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Italian Cadastre of Artificial Cavities

Part 1

(Including introductory comments and a classification)

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mountain slope («having at its foot»), towards the Lecco del Lario branch (Lake Como), however the «there is constant ice and wind» does not appear to be consistent as its position is simply concealed, "in the shade". In any event, climatologic studies relative to the period in which Leonardo visited or passed through the area, would have to be conducted. On the other hand, the «cave» could refer to the following: this being a karst and inaccessible area, there are surely numerous, unknown caves. The only part indicative of the path, «with 200 descending steps», is the set of steps, in particular the latter, of which approximately 100 steps survive. Taking into account the missing sections, the descending stairway would have had at least 150 steps or thereabouts. It should however be noted that no mention of mining activity is made. It could be assumed that mining had ceased some time before or that Leonardo did not actually see the cave and that it was simply described to him. We do not believe, had he visited Ferrera, that he would not have been struck at least by its vastness. While taking into consideration the various exceptions, we can reasonably assume that the Ferrera Cave is the cavity mentioned, but that information on its existence was provided to Leonardo by third parties.

Bibliography: Cappa G., Cigna A., De Michele E., Parea G. C., *Ricerche sugli aspetti del fenomeno carsico profondo nel Gruppo delle Grigne (Lombardia). IV. La caverna Ferrera di Mandello 1502 Lo*, in Museo Civico di Storia Naturale, *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano*, vol. CI, Milano 1962, pgs. 20-42.

Buzio A., Casini A., Padovan G., *Attività estrattive nelle Grigne. Alcune note riguardo la Grotta del Pallone e la Grotta Ferrera,* in G. Padovan and I. Riera (edited by), *Atti XV Congresso di Speleologia Lombarda. Sant'Omobono Imagna Terme (2-3 Ottobre 1999)*, Volume 3 - Speleologia in Cavità Artificiali, Milano 2000, pgs. 141-162.

Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.

Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3 - *Piedmont*

References to various defence works in the area now known as Piedmont date to as far back at the X century (fig. III.5). Some works survive, having undergone significant transformation. Others were built over the years to meet the changing needs of the towns in respect of defence, territory control and blockades for possible invasion directives from adjacent areas. Defensive works continued to be built until the mid XX century.

Fig. III. 5. *Geographic framework: Piedmont Region.*

Fort San Vittorio in Tortona (Alessandria) and Fort Demonte in Valle Stura (Cuneo). Between 1714 and 1770, the Savoia ordered that strategic barriers be developed for their properties in north-western Italy. This was because the previous network of fortresses erected by the Dukes of Savoia from the XVI to the XVII centuries had suffered extensive damage during the wartime operations of the Spanish Succession. The acquisition of new territories thus imposed the construction of modern fortification works. Thus, new building plants for the erection of strongholds to block the old Piedmont invasion roads were opened.

Each stronghold was functionally placed within the territory of the Kingdom. Each was positioned in such a way as to receive rapid assistance if threatened by enemy armies and to act as a logistics base in the event of offensive action. The large calibre battery cannons and the imposing walls followed in the footsteps of blockade fortifications as a deterrent to Piedmont invasion. The Brunetta di Susa, Exilles and Demonte Forts, the Fenestrelle Forts, the Citadels of Alessandria and Turin and the Fort of San Vittorio in Tortona allowed the Savoia army to hold their positions on the western alpine front and on the south-eastern front. However, during the so-called War in the Alps, the lack of blockade works in the south-western sector allowed French armies to outflank the defensive works in April 1796 and to thus defeat the King of Sardinia in the field of battle. The victorious French carried out the demilitarisation of the Strongholds which had prevented the Italian peninsula from coming under attack. Thus, the

defensive Piedmont enceinte was destroyed between 1796 and 1801, by mine and pickaxe. For a number of reasons, the only works to survive were Fenestrelle Fort and the Citadels of Alessandria and Turin (Vigilino Davico 1989).

One of the military engineers who was to confront the new wartime realities and adapt Piedmont strongholds was Lorenzo Bernardino Pinto, Count of Bari (Bianzè 1704 - Turin 1789). Among other things, he dealt with the restoration of Fort San Vittorio in Tortona and Fort Demonte in Valle Stura.

The construction of Fort San Vittorio began in 1774 on the hill above Tortona (fig. III.6). the building was built on a previous fortification with mediaeval layout. The western crownworks were retained and restructured accordingly. The rear Hornwork parapet is raised and defiles Fort San Vittorio's western front. Of an irregular rectangular shape, it has angle ramparts, ditches and counterscarp works. Despite its small dimensions, the Fort is well-structured and its batteries are positioned on multiple levels. Occupied by French troops following the War in the Alps, it was besieged by Austro-Russian troops in 1799 (Comoli Mandracci, Marotta 1995). It was demolished a few years later. The current park layout to some extent preserves structures covered by soil and debris, to be restored at a later date.

Fort Demonte once blocked Valle Stura and was built on the site of the old Consolata Fort, following its attempted demolition on the part of French troops in 1744 (fig. III.7). In 1754 the construction plants, utilised for more than ten years, were supervised by Bernardino Pinto. The fort was built on multiple storeys so the enemy could be attacked with plunging fire. It was disarmed and mined following Napoleonic invasion. Erroneously regarded as a simple pile of ruins, the fort's core remained intact, carved as it was, directly into the rock. In fact, only the masonry structures were almost completely demolished and the Fort was at any rate, recoverable as a historic monument.

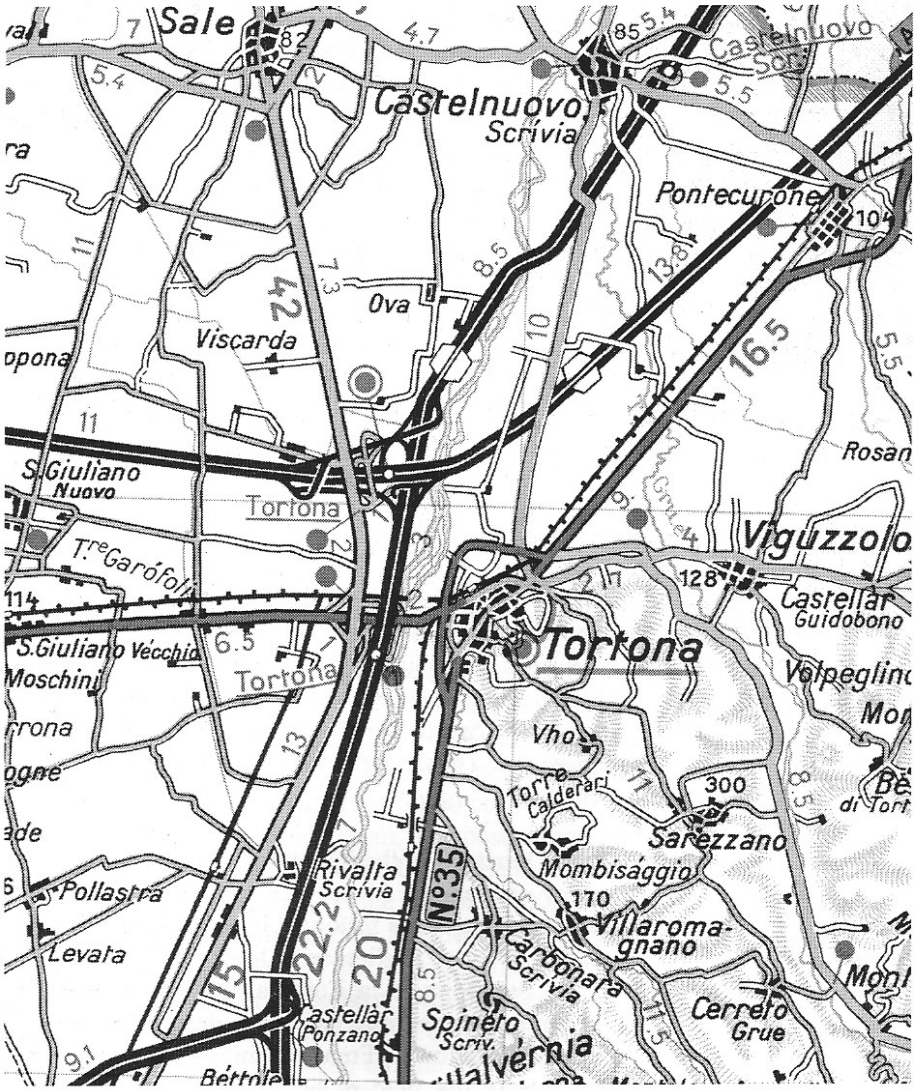


Fig. III. 6. *Geographic framework: Tortona and Fort San Vittorio (Touring Club Italiano 2002 a, table 22).*

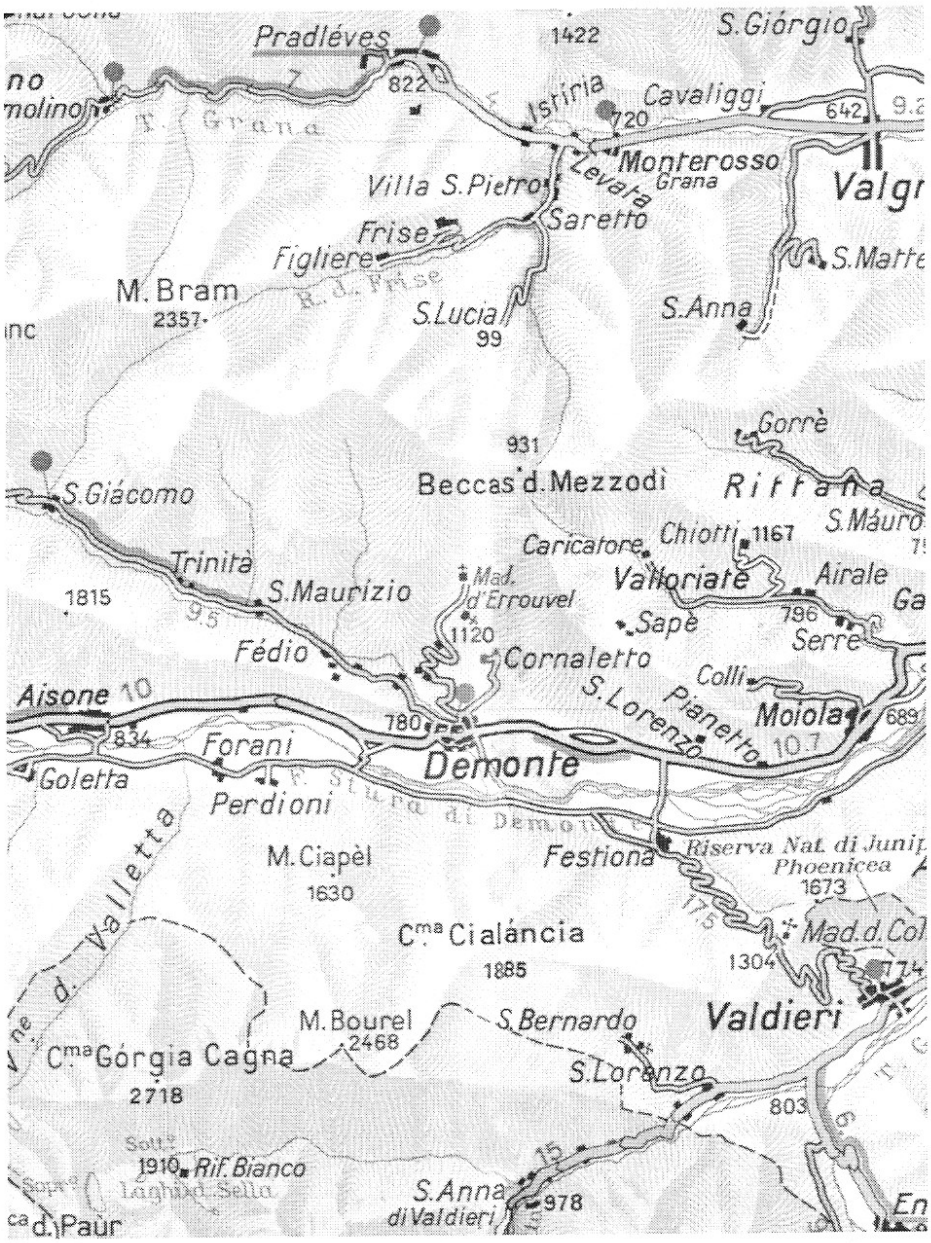


Fig. III.7. *Geographic framework: Valle Stura and Fort Demonte (Touring Club Italiano 2002 a, table 27).*

Verrua Fort (Turin). Built on a hill to the northwest of the River Po, only the heart of the Fort, consisting of the Donjon, the "bomb-proof" Barracks and a few bastioned sections, still survives (fig. III.8). The first reference to the "Verruca" settlement appears in a diploma issued in 999 by Emperor Otto III in favour of Leo, Bishop of Vercelli (Bazzi 1907, pg. 6. Signorelli A., Signorelli B. 2000, pg. 174). In 1159, Emperor Frederic Barbarossa orders that the Verrua defence works be improved and during his reign these are repaired and extended. At the end of the XVII century, the structure of Verrua Fort is that of a triple bastion fortification protecting the only flank not protected by rock. It communicates with the fortified settlement of Crescentino, situated on the opposite bank of the river, by means of boats and terrepleine works. On the opposite side, in a south-south-westerly direction, two defensive lines branch out from the fort forming a trenched field, which communicates with the Fort Royal on the nearby Carbignano hill. The sieges which would make the fort famous throughout Europe take place in 1625, against Spanish troops and in 1704-1705 against French troops. Following the second siege, the Fort was partly destroyed and only its central core remained functional. In 1955, the hill and therefore the ruins were purchased by "Cementi Victoria S.p.A." and a quarry was opened. The Fort was thus partially eliminated, with no intervention for the conservation of the structure on the part of competent authorities. With the approval of the Municipality of Verrua Savoia, Milan's Speleological Association of Artificial Cavities (Associazione Speleologia Cavità Artificiali Milano – S.C.A.M.) registered and studied the fort's underground and surface structures.

