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CASE REPORT

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The Death of Countess Agusta in Portofino (Northern Italy) and the Soil from Two Mismatched Slippers

ABSTRACT: Accident, suicide, or homicide might have caused the death of Countess Agusta who fell from the 80-m tall cliff of her villa. Two mismatched slippers were recovered along the cliff. Use was made of microscope, X-ray diffractometry, scanning electron microscopy, and microprobe techniques to compare 40 mg of soil collected from the slipper soles with samples from the villa garden. Structural details of the slipper soles were consistent with the lady wearing them during the fall. Analysis of the soil residues confirmed that they originated from the garden only. The features of a few, minute glass chips adhering to the slipper soles reasonably matched those of other fragments that were found on a small ledge on the cliff beyond the garden parapet. Based on this and other evidence, the case was closed with a verdict of accidental fall.

KEYWORDS: forensic science, forensic geology, Agusta, slippers, soil, glass

Soil or dirt on footwear, clothing, vehicles, and tools may provide insight on provenance, itineraries, and links with a crime scene (1–4). Soil may contain fragments of rocks and minerals as well as organic material. As crimes often occur in sites of human activity, soil may also embody particles of fibers, plastics, paints, metals, glass, and bricks. When the questioned soil samples generically match the control samples, these materials are very useful to support provenance from the same micro-environment. In the case under review, the composition of soil traces on a pair of slippers, though in minimal amounts, provided crucial evidence for reconstructing the last whereabouts of Countess Agusta who plunged to her death from her cliff-top villa on the Italian Riviera.

The Case

Portofino is a picturesque sea resort on the Ligurian coast, located *c.* 40 km east of Genoa (northwest Italy). Splendid properties owned by jet-set multimillionaires rise on the hills overlooking Portofino's harbor. Countess Francesca Graffagni Vacca Agusta lived in one of these properties: Villa Altachiara, a 40-room luxury residence with pool, helipad, and park.

At 7 PM on 8 January 2001, after a troubled day with a mix of alcoholic drinks, tranquillizers, and quarrels and in a disturbed state of mind, the countess went out in the garden wearing a bathrobe and slippers and disappeared. There were only three people in the house: her Mexican companion, Rafael Tirso Roncado; a friend, Susanna Torretta; and a Polish cook. After a while, they got worried and began searching the house and the 10-acre park without success. At 2 AM, a call to the local Carabinieri's station gave the alarm.

The villa is right on the sea. The side of the villa facing the sea has a 10-m wide lawn bound by a low parapet, and beyond it, a 80-m tall and very steep cliff (Fig. 1). After the Carabinieri's search of the house and park failed to find traces of the missing countess, divers explored the sea area under the cliff. At a depth of 14 m, they found her glasses and bathrobe ripped in the back, but no trace of the body. Later, along the cliff, firemen recovered two slippers. After two weeks, her decomposed corpse, mangled by fish bites, was found on the French coast, between Toulon and Marseille, 300 km west of Portofino. The location of the corpse was compatible with the direction and speed of local sea currents.

The media gave wide coverage to the countess's death. A flamboyant former model and a keen socialite, she had married Count Corrado Agusta, owner and tycoon of a helicopter company (nowadays Agusta Westland). She obtained possession of the villa after divorcing from him in 1985 and of a multimillionaire estate after his death in 1989. Then, after becoming embroiled in a political corruption investigation and charged with laundering kickback money for the former Italian Prime Minister Bettino Craxi, she fled to Mexico, came back, and served a jail term.

Investigators needed to assess how the countess died also because her large inheritance was disputed between her Mexican companion and one of her former lovers. Was it an accidental death? Did she commit suicide? Was she pushed over the parapet down the cliff and by whom? The Scientific Investigation Department of the Carabinieri (RIS) of Parma conducted a careful survey of the house and surrounding grounds, and their laboratory analyses excluded the presence of blood or traces of violence. The postmortem examination revealed no water in her lungs and that death had occurred from a strong blow to her head before falling into the sea. The fractures and wounds of her body were compatible with a fall along the jagged, rocky cliff face.

As a forensic geologist, I was called by the Court to participate in the survey of the villa, analyze the cliff rock stratigraphy and the garden soils, and possibly establish correlations with the traces of dirt or soil on the countess's clothes and slippers recovered along the cliff. The investigations were intended to shed more light on what happened before the countess fall down the cliff.

