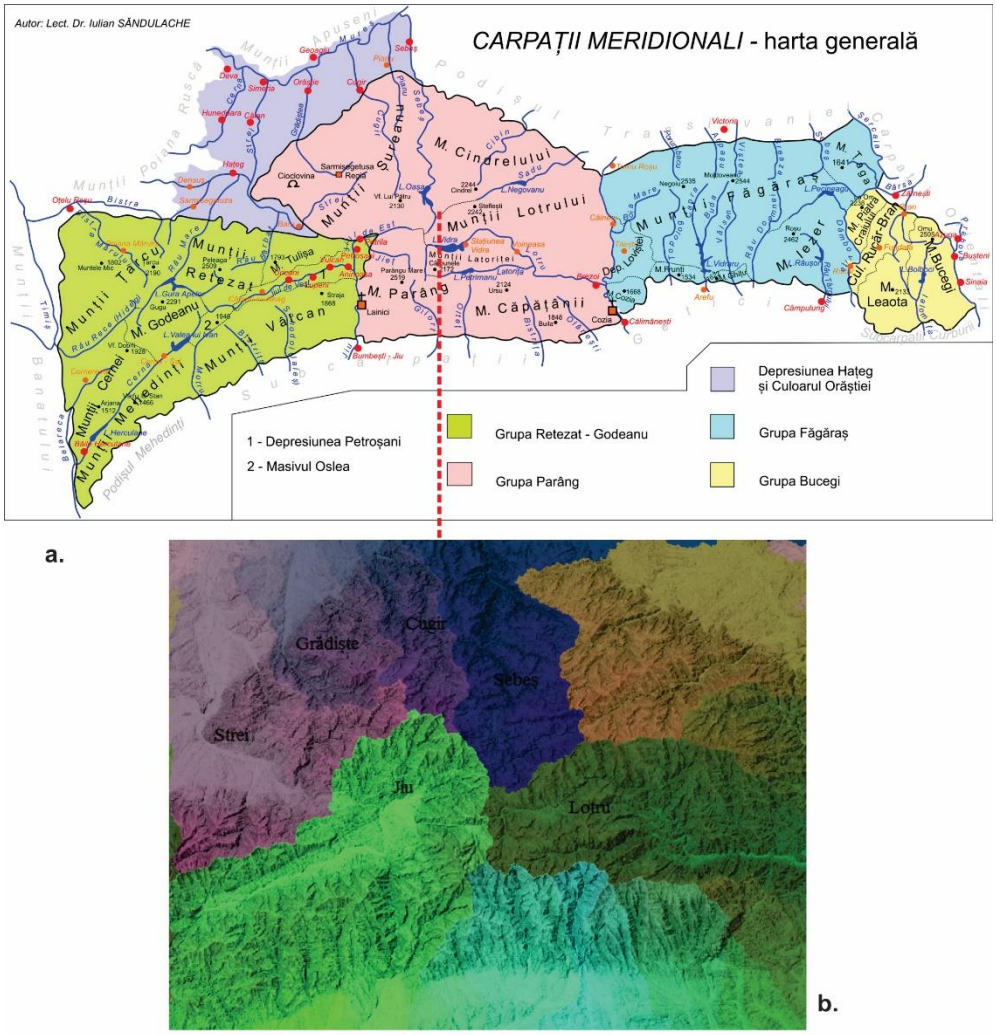
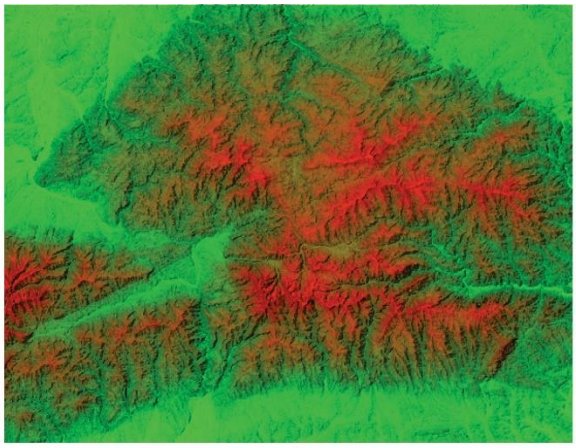
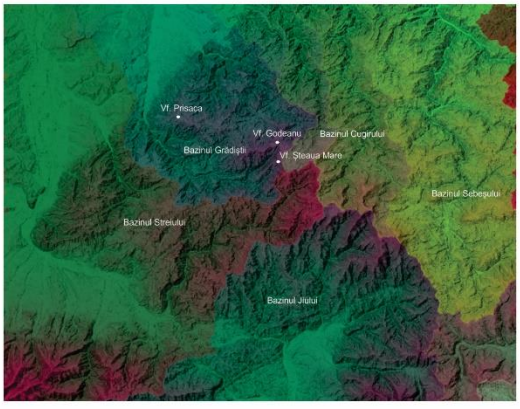