Fig. III.8. *Geographic framework: Fort Verrua (Touring Club Italiano 2002 a, table 10).*

Pavarolo Castle (Turin). Pavarolo territory is in north-western Monferrato, on the left bank of Rio Morto (fig. III.9). The fortification works which still occupy the hilltop date back to the XVIII century restoration of the XIV century castle. The castle consisted of a curtain wall protecting the keep and the residence of the yet to be identified Castle Lord. The remains of the curtain can be seen under the last road curve just before the top of the hill. Registration of the artificial cavities was possible thanks to the support of the castle's current owners, the Zavattaro Ardizzi Family.

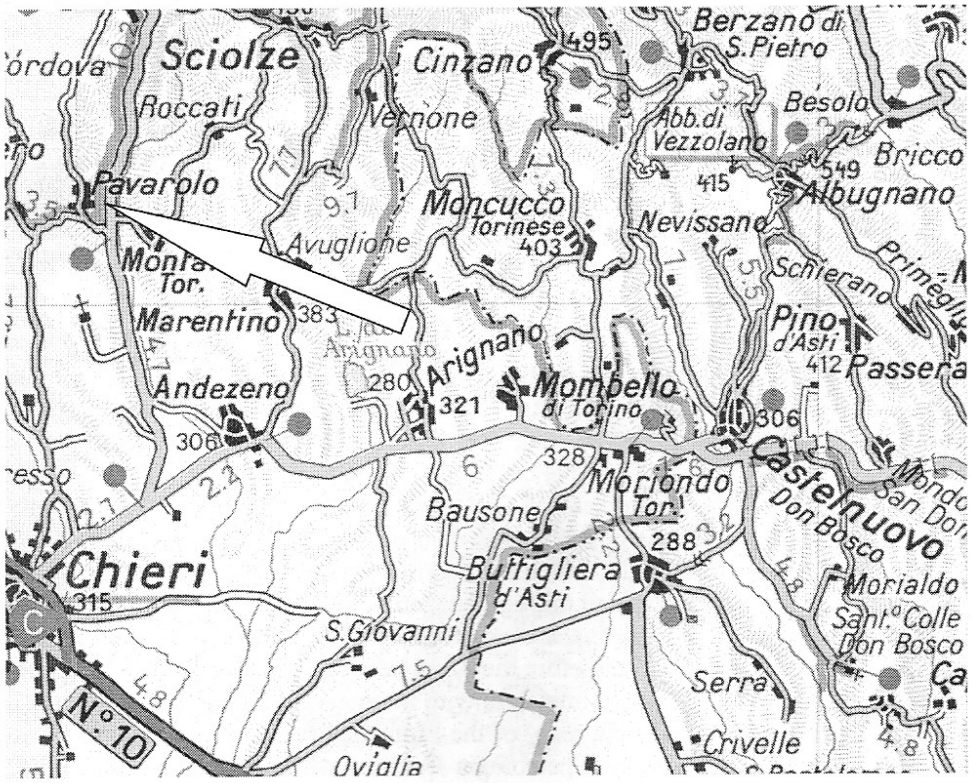
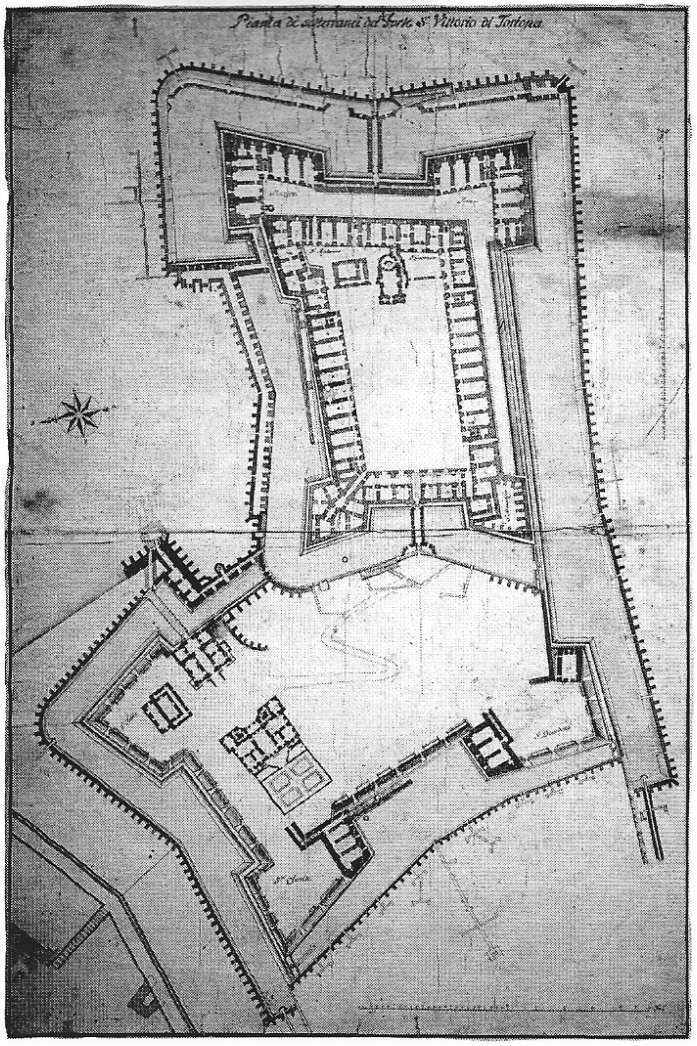


Fig. III.9. *Inquadramento geografico: Castello di Pavarolo (Touring Club Italiano 2002 a, table 22).*

III.3.1 - *CA 00001 PI AL; "Barbarossa Tomb"; Countermine Tunnel in the Counterscarp Ditch of Gate San Vittorio*

Cadastral number: CA 00001 PI AL
Denomination: "Barbarossa Tomb"; Countermine Tunnel in the Counterscarp Ditch of Gate San Vittorio (figs. III.10. a, III.10.b, III.11 and III.11.a)
Region-country: Piedmont, Italy
Province: Alessandria
Municipality: Tortona
Locality: Colle di Tortona, Fort San Vittorio
Location: Fort San Vittorio ditch
Ownership: Municipality of Tortona
Cartography: //
Geological unit: the municipality of Tortona in the province of Alessandria is situated along the central basin of the River Po, between the right bank of the Scrivia and the foothills of the Ligurian Apennines. The relief towering over the city, upon which Fort San Vittorio stands, is the Mombisaggio Formation consisting of yellow sandstones and calcarenites through to the lower, coarser sandstones with sandy Miocene marl intercalation (Serravalliano - Langhiano). From a tectonic point of view, the "Sperone di Tortona" (Tortona Spur) consists of two anticlinal structures, one passing through Berzano di Tortona and the other through Cerreto Grue, at the centre of the "Calcari di Zebedassi" (Zebedassi Limestones) emerge. These are separated by a synclinal structure essentially consisting of Monte Piano Marls, Ranzano Sandstones and Antognola Marls with axial depression, highlighting the Mombisaggio Formation
Altitude: //
Position: //
Context: Fort San Vittorio
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: presence of organic and inorganic waste in the first section and structural collapse in the final section
Typology: 6 - countermine or demolition tunnel
Description: the entrance to an underground work is visible for the counterscarp ditch protecting Gate San Vittorio. Known locally by the name of "Barbarossa Tomb", the work is currently located just above the bottom of the ditch and is partially filled due to the demolition of the defensive structure. The counterscarp masonry lining is almost completely missing therefore it has not been possible to ascertain whether or not it was excavated through a wall. The entrance was equipped with a masonry structure which served as a metal gate. This was removed, most probably when the area was transformed into a park. The underground system is carved in sandstone and its exposed roof and walls present visible signs left by early tools. Unfortunately the first section is full of debris and waste material, while the final section shows signs of structural collapse. It extends for 34.12 m and there are three sections facing different directions. The initial part of the first section has a short and worn descending stairwell consisting of eight steps, covered in detritus and waste material; the tunnel points in a 282° direction. The walls and roof are irregular in appearance. This can be attributed in part to the natural characteristics of the rock matrix, in this section presenting fissures and pockets of unconsolidated material, which has become detached over time leaving small vacuums. In certain points there are clear signs of rock extraction, which have altered its original appearance. The height varies between 2.18 m at the entrance and 1.93 m half-way along the stairwell and 1.96 at the end of the room. The width also varies, being 1.27-1.28 m at the base of the piers and 1.42-1.32 m at the top of the piers. Overall, the excavation is regular and level, with a height of between 1.96 and 1.8 m and a width of between 1.28 m and 1.02 m. Beyond the stairwell, the passage continues in a 275° direction. The roof consists of a drop arch, the height of which decreases towards the end of the first section. The walls are slightly curved and parallel one to the other. The excavation face is relatively well-finished. It is therefore unlikely that the change of direction in the second section resulted from a structural error when positioning the first section. The second section branches off following a rectilinear 200° direction. This long tract has a slightly smaller section that the latter, with a base width of between 1.02 and 1.12 m. Its roof has a semi-circular vaulting, which rises slightly in respect of the entrance. In some points the walls curve outwards, in others they simply narrow towards the base. The floor is covered in dust and detritus. Towards the second section there is a partial breach of the walls of unknown origin. The first section presents just one niche for the placing or hooking of a lamp, whereas there are ten in the second section. They are 13 cm wide by 14 cm high and 6 cm deep on average. Although indicative of a certain acquired order on the part of those who conducted the excavation and the regularization of the passage walls, the positioning of the niches is not perfectly regular. On the left wall such niches are positioned close together in couples, the distance between the second niche of the first "couple" and the first niche of the next couple being double the distance between the first and the second niche of the previous couple. On the other wall only two niches are visible, positioned half way between the first and second



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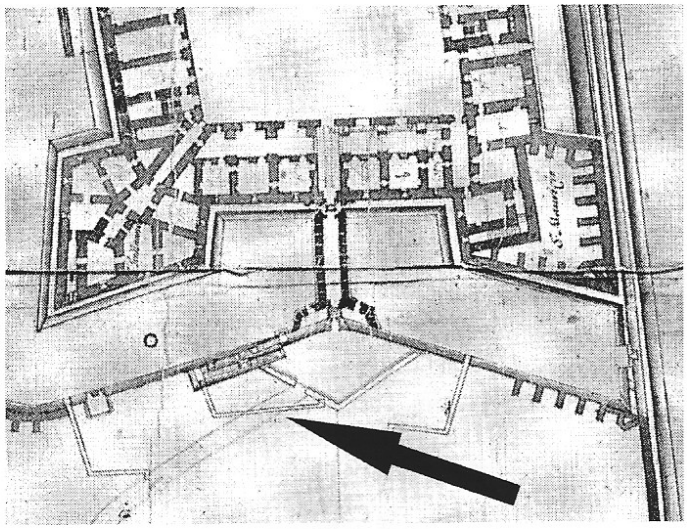

b

Fig. III.10.a. *Plan of Fort San Vittorio subterranean structures in 1799 (source: Comoli Mandracci, Marotta 1995, pg. 59).*
Fig. III.10.b. *Arrow indicates the Countermine Tunnel in the Counterscarp Ditch of Gate San Vittorio.*