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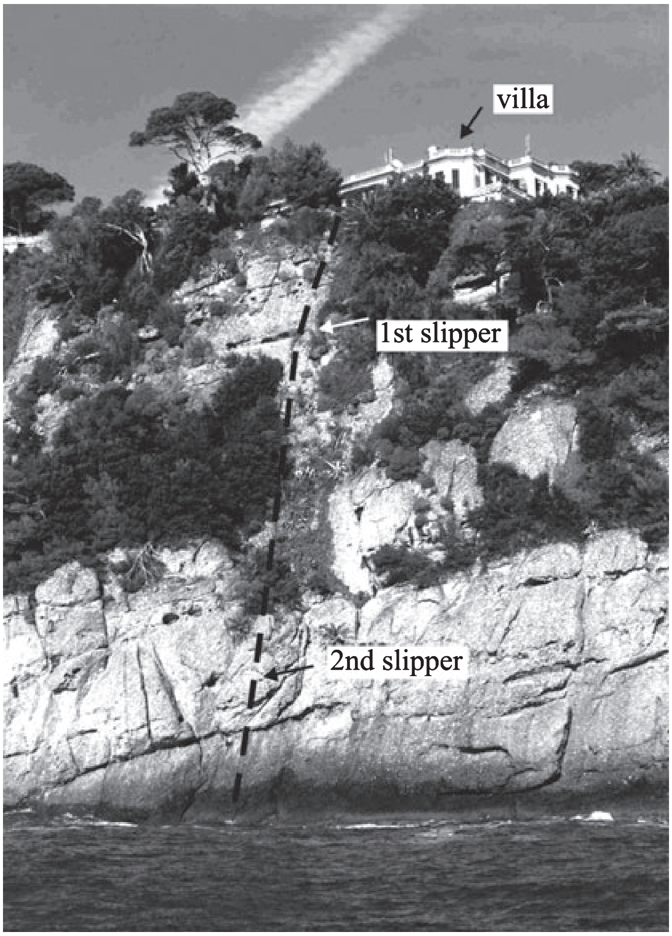

FIG. 1—*Villa Altachiara and 80-m tall cliff. The dashed line identifies the presumable direction of the fall (modified from an ANSA photo).*

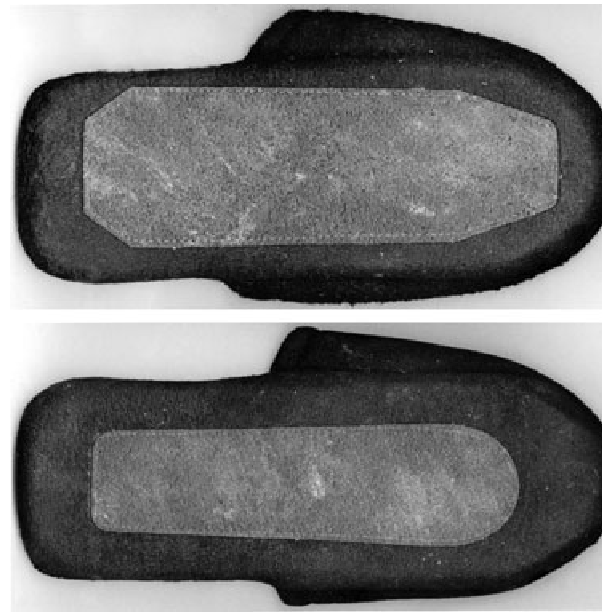

FIG. 2—*Soles of mismatched slippers. The sole shape of the upper (blue) slipper is different from the lower (black) slipper.*

Materials and Methods

Available exhibits were: i) one sweatshirt and one pair of trousers found in the house and smeared with brownish soil, which were of no relevance and will not be dealt with later on; ii) two pairs of slippers; iii) five soils from the cliff and five from the garden; and iv) plants from the garden.

All samples were studied under the stereoscopic microscope. Thin sections of the soils were analysed, after embedding their sandy fraction into epoxy resin. X-ray diffractometry (XRD) spectra were collected at 2θ angles of 2°–60°, using $CuK_{\alpha 1}$ radiation on a Seifert MZ IV (Seifert GmbH, Ahrensburg, Germany) equipped with monochromator. Analysis of individual particles was carried out with a Zeiss 940-A SEM-EDX (Carl Zeiss NTS GmbH, Oberkochen, Germany) and a CAMECA SX 50 electron microprobe (CAMECA, Gennevilliers, France), available at the author's department.