Fig. 1.a. Main groups of the Meridional Carpathians, after http://www.unibuc.ro/prof/sandulache_m_i/img/Carp.Meridionali_jpeg.jpg., accessed on 6.6.2015.

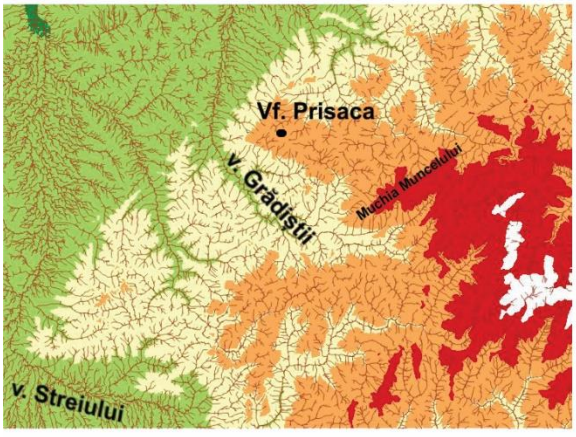
1.b. Main hydrographic basins of the Parâng mountains.



a. Altitudinal representation of the Parâng mountains.



b. Water basins of the north-western part of the Parâng mountains.



c. Altitudinal representation of the north-western part of the Șureanu mountains.

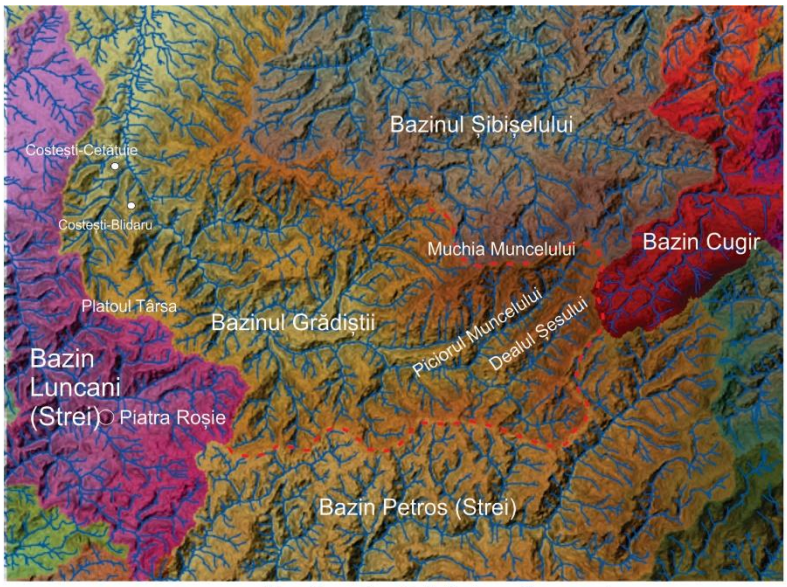


Fig. 3a. The Grădiște valley and its neighboring hydrographic basins.