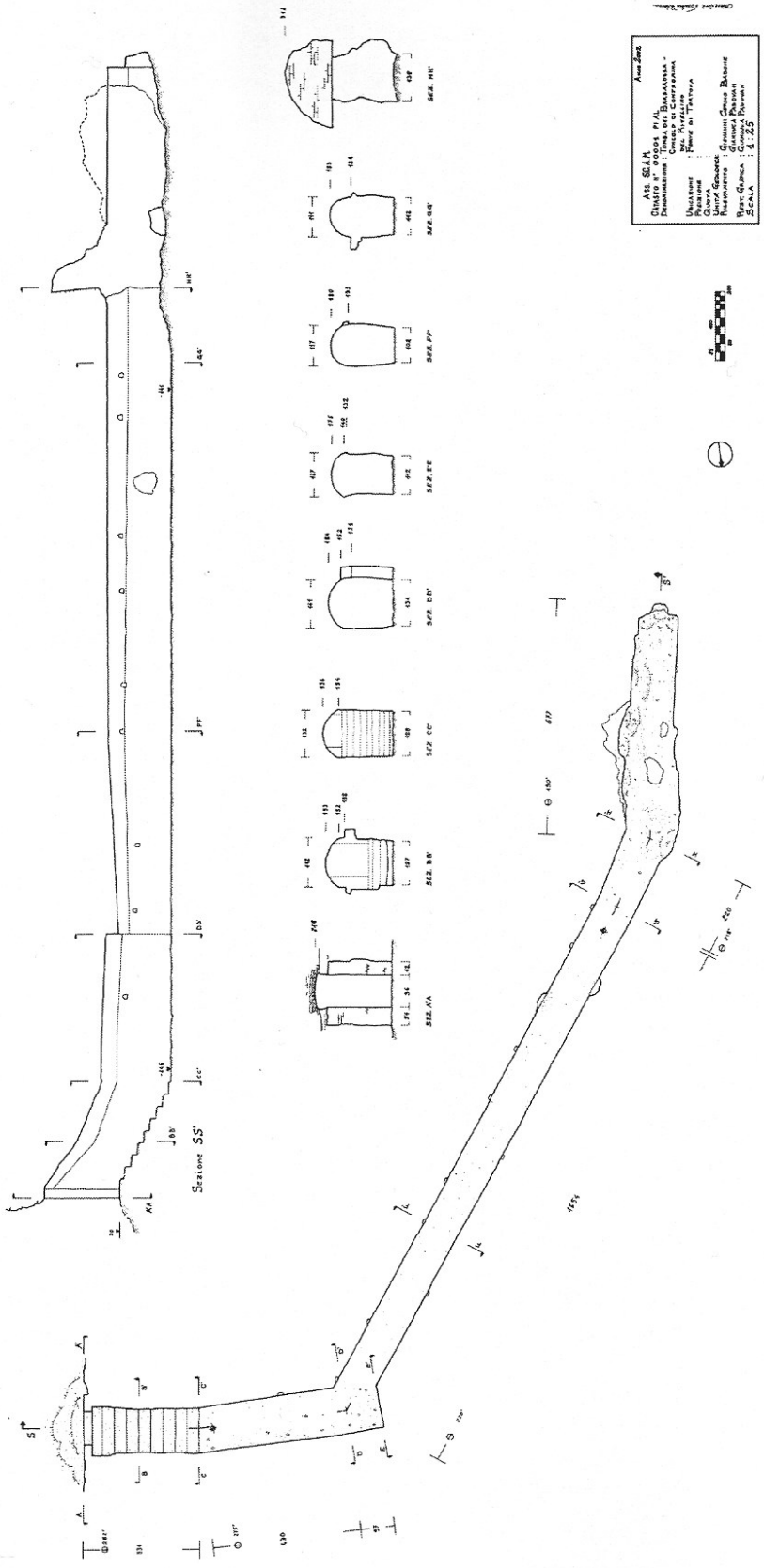

Fig. III.11. *Ravelin Countermine Tunnel Planimetry (CA 00001 PI AL), known locally as "Barbarossa Tomb". The structure extends below the ravelin protecting Gate San Vittorio (Ass.ne S.C.A.M. Archive).*

Fig. III.11. a. *Ravelin Countermine Tunnel (CA 00001 PI AL), known locally as "Barbarossa Tomb"(photo G. Padovan).*

couple and the second and third couple. There may have been a further niche in the location of the current breach in the wall. Furthermore, if the first couple is situated under the springer then the second couple is in line with the springer, the third is above it and the fourth is at an even higher level. The last section, 6.77 m long, curves to the left in a 190° direction. Towards the base of the work, there are collapsed walls and the ceiling excavation intercepts a slightly sloping brick wall, which appears to be the external wall facing of the overlying ravelin. The only perplexing aspect is that we would have expected the battered plinth to slope in the opposite direction: this is the only aspect that remains unclear. Just beyond this, the left wall has collapsed, however the structure has not been entirely compromised. Here the floor is obstructed by detritus and large blocks of rock. The bottom of the passage appears to have been lowered a few tens of centimetres by irregular excavations, which probably took place before the work was built. Only one niche is visible on the right wall, in proximity of the excavation front. A small, regular channel has been cut into the arch of the latter, which at the head of the excavation follows the wall down to the right. Two nails with metal heads would normally indicate an electric cable recess therefore this is a relatively recent work. What needs to be ascertained is whether the structure was used as an air-raid shelter during the Second World War.
Interpretation: late XVII century plans show no defence work opposite San Vittorio Gate. However, a table from 1799 confirms the existence of a ravelin (or structure identifiable as such) with three nearby underground works. Taking into account that the tunnel system in question is accessed through a broken wall, it is possible that it was created (most probably at the same time as the other two) by French troops during their short occupation of the Tortona stronghold. In any case the passage works open onto the ditch counterscarp. The first and the third tunnel are L-shaped and each has a short terminal branch, in all appearances a demolition chamber, facing outwards from the Fort's nucleus. This second tunnel first leads to the top of the ravelin's external point, almost reaching it by means of a slightly obtuse angle. As in previous examples, there is a short tunnel section at the apex, but its chamber faces directly into the ravelin, directly below the perimeter wall. The first and third tunnels are thought to be countermine tunnels, while the sole purpose of the second tunnel seems to be the demolition of the ravelin. Given its position, it may also have been used as a countermine branch excavation base. The evidence present a work that is slightly different from a standard countermine tunnel: it has no demolition chamber and the tunnel extends beyond the foundation wall. As already mentioned, the wall should slope in the direction of the chamber rather than in the opposite direction. This could indicate that the wall is something other than the anticipated left ravelin wall or it could be indicative that the tunnel comes into contact with the ravelin's right facade, passing by the other without exposing it. The latter assumption would imply that the foundation wall of the left façade is not as deep as the other. There is in any case no demolition chamber.
Dating: 1797-1798.
Notes: the evidence again indicates that following the fort's demolition little was left. The casual discovery of this basic tunnel was completely unexpected. First of all, the information emerging from the current park layout is testament to the fact that the military structures were irreparably damaged but not obliterated. Clearing the debris would therefore reveal the entire defensive perimeter. Secondly, we should ask ourselves why the tunnel was never used: when charged it could easily have blown up the salient angle of the ravelin through to the foundations and far more quickly and effectively. It should come as no surprise that the utmost of care was taken to ensure that the structures, especially those structures of intricate design were not irreparably damaged, as in the case of Fort Demonte.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F., Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.2 - *CA 00001 PI CN; Counterscarp Gallery of the Bastion of Saint Ignatius*

Cadastral number: CA 00001 PI CN
Denomination: Counterscarp Gallery of the Bastion of Saint Ignatius (figs. III.12, III.13, III.14, III.15, III.15.a, and III.16)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Demonte Fort, situated on the left bank of the River Stura of Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte

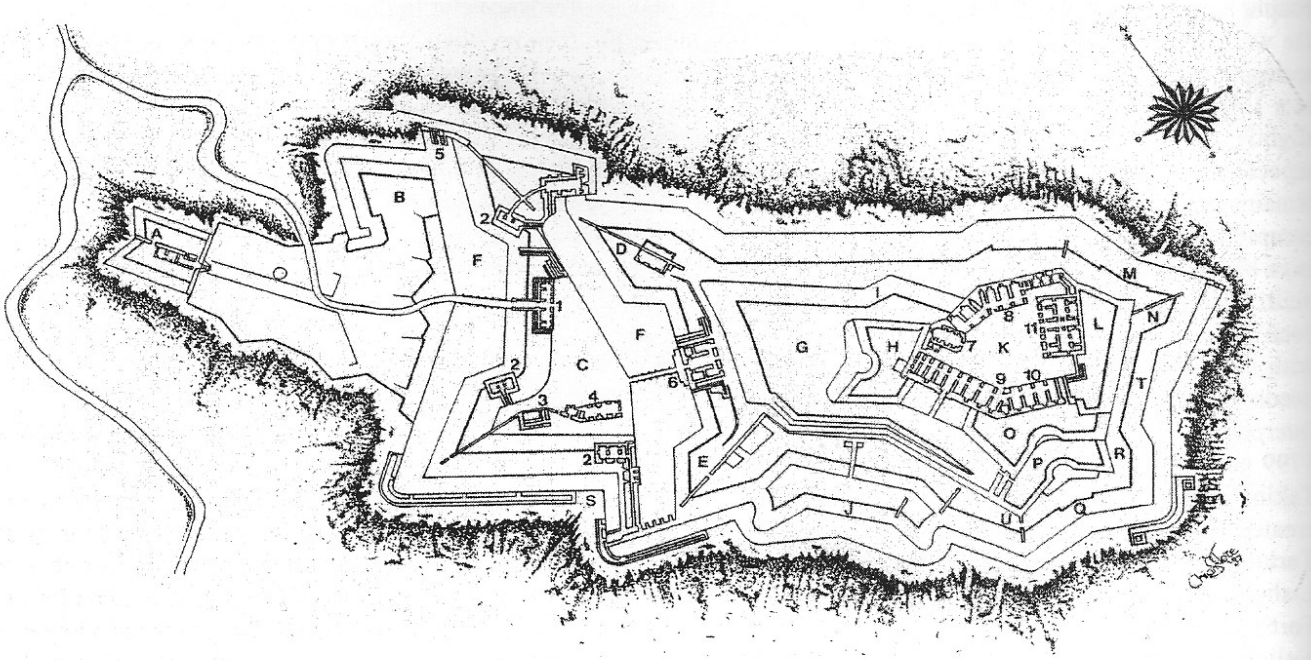

Fig. III.12. *Graphic exemplification of the Fort Demonte system during the latter part of the XVIII century, detailing the primary defensive structures (from: Gariglio 1997, pg. 195). A: San Marcellino redoubt. B: lunette. C: hornworm. D: San Paolo Bastion. E: Bastion of Saint Ignatius. F: ditch. G: Beato Amedeo battery or Royal Battery H: San Ferdinando Bastion Fortification. I: San Anna Demi-Bastion. J: Low work or Tennaillon facing Stura. K: Superior or Knight Square. L: Royal Battery. M: Tenaille of San Giuseppe. N: San Giuseppe Demi-Bastion. O: San Maurizio Bastion Fortification. P: San Lorenzo Bastion Fortification. Q: Tenaille of San Michele. R: San Michele Demi-Bastion. S: counterscarp gallery. T: front facing Podio. U: Green Demi-Bastion. 1: Royal gate and guard-house. 2: casemates. 3: gunpowder magazine. 4: laboratory and armoury. 5: possible location of San Marcellino Well (if this was in fact excavated). 6: main gate. 7: San Carlo Church. 8: Nordo or San Carlo districts with bread oven and cistern. 9: South districts. 10: cistern. 11: Governor's Palace (Ass.ne S.C.A.M. Archive).*

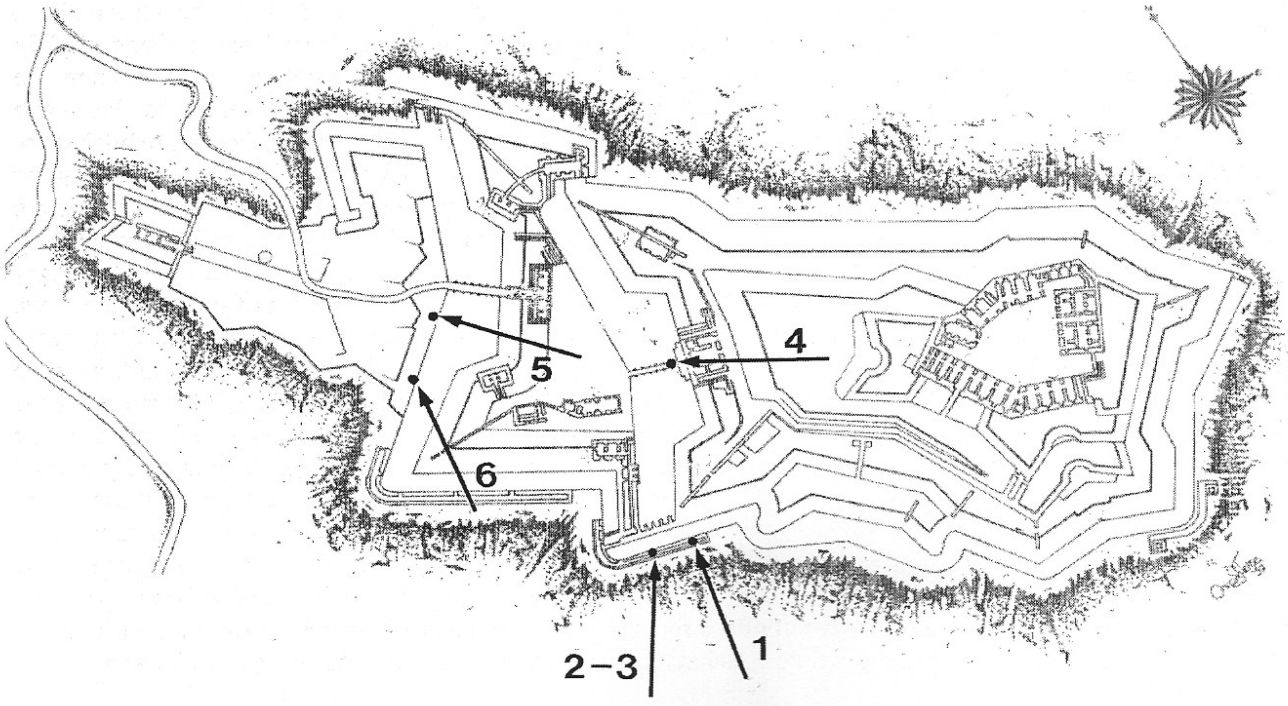

Fig. III.13. *Graphic rendition of the Fort Demonte installation during the latter part of the XVIII century (from: Gariglio 1997, pg. 195). The artificial cavities surveyed are listed below: 1: Counterscarp Gallery of the Bastion of Saint Ignatius. 2: Countermine Tunnel of the Bastion of Saint Ignatius. 3: Ditch Drainage Tunnel of the Bastion of Saint Ignatius. 4: Ditch Counterscarp Cistern of the Main Gate. 5: Primary Shelter in the Hornwork Counterscarp . 6: Secondary Shelter in the Hornwork Counterscarp (Ass.ne S.C.A.M. Archive).*

Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These are marginal marine environment deposits
Altitude: //
Position: //
Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: structural collapse of the current entrance
Typology: 6 - counterscarp gallery
Description: the Bastion of Saint Ignatius is external to the stronghold and faces a south-westerly direction, towards the River Stura. Given the less pronounced slope of the relief as compared to the other flanks, this side is the most exposed, as attested by the 1744 siege. The Bastion is protected by a ditch with counterscarp gallery, of which the final, north-east facing section with sortie is essentially intact. The other sections have been destroyed and only rubble remains. In any case, a more detailed investigation confirms that the gallery remains intact as far as the springer and only a few sections of the upper breastwork are damaged; various other sections provide evidence of the vaulted roof. All the loopholes should therefore be intact. A second postern, with its original roofing, can be seen towards the end of the north-east branch. However, the ditch is full of rubble. The counterscarp gallery is a key point in the external defence of the sector, from which it kept control over the ditch itself by loophole gunfire and the launch of sortie attacks. The north-east sector was also controlled by enfilade fire along the re-entrant flank and the south-west salient of the Tenaillon facing Stura: imposing and carved in the rock almost in its entirety, so much so that it is perfectly visible despite its demolition, it is surrounded by a well-defined ditch, which despite being full of rubble, measures 12 m in depth. The section of gallery which has been uncovered is rectilinear and measures 11.36 m in length. Only the first 2.2 m no longer have the original vaulted covering. It is partially buried and the some sections of the wall facings show evidence of demolition attempts. A short tract of gallery, now completely buried and which once lead to the postern, branches out three metres from the bottom. The main gallery is 1.82 m wide; its current maximum height is 3.22 m, and 2.4 m from the springer. The punch-dressed masonry and stone walls are lined. The external wall (facing south-east) is more than 1.72 m deep, as can be calculated from the demolition chamber created through a wall, without entirely perforating it and in front of the postern. This side also has a niche, which was presumably used for lighting purposes. It has a lined semi-circular brick barrel vault, rising slightly beyond the lateral branch, the cross vault of which breaks its uniformity. In an almost entirely vault-free section, the breach almost perpendicularly cuts the structure thus revealing its construction style: three rows of bricks placed one next to other, one on top of the other and head to head form the design of the barrel arch. Further up, regular stone rows cover an area of approximately half a metre and come into contact with at least one line of stone bricks sloping outwards towards the parapet. There are further rows above this and although these are difficult to interpret, they are needlessly regular and are almost all made of stone. The roof is therefore both thick and solid and is undoubtedly bomb-proof. The part overlooking the ditch has three brick-framed loopholes, which are scratched and exposed by demolition attempt. These are partially buried by detritus and are currently situated at a depth of just over 2 metres. Inside the structure, at least the pillar arch and the walls are made of exposed brick. Strangely, one is different from the other. The latter is wider, the central one is narrower and distinctly higher than the latter and the third, near the current entrance, is slightly wider than the central loophole while its height cannot be determined on account of the soil which covers it. Despite the fact that the entire complex is in a state of ruin, the precision and care involved in the construction of the structure are evident. Furthermore, if the loopholes are not all the same, there is surely a valid reason for this. The walls of the other short tunnel have been partially demolished together with a short section of roof lining although the tunnel itself is fairly solid and presents no danger. Demolition chambers constructed by breaking through walls can be seen on both sides of the tunnel. The base of the tunnel holds the entrance to the postern as well as the collapsed pillars and part of the vaulted arch. The visible part of said arch consists of perfectly square and perfectly positioned stones. On the left of the room's granite frame is a hole, which would have held one of the two door closure hinges. The postern would thus have been accessed by means of a flight of stairs or a sloping floor.
Interpretation: surviving section of counterscarp gallery with ditch sortie.
Dating: XVIII century.
Notes: an adequate dig would completely uncover the structure. The recovery of the entire ditch is also recommended.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F.,

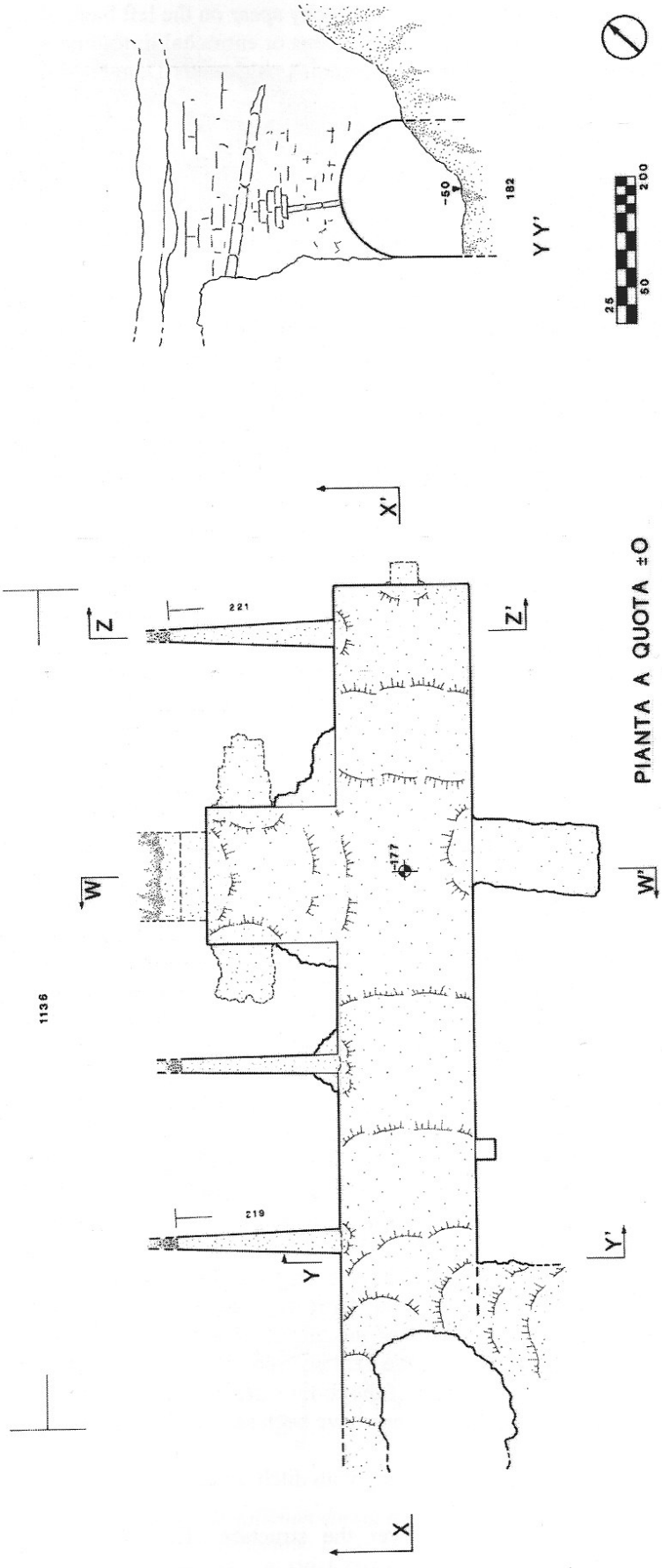

Fig. III.14. *Plan of the Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00001 PI CN) (Ass.ne S.C.A.M. Archive).*

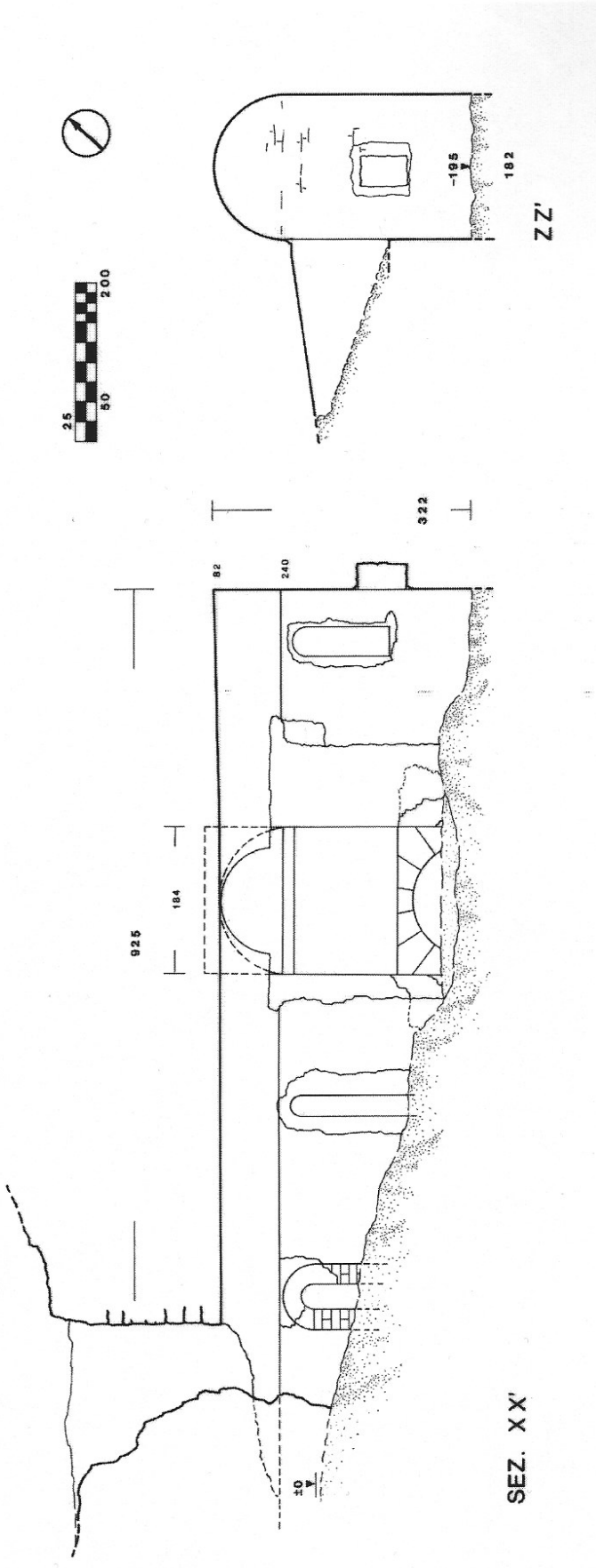

Fig. III.15. *Longitudinal section of the Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00001 PI CN) (Ass.ne S.C.A.M. Archive).*