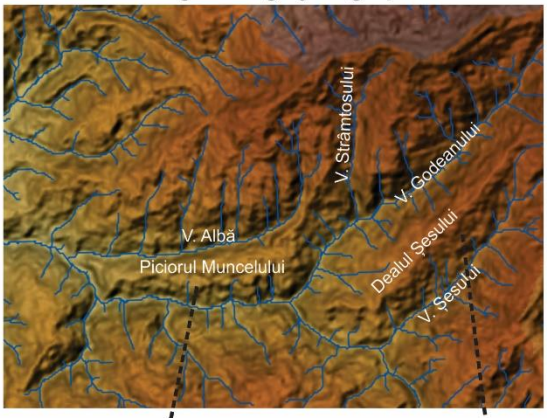


Fig. 3b. Detail with the primary sources of the Grădiște valley.

Fig. 3c. Elevation profile of the Piciorul Muncelului mountain foot, after Google Earth, accesed on 01.12.2017.

Fig. 3d. Elevation profile of the Șesului mountain foot, after Google Earth, accesed on 01.12.2017.

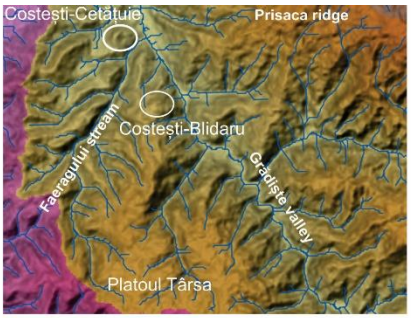


Fig. 4a. The hydrography around the entrance on the Grădiște valley.

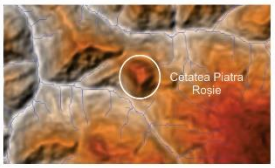


Fig. 4b. The hydropraphy around Piatra Roșie fortress

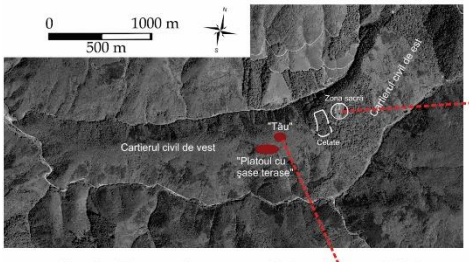


Fig. 4c. The settlement on Piciorul Muncelului, modified after R. Mateescu, 2012,Fig. 4.

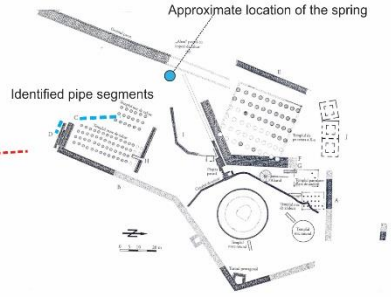
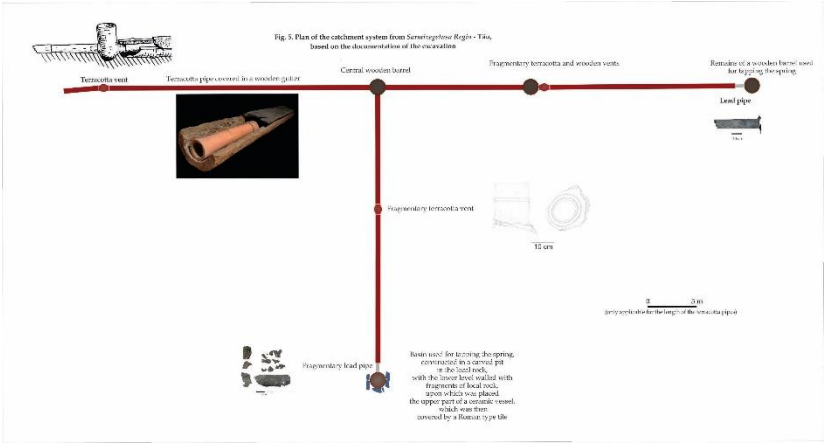


Fig. 4d. Plan of the sanctuary, modified after R. Mateescu, 2012, Fig. 31.