Fig. III.15. a. *Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00001 PI CN) (photo G. Padovan).*

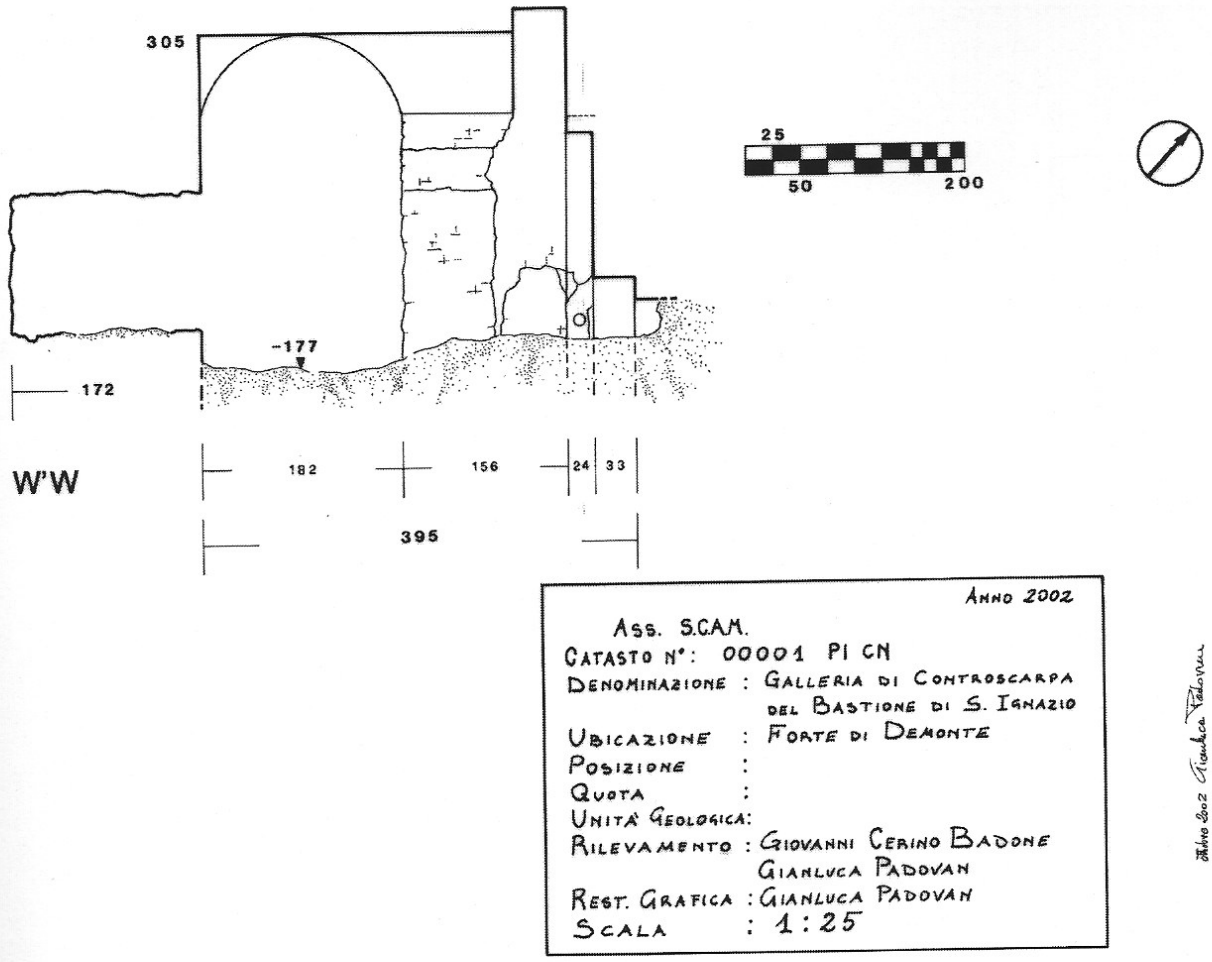

Fig. III.16. *Transversal section of the Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00001 PI CN) (Ass.ne S.C.A.M. Archive).*

Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.3 - *CA 00002 PI CN; Countermine Tunnel of the Counterscarp Gallery of the Bastion of Saint Ignatius*

Cadastral number: CA 00002 PI CN
Denomination: Countermine Tunnel of the Counterscarp Gallery of the Bastion of Saint Ignatius (figs. III.17, III.18 and III.18.a)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Fort Demonte, situated on the left bank of the River Stura in Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte
Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These consist of marginal marine environment deposits
Altitude: //
Position: //

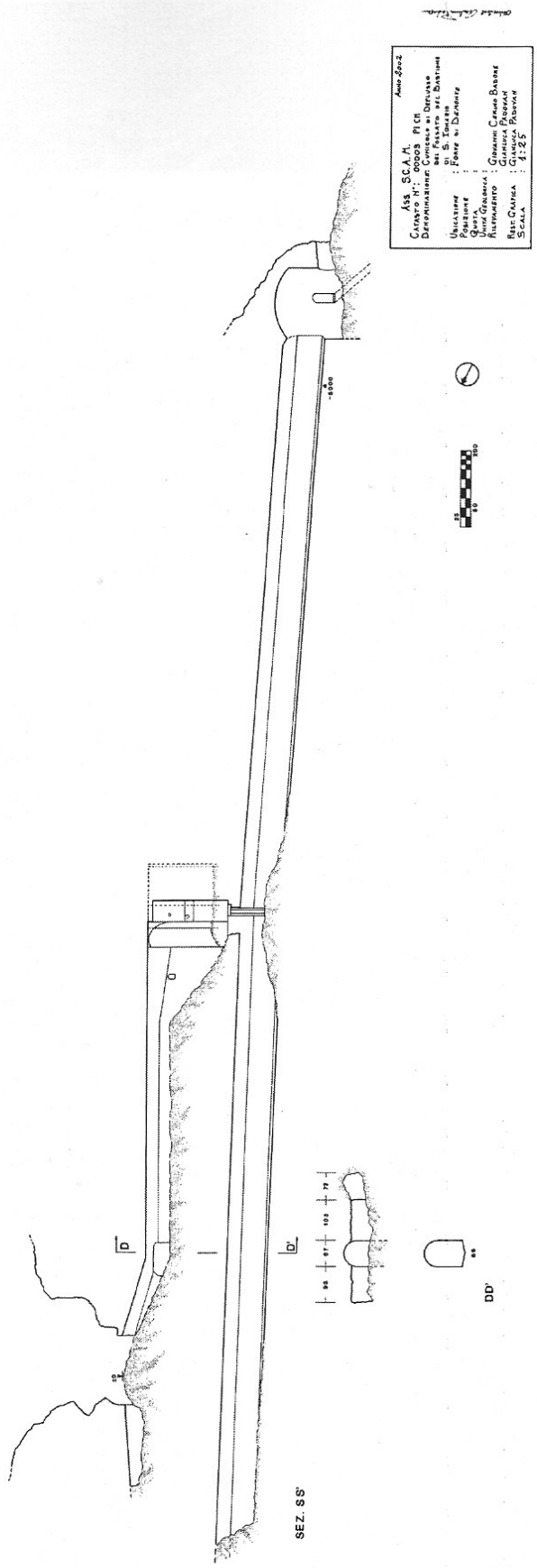

Fig. III.17. *The section shows the upper section (altitude 0) of the uncovered Counterscarp Gallery of the Bastion of Saint Ignatius, its loophole overlooking the ditch (to the left). On the right is the entrance to the Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00002 PI CN), which provides access to the underlying Ditch Drainage Tunnel of the Bastion of Saint Ignatius (CA 00003 PI CN). Section DD' shows the two demolition tunnels which would have contained unutilised demolition chambers (Ass.ne S.C.A.M. Archive).*

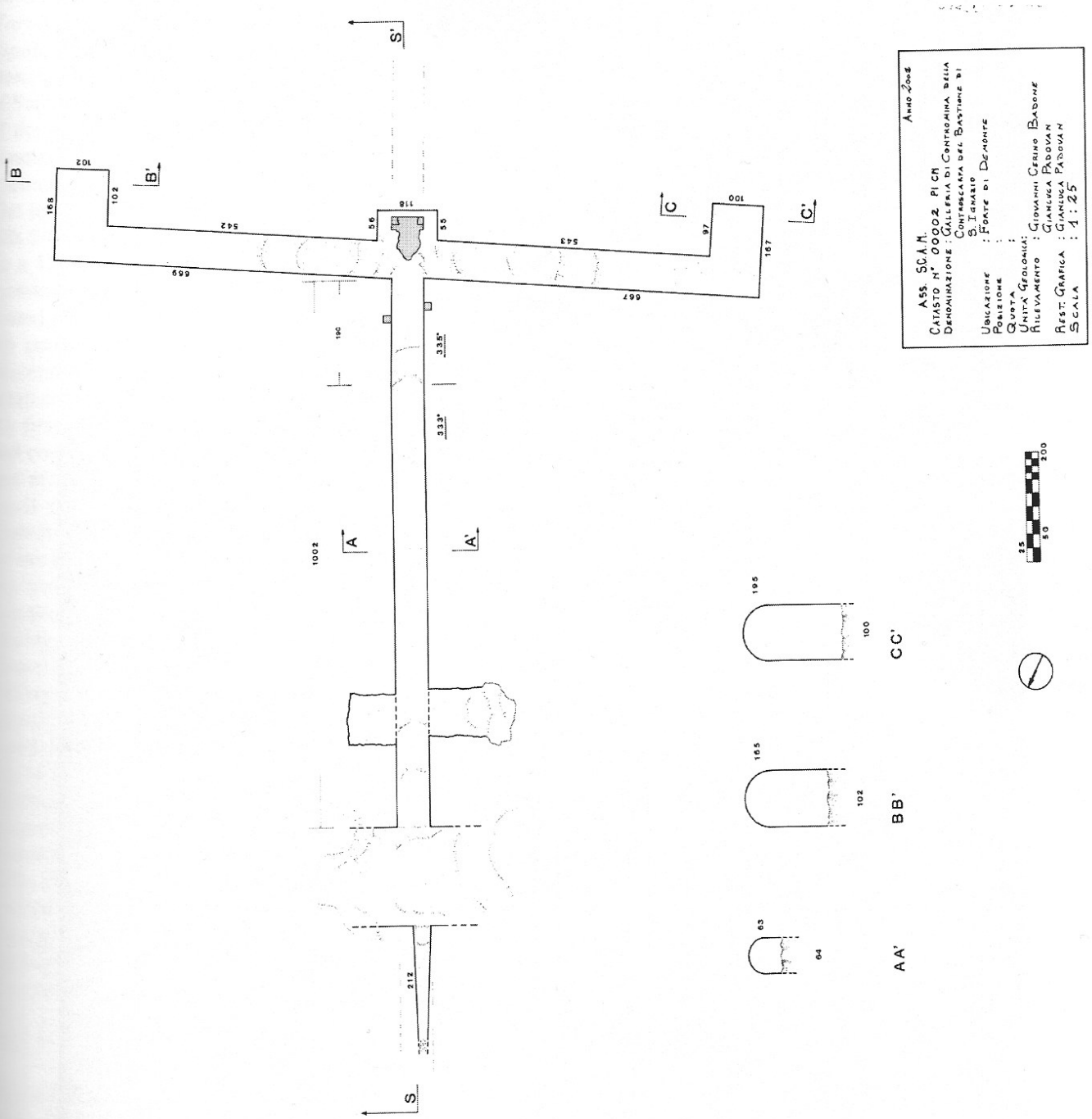

Fig. III.18. *Plan of the Countermine Tunnel of the Counterscarp Gallery of the Bastion of Saint Ignatius (CA 00002 PI CN). From the left are the loophole overlooking the ditch, the uncovered Counterscarp Gallery of the Bastion of Saint Ignatius and the Countermine Tunnel with its two demolition tunnels; at the front is the guide for the sluice gate of the underlying Drainage Tunnel from which, the countermine branches and their relative chambers laterally branch (Ass.ne S.C.A.M. Archive).*

Fig. III.18.a. *"Tenaglione verso Stura" cut into the limestone, situated east of the Bastion of Saint Ignatius (photo G. Padovan).*

Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: the tunnel is currently accessed by means of an opening excavated in collapsed material
Typology: 6 - countermine tunnel
Description: the entrance to the Countermine Tunnel is situated along the Counterscarp Tunnel branch of the Bastion of Saint Ignatius. It is approximately 30 m from the vaulted counterscarp gallery. It is buried to almost the full height of the piers. The uncovering has salvaged a short section of masonry vaulted arch and a deep loophole opposite the countermine, partially blocked by detritus, through which the pillar arch and the exposed bricks can be seen. The countermine branch is in the classic T-shape, with an unusual (and perfectly aligned) underlying hydraulic conduit. The length of the branch access varies between 0.64 m and 0.67 m; it has a lined semi-circular barrel arch and debris fills 5/6 of the tunnel, almost as far as the springer. The tunnel has a short, descending first section and then proceeds on a 153°-333° axis almost to its end where it slopes slightly to the right by 2°. Here, despite the fact that the arch maintains the same height the tunnel gives the impression of descending via a set of steps. The short, final tract of tunnel presents a niche on each side, once used for lighting purposes, as attested by the weak halos of carbon black on the small arches of each niches. It should be mentioned that breaking down a wall in the point where the first descending tact and the rectilinear tract meet, revealed two demolition chambers, one opposite the other. Despite the scrap contained within them, they show that the masonry structure was made of stone bricks and stone material. After the first 1.03 m, the one on the right continues a further 0.72 m, indicative that the tunnel was created using the cut and cover method and that its lateral wall is at any rate one metre deep. The demolition chambers are fully brick-lined and are sufficiently large to be charged with "globes of compression". Returning to the entrance branch, this has a small room at its opening, to provide room to control a sluice gate for the underlying hydraulic conduit. Two horizontal granite inserts are grooved in such a way as to support the winch. The granite guides for the sluice gate are on the floor, which has now subsided.
Interpretation: countermine system with two demolition chambers, which were probably used with "globes of compression".
Dating: XVIII century.
Notes: an adequate dig would completely uncover the structure. Restoration of the entire ditch and counterscarp gallery is desirable. Similar works, that is countermines with underlying drainage systems, would also have been created within Fort San Vittorio in Tortona (Alessandria). A multi-colour watercolour painting of Fort San Vittorio, dated 14 September 1799, depicts one serving the ditch opposite the Hornwork (Comoli Mandracci, Marotta 1995, pg. 51 and pg. 167).
Bibliography: Comoli Mandracci V., Marotta A., *Tortona e il suo castello. Dal dominio spagnolo al periodo postunitario*, Alessandria 1995.
Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F., Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.4 - *CA 00003 PI CN; Ditch Drainage Tunnel of the Bastion of Saint Ignatius*

Cadastral number: CA 00003 PI CN
Denomination: *Ditch Drainage Tunnel of the Bastion of Saint Ignatius* (figs. III.19 and III.20)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Fort Demonte, situated on the left bank of the River Stura in Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte
Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These consist of marginal marine environment deposits
Altitude: //

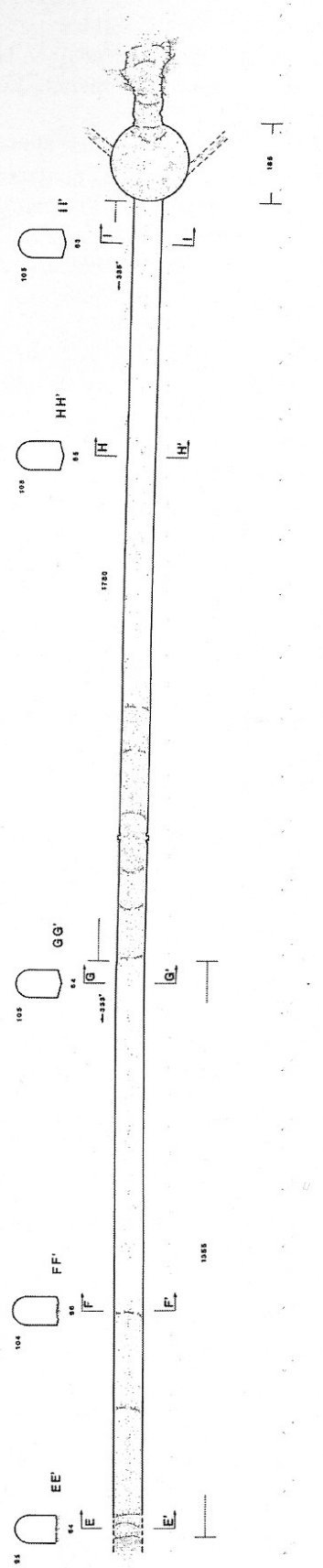

Fig. III.19. *Transversal section plan of the Ditch Drainage Tunnel of the Bastion of Saint Ignatius (CA 00003 PI CN) (Ass.ne S.C.A.M. Archive).*

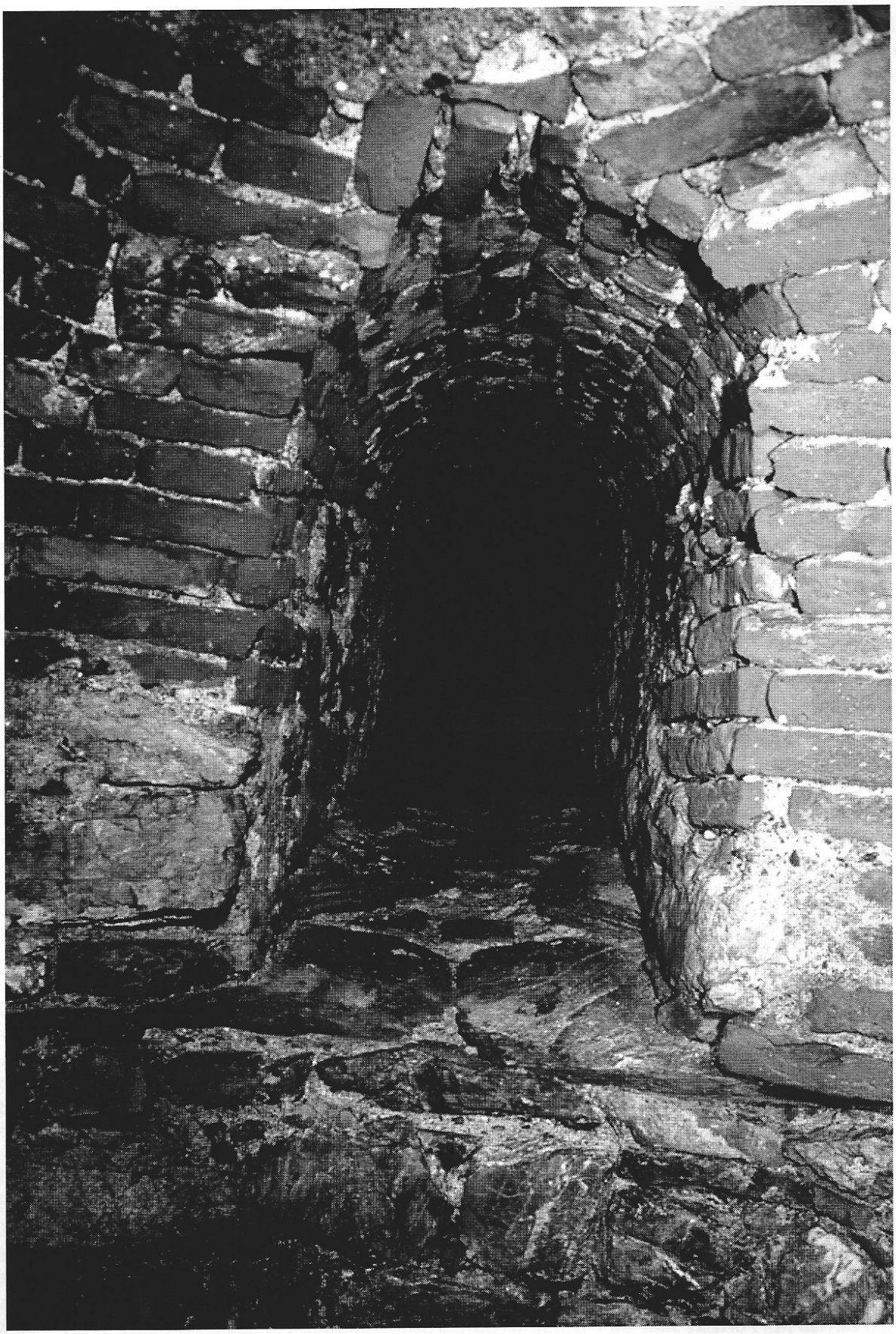

Fig. III.20. *Ditch Drainage Tunnel of the Bastion of Saint Ignatius (CA 00003 PI CN) (photo G. Padovan).*

Position: //
Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: the Fort's external exit was created by breaking a wall and has partially collapsed
Typology: 2d - drainage tunnel
Description: this structure was used for the discharge of rainwater and icewater, which would otherwise stagnate in the ditch (the system was designed in such a way that it would remain dry and would not be subject to flooding). Almost the entire channel survives and despite its entrance now being buried, water still filters into the channel. The hydraulic system is level with the overlying tunnel which leads to the mine branches: it starts off in a 153° direction and again slopes by 2° and follows the 155°-335° axis. The first section from the ditch follows a -3° inclination as far as the granite guides, at which point it follows a -5° as far as the circular chamber. The centre of the passage is 1.05 m high and its length is of 0.63 m to 0.66 m; just over 30 m are practicable. It has mortar-lined punch-dressed masonry and stone piers. The semi-circular barrel vault is in exposed brick. The passage bottom has a slight V-shape for improved runoff. It is made of large, flat, coupled schistous stones, each one converging towards the centre; each couple overhangs the next thus forming a step-like structure with 0.4 m tread and height of 4-7 cm. This inclined floor was covered by a layer of coarse, pale yellow, hydraulic mortar, the bulk of which has been eroded by water, thus revealing the layout of the underlying stones. The tunnel terminates in a circular chamber at slightly higher altitude, almost entirely in exposed brick with occasional blocks and unworked stone. The chamber has a conch vault and its base is covered by debris and detritus. Its diameter is of 1.85 m. The XVIII century planimetry (Viglino Davico 1989, pg. 192), table confirms that the room has three branches, the lateral branches (the sizes of which have been calculated from survey information) could be approximately 10 m long, while the central branch is at least 15 m long. The system appears to have various sections. There are two conduits similar to loopholes along the walls. In respect of the continuation of tunnel axis, they are not exactly symmetrical one to the other. One faces east while the other faces south. The first is slightly larger than the second and both are brick-lined, while their bases consist of an inward-protruding single large, flat stone. Both distinctively slope downwards and both are blocked by detritus. Opposite the tunnel, in a trench-type structure the walls of which are made of large dry stone blocks is a breach in the surface wall. Originally there would also have been a conduit of a similar type to the two previously mentioned. White and/or black water drainage system outlets are notorious for being the weak points of fortified perimeters. An optimal solution to obviate the danger posed by the eventual transit of enemy soldiers within the discharge conduit was created. We shall now attempt to explain said solution. First of all, the system has been designed in such a way that it does not lead directly to the surface. At its head is the circular chamber which probably acts as a settling basin and prevents detritus and twigs from being dragged inside and blocking the three narrow conduits. The conduits, in turn, communicated with three tunnels, significantly below the chamber, which discharge the waters externally. It is not thought possible that 10 m to 15 m long inaccessible conduits were created for the simple reason that in the event of obstruction or collapse of one of these conduits, the only solution would have been to demolish the entire conduit until the section to be cleared could be located. For the very same reason, it is thought that the three terminal branches would have been accessible from the surface. Periodic maintenance would thus have been possible. The purpose of the connecting branches, that is the three sloping conduits, is therefore that of preventing direct access to the system while at the same time allowing the rapid discharge of water. An enemy could have easily accessed the terminal branches, possibly by means of excavation to the underlying conduit, but this would have taken a long time and would have been easily thwarted by the simple act of throwing a hand grenade from the chamber into the conduits. Loading the conduits with explosives would have been of little use to the besieger, both on account of the depth and lower altitude and on account of the distance between the conduits and the fort's external defences. For instance, the countermine chambers are more than 15 m away from the circular chamber. No advantage would have been gained by blocking the conduit other than flooding of the ditch.
Interpretation: ditch water drainage tunnel.
Dating: XVIII century.
Notes: removing the debris would permit the system to be fully restored.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F., Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Viglino Davico M., *Fortezze sulle Alpi. Difese dei Savoia nella Valle Stura di Demonte*, Cuneo 1989.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.5 - *CA 00004 PI CN; Ditch Counterscarp Cistern of the Main Gate*