Fig. 4e. Photo of the Tău area by D.M. Teodorescu in 1921 (from of the archaeological sites archives).



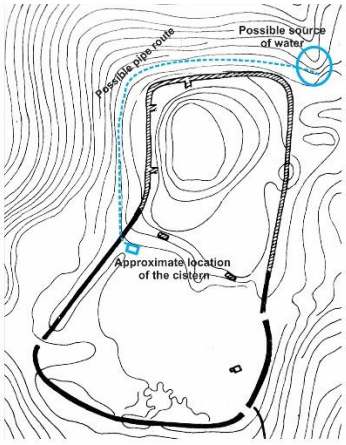


Fig. 6a. Plan of the fortification at *Sarmizegetusa Regia*, modified after I. Glodariu, 1996, Fig. 24.

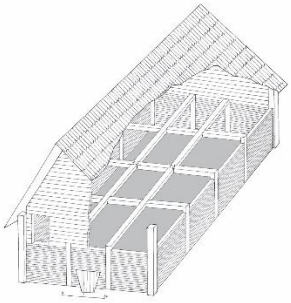


Fig. 6b. Reconstrucion proposal of the cistern, after G. Gheorghiu, 1996, Fig. IV.

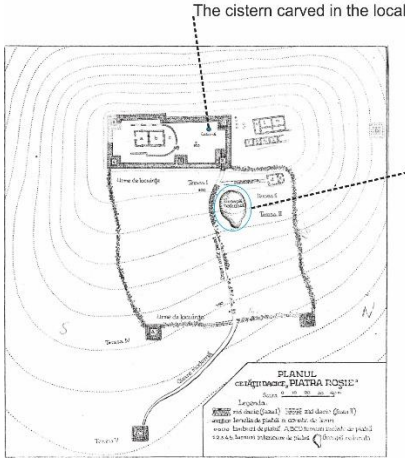


Fig. 6c. The plan of the Piatra Roșie fortress, modified after C.Daicoviciu, 1954, Pl.II.

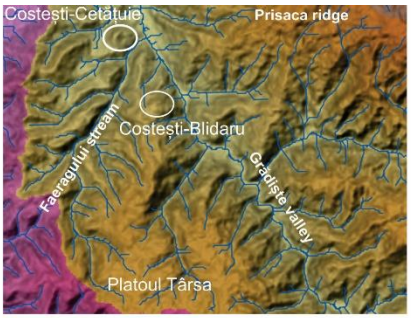


Fig. 4a. The hydrography around the entrance on the Grădiște valley.

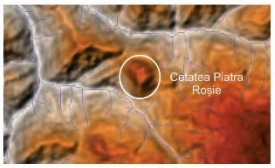


Fig. 4b. The hydropraphy around Piatra Roșie fortress

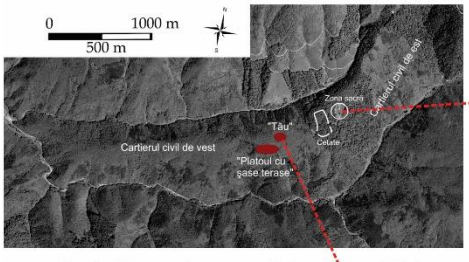


Fig. 4c. The settlement on Piciorul Muncelului, modified after R. Mateescu, 2012,Fig. 4.

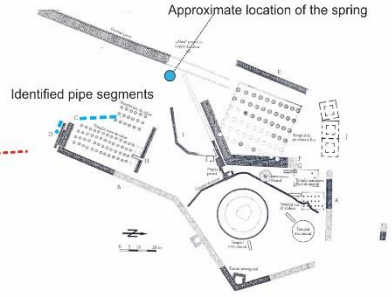


Fig. 4d. Plan of the sanctuary, modified after R. Mateescu, 2012, Fig. 31.

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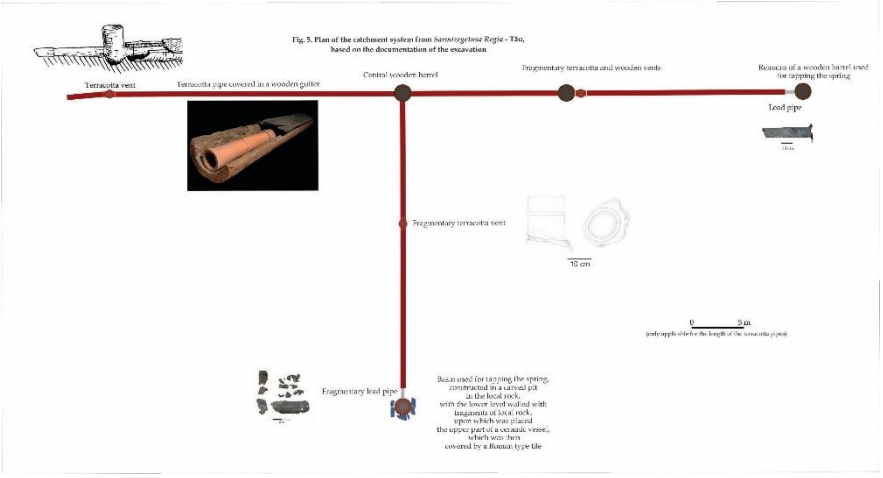

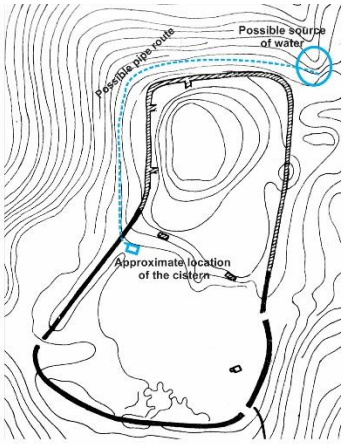

Fig. 6a. Plan of the fortification at *Sarmizegetusa Regia*, modified after I. Glodariu, 1996, Fig. 24.

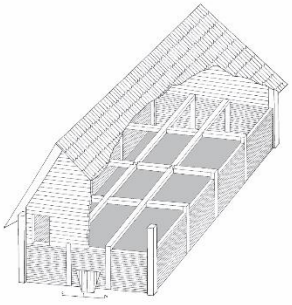

Fig. 6b. Reconstrucion proposal of the cistern, after G. Gheorghiu, 1996, Fig. IV.

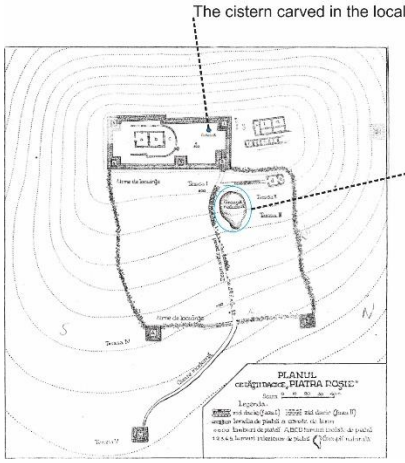

Fig. 6c. The plan of the Piatra Roşie fortress, modified after C.Daicoviciu, 1954, Pl.II.

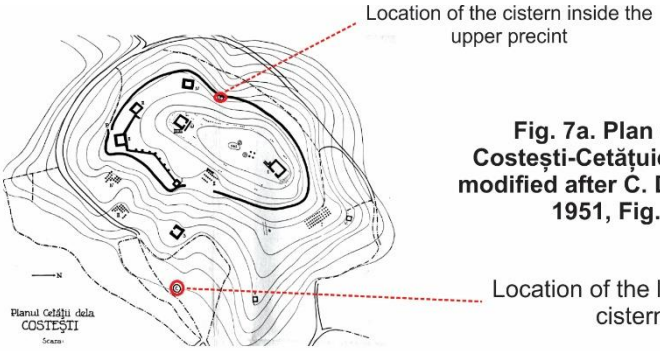

Fig. 7a. Plan of the Costeşti-Cetăţuie fortress, modified after C. Daicoviciu, 1951, Fig. 5.