Cadastral number: CA 00004 PI CN
Denomination: *Ditch Counterscarp Cistern of the Main Gate* (fig. III.21)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Fort Demonte, situated on the left bank of the River Stura in Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte
Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These consist of marginal marine environment deposits
Altitude: //
Position: //
Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: the cistern is being restored by the Municipality
Typology: 2c - cistern
Description: a cistern for the storage of meteoric water is situated under the grade plane in the counterscarp ditch wall, which protected the Main Gate. Current excavations have removed debris and detritus from the ditch and uncovered the entrance to a small room, the floor of which contains the opening of a cylindrical well providing access to the underlying storage chamber. The well's shaft is brick-lined and its internal diameter is 1.53 m. The water level reaches to just under the cistern's edge and provides a glimpse of the underlying room, which may have a conch vault, at a depth of almost 3 m; the halyard, on the other hand, reaches the base of the cistern, which possibly consists of a detritic cone at a depth of 6.38 m. The room, lined at least on the outside with large stone blocks, was undoubtedly well protected.
Interpretation: cistern for the storage of meteoric water.
Dating: presumably XVIII century.
Notes: the cistern and the ditch should be emptied for a full examination and recuperation of the entire area.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F., Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.6 - *CA 00005 PI CN; Primary Shelter on the Hornwork Counterscarp*

Cadastral number: CA 00005 PI CN
Denomination: Primary Shelter on the Hornwork Counterscarp (fig. III.22 and III.22.a)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Fort Demonte, situated on the left bank of the River Stura in Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte
Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These consist of marginal marine environment deposits
Altitude: //

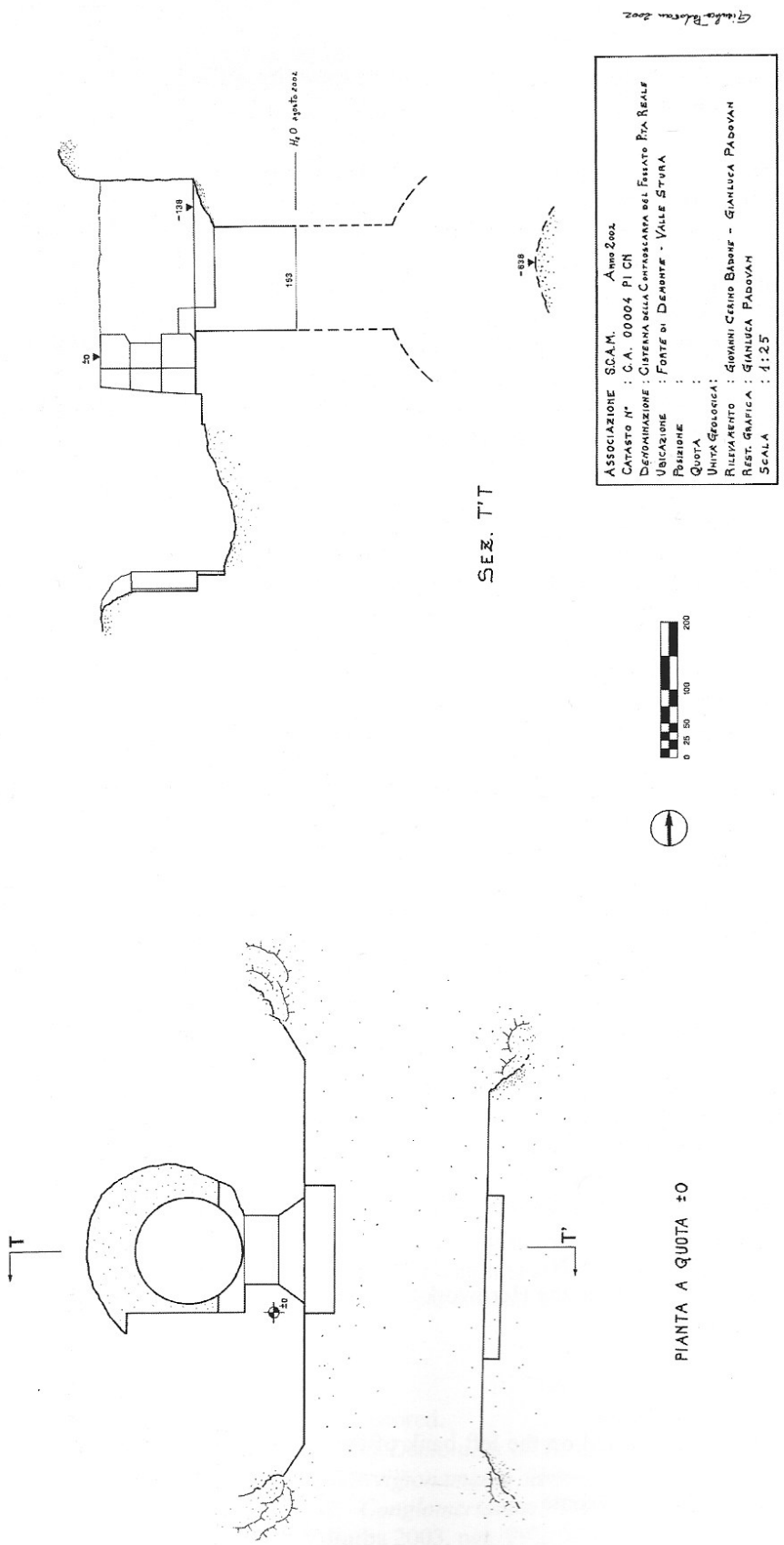

Fig. III.21. *Counterscarp Cistern of the Royal Gate Ditch (CA 00004 PI CN) (Ass.ne S.C.A.M. Archive).*

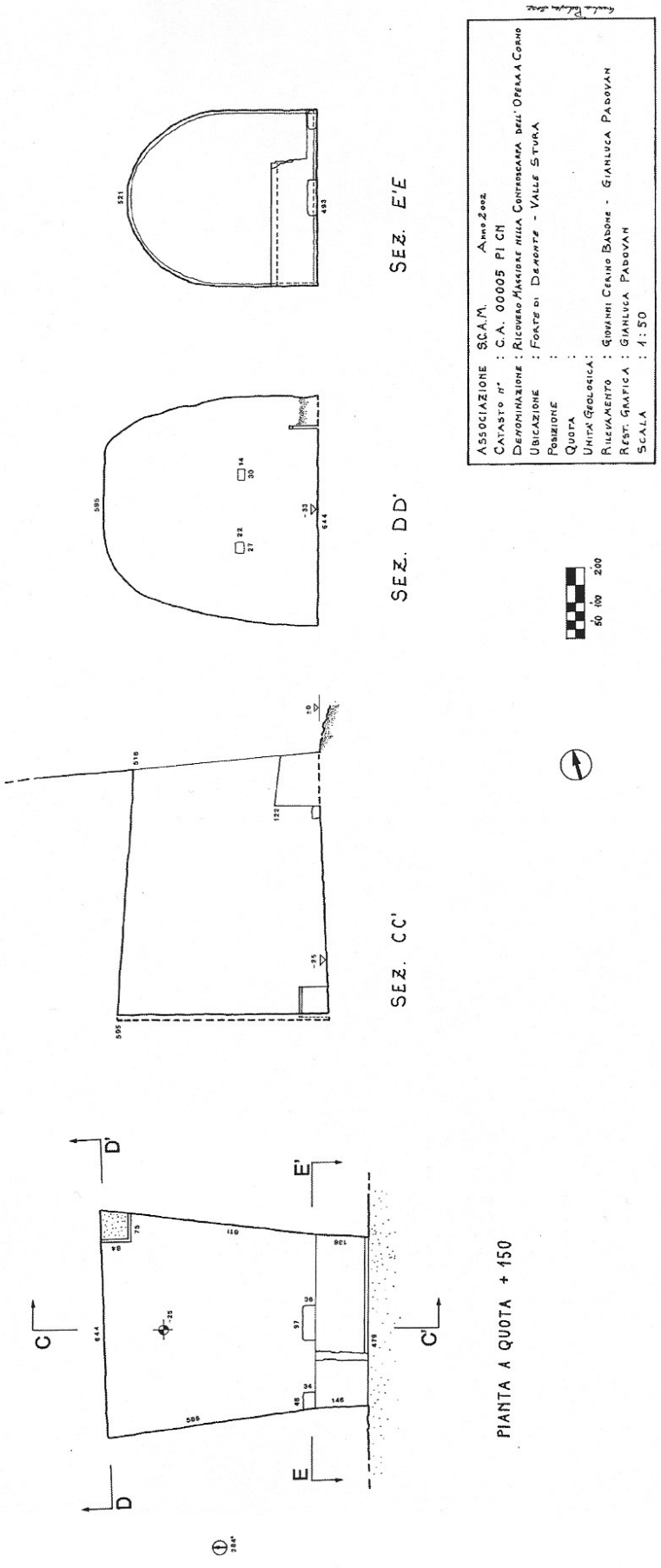

Fig. III.22. *Primary Shelter on the Hornwork Counterscarp (CA 00005 PI CN) (Ass.ne S.C.A.M. Archive).*