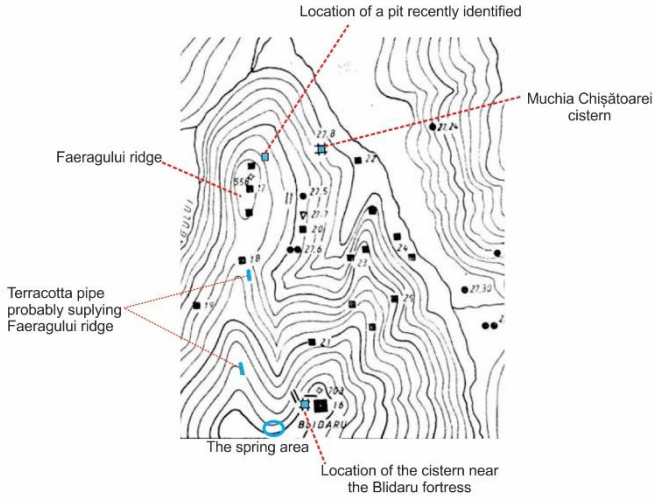

Fig.7b. The area around Blidaru fortress, modified after H. Daicoviciu, 1989, Fig. 40.

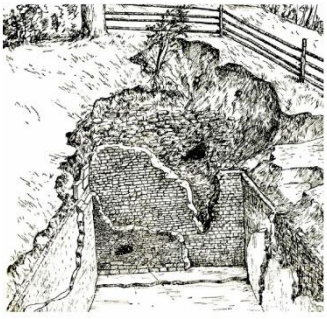

Fig. 7c. Drawing of the cistern, after C. Daicoviciu, 1954, Fig. 16.

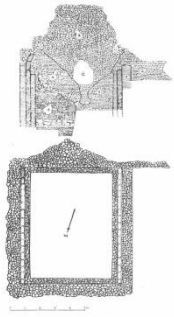

Fig. 7d.Wall profiles of the cistern at Blidaru, after C. Daicoviciu, 1954, Fig. 18, Fig. 19.

Fig. 7e. Photo of the walls and the blocks that remained from the arch of the cistern at Blidaru (from the archaeological sites archives).

Fig. 8a. The terracotta pipe near Curmătura Faeragului, after Pescaru et al., 2014, Fig. 4/1.

Fig 8b. Pit identified under the Faeragului ridge, after Pescaru et al., 2014, Fig. 4/1.

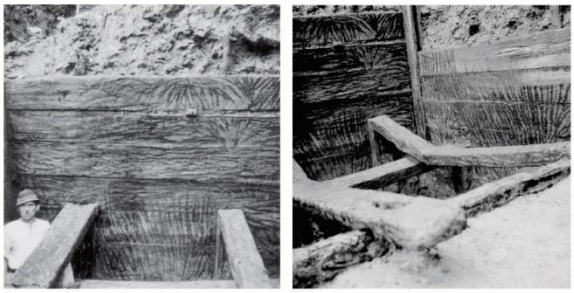

Fig. 8c. The cistern at Muchia Chișătoarei, after Pescaru et al., 2014, Fig. 3/1.

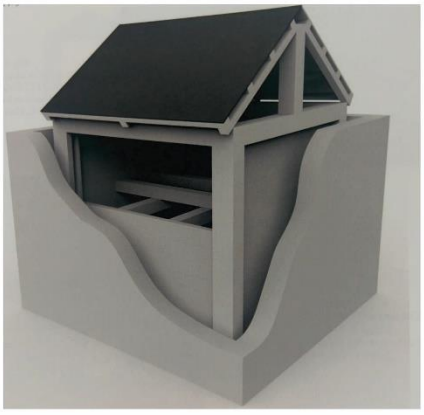

Fig. 8d. Virtual proposal of reconstruction of the cistern at Muchia Chișătoarei, after Neamțu et al., 2015, Ch. X, Fig. 4.

Fig. 8e. Modern cistern found on a nearby valley, personal photo.