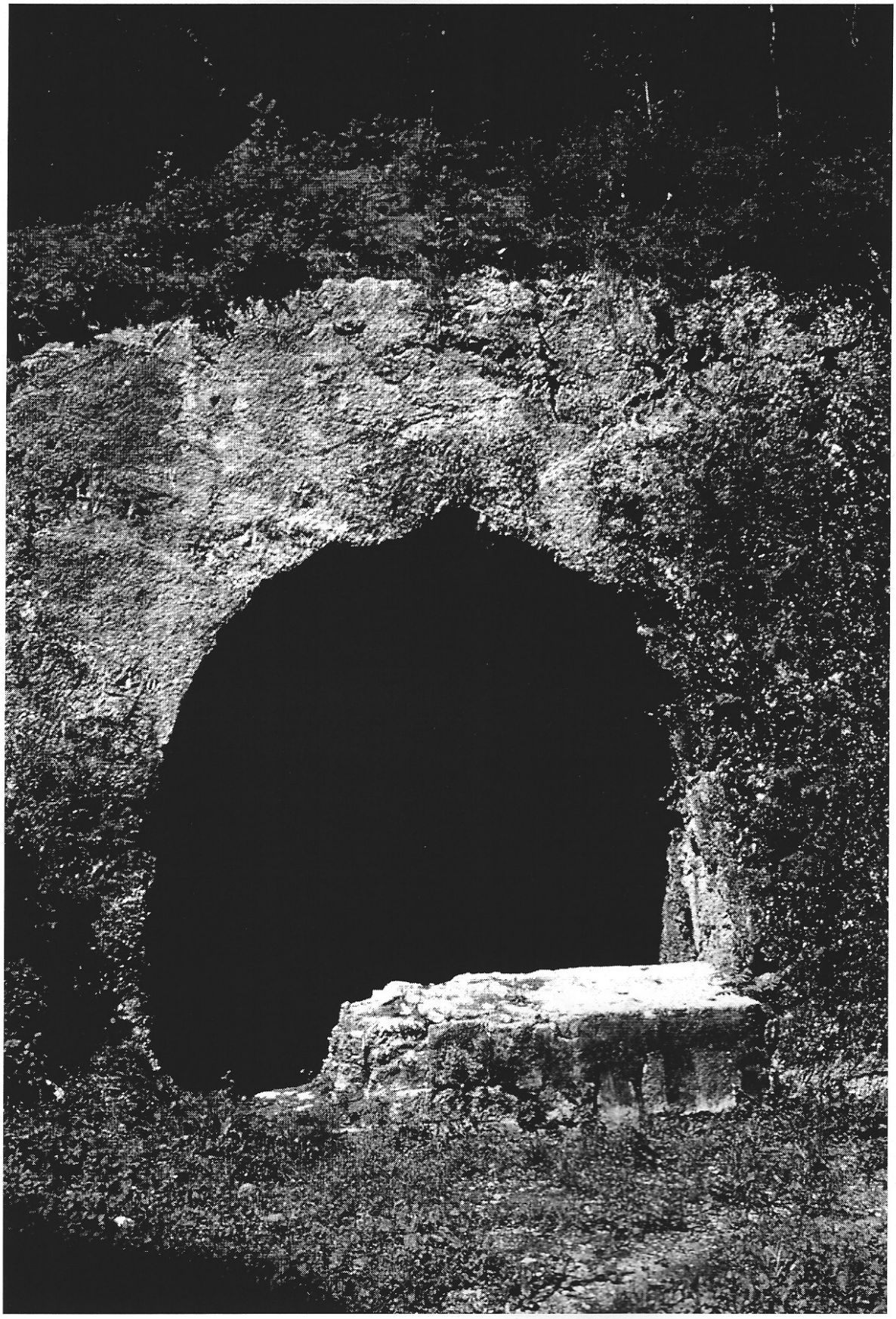

Fig. III.22.a. *Primary Shelter on the Hornwork Counterscarp (CA 00005 PI CN) (photo G. Padovan).*

Position: //
Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: none
Typology: 6 - military structure
Description: two stone-carved rooms are to be found in the counterscarp of the cyclopean ditch protecting the Hornwork, which is carved into the rock. The first, known as the Primary Shelter, is situated next to the stairwell which leads from the counterscarp to the bottom of the ditch. The large, trapezoidal room (4.79 x 7.32 x 6.44 x 7.47 m) is easily accessed and contains no debris. Inside there are currently tables and chairs as well as a fireplace in the inside left corner. At the entrance, the semi-circular vaulted arch measures 5.16 m whereas it is squashed towards the base. It is 5.95 m high. The entrance is protected by a low but thick masonry wall, the upper part of which gently slopes outwards. It could easily be the original boundary rather than a later structure built during the restoration of the covered area, despite the traces of fairly recent hydraulic mortar, thought to have been used during maintenance works. The rock floor, which gently slopes inwards, cannot be dated due to the fine layer of detritus and hay, which cover it; the exposed walls show clear evidence of excavation tools. The bottom part has two recesses (of 27 x 22 cm and 30 x 14 cm), believed to have been used for the placement of wooden supports. There are non recesses for hinges or bolts, therefore the does not appear to have had a door closure. In the event of siege, the room would certainly not have been considered safe.
Interpretation: its purpose is assumed to be that of storage area for wood or fodder for draught, pack and saddle animals. Under enemy fire, this material could clearly have caught fire, however on the whole this is the best place for such an eventuality as little or no damage would be caused.
Dating: thought to be XVIII century.
Notes: the large ditch could easily be cleared of debris and restored to its original, imposing form, with little effort or expense.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in *Atti Montello 2002. Conglomeriamoci*, 21° Incontro Internazionale di Speleologia. *Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.7 - *CA 00006 PI CN; Secondary Shelter on the Hornwork Counterscarp*

*Cadastral numbe*r: CA 00006 PI CN
Denomination: Secondary Shelter on the Hornwork Counterscarp (fig. III.23)
Region-country: Piedmont, Italy
Province: Cuneo
Municipality: Demonte
Locality: Promontorio del Podio
Location: Demonte Fort, situated on the left bank of the River Stura in Demonte, a few hundred metres east of the town of Demonte
Ownership: Municipality of Demonte
Cartography: C.T.R. 1:10.000
Geological unit: Fort Demonte rises on a low and narrow rocky spear on the left bank of the River Stura, in proximity to an alluvial cone. The substratum consists of grey arenaceous or entrochal limestone with streaks of pink or yellow-red, with flint layers and Crinoid fossils and grey or greenish calcareous Dogger-Malm slate (upper-late Jurassic). These consist of marginal marine environment deposits
Altitude: //
Position: //
Context: Fort Demonte
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: care should be taken at the entrance, which is subject to falling material from the top of the ditch
Typology: 6 - military work
Description: in all appearances the same as the Primary Shelter on the Hornwork Counterscarp (CA 00005 PI CN), but situated on the south side of the ditch at a slightly lower altitude; difficult to interpret as it is almost completely

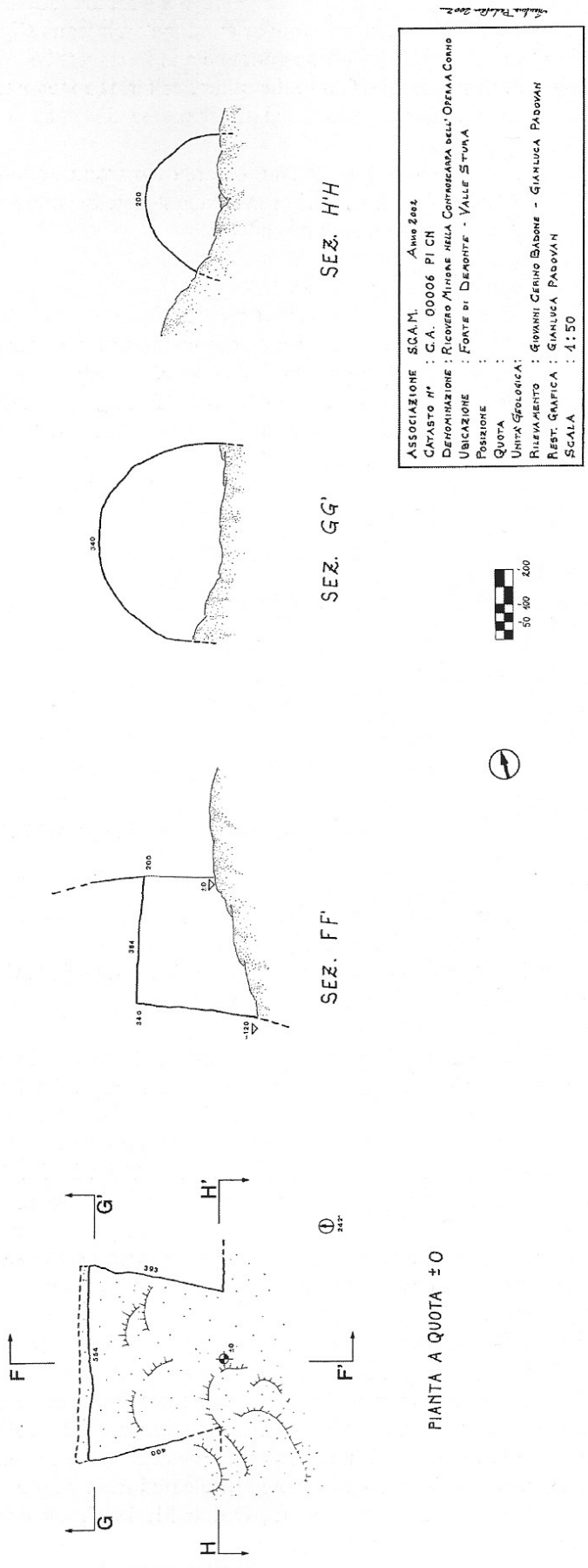

Fig. III.23. *Secondary Shelter on the Hornwork Counterscarp (CA 00006 PI CN) (Ass.ne S.C.A.M. Archive).*

buried. It is carved into the rock and is trapezoidal in shape (1.93 x 4 x 5.54 x 3.93 m) with a height measures 2 m at the entrance and 3.4 m high at the base. The semi-circular entrance arch leans slightly towards the base. The buried section does not allow for a clear interpretation of the entrance and it has not been possible to determine whether the shelter is protected by a low wall in similar fashion to the other shelter. It appears to have been carved less accurately however this could be due from the fact that material has become detached from the roof, resulting in uneven surfaces.
Interpretation: its purpose is assumed to be that of storage area for wood or fodder for draught, pack and saddle animals. Under enemy fire, this material could clearly have caught fire, however on the whole this is the best place for such an eventuality as little or no damage would be caused.
Dating: thought to be XVIII century.
Notes: the room and rear-lying ditch could be restored.
Bibliography: Padovan G., *Due noci dure da rompere. I forti di Demonte e di Tortona alla fine del XVIII secolo: l'organizzazione della difesa, la rete di contromina e l'approvvigionamento idrico*, in Anzanello E., Dal Cin F., Gasparetto P., Gava S. (edited by), *Atti Montello 2002. Conglomeriamoci. 21° Incontro Internazionale di Speleologia. Nervesa della Battaglia 1-3 Novembre 2002*, Villorba 2003, pgs. 293-365.
Data ownership: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002.
Compiled by: Gianluca Padovan (Ass.ne S.C.A.M.).

III.3.8 - *CA 00001 PI TO; First Cannon Room*

Cadastral number: CA 00001 PI TO
Denomination: First Cannon Room (figs. III.24, III.25, III.26, III.27, III.28, III.29 and III.30)
Region-country: Piedmont, Italy
Province: Turin
Municipality: Verrua Savoia
Locality: Verrua Hill
Location: "Bomb-proof" Barracks
Ownership: private
Cartography: CTR 1:10.000
Geological unit: marls, sandstones and Pliocene limestone resting on an Eocene Clay Shale Formation
Altitude: (ellipsoid) 304.07 m
Position: U.T.M. 429359.7506 E; 5002668.4365 N
Context: within the Donjon structure, upper area
Operations conducted: excavation, survey, photographic service
Work carried out by: Associazione Speleologia Cavità Artificiali Milano (S.C.A.M.); 2002
Warnings: structural collapse at entrance, poor air circulation
Typology: 6 - shelter
Description: the structure underlies the semi-circular parapet of the Donjon and is on the radial axis. The chamber is composite in shape and has a barrel vault, formed by a trapeze, the base of which supports a section of circle, the curved side of which follows the internal profile of the semi-donjon while the lower base faces the centre of the structure. Its base is significantly raised due to the soil which fills the room. The entrance consists of the collapsed entrance archway. From the entrance, the structure measures 1.91 x 4.17 x 2.97 x 4.29 m; the maximum height of the buried section is 1.64 m. As the first section is buried to above the piers, the room is believed to be slightly wider and longer. The piers and the vaulted roof are made of brick, while the infill wall is made of regular sections of pebbles, broken rocks and stones and occasional stone fragments, alternating with regular sections of bricks.
Interpretation: room under the parapet, which may have been used to shelter a piece of artillery and/or to keep munitions in the event of an attack.
Dating: built at the same time as the Donjon, it dates to between the third and fourth quarters of the XVII century.
Notes: the probe descends into the buried section by more than one metre and the room is thought to be more than 2 m in height. Near the entrance, the walls may slightly converge towards the centre, further enclosing the entrance, in the same fashion as the structure of the Fourth Cannon Room. Except for the collapse at the entrance, the structure presents no damage. There are several small formations on the roof. In order to conduct a complete investigation, the structure and the entire upper section of the Donjon should be cleared from within.
Bibliography: Padovan D., Padovan G., Bordignon L., Ottino M. 1997, *La Fortezza di Verrua Savoia*, in Club Alpinistico Triestino - Gruppo Grotte Sezione Ricerche e Studi su Cavità Artificiali, *Atti del IV Convegno Nazionale sulle Cavità Artificiali – Osoppo 30/31 Mggio - 1 Giugno 1997*, Trieste 1997, pgs. 187-208.