Results and Discussion

The Slippers and the Soil Traces

Firemen recovered the countess's slippers stuck on the cliff face: a black one 20 m from the top and a blue one in a fissure 10 m from sea level (Fig. 1). Although the slippers had mismatched colors and different sole shapes, they were of the same model and with equal left and right. The upper and lateral sides consisted of synthetic material with a 1-cm long nap; the sole, sewn with large stitches, was black with a rough surface. Their counterparts, collected in the countess's bedroom, were clean and with very little sign of wear and proved to be a useful comparator sample.

Both the slippers from the cliff had a thin smear of brownish soil and plant fragments adhering to their soles and lateral nap (Fig. 2). The soil was spread over most of the sole and transversal streaks could be observed. The streaks followed the same direction as the long axis of the sole, though with an angle of 30° on the blue slipper and 45° or more on the black one. At the sole end, in the back portion of the blue slipper (and to a lesser extent in the black one), part of the nap fibers appeared to have been pressed and stretched along the same alignment as the traces of soil (Fig. 3). As verified on the slippers found in the house, the naps were elastic and non-deformable by simple manual pressure.

Examination of the structure of the soles indicated that the slippers and the soil on them had been scraped along a stiff surface and subjected to strong strain. No detail of the sole surfaces and margins suggested that after the first alignment, the soil residues had undergone other static or dynamic stresses. Therefore the strain was assumed to have occurred in the last stage of the life of the slippers and to be compatible with the effect of the weight of a body sliding along the rocky cliff.

FIG. 3—*Left: Blue slipper found inside the villa. Right: Blue slipper recovered on the cliff; note the signs of strain of the nap in the back portion of the sole.*

Upon investigations, it was not known whether some of the occupants of the villa might be charged with murder and part of the evidence had to be preserved for possible defense examination at a later stage. Therefore, half of the sole was left intact and a sample of soil (18 mg from the blue slipper and 25 mg from the black one) was obtained by dry scraping only. The samples had a dominant volume of plant fragments associated with mineral grains and anthropic elements. Only few vegetal components had a size of over 1 mm; most of the mineral grains were less than 0.3 mm or finer.

The plant fragments were made up of dominantly dry, brownish parts of stems and leaves of *gramineae*. Remains of *Verbena* cfr. *officinalis, Viburnum tinus,* floral organs, and a whitish petal, ascribable to *Compositae*, were also identified. A 2-cm leaf of *Plumbago europaea* with saline concretions was detected under the blue slipper on the right side. A leaf fragment of *Viburnum tinus* was observed inside the blue slipper. All these plants are very common in the villa's garden. A 5-mm long, single white animal hair was under the blue slipper.

The thin-section study identified rock fragments to be micaceous quartzites, phyllites, a few micritic limestones, and several minerals: quartz, K-feldspar, plagioclase, muscovite, biotite, chlorite, clinopyroxene, amphiboles, epidotes, tourmaline, and iron oxides. The major components quartz, feldspar, and mica had clear peaks on the XRD pattern (not reported). These rocks and minerals are all present in the geological formation of the cliff and constitute the bedrock of the garden. No sample was found to be contaminated with soil of different provenance.

Anthropic fragments in the samples collected from the soles included: diffuse white, blue, and black fibers from the slipper nap; a few millimeter long red fibers; shreds of a thin white plastic sheet; a few minute colorless glass chips with sharp edges and irregular shape.

The Soils of the Cliff and Garden

Macroscopic and thin-section analyses confirmed the geological map data (5): the villa is built on an Oligocene formation named "*Portofino conglomerate*." Coarser levels alternate with sandstones and shales. During the survey, with the help of firemen, one officer from the Carabinieri team (Col. L. Garofano) and one pathologist (Dr. R. Testi) descended the steep cliff with ropes, looking for evidence of the countess's fateful fall. They also picked three samples of soil from rock cavities. Two other samples were collected by the author at different levels on the cliff face.

In the portion of the lawn extending from the parapet to the living rooms of the villa (Fig. 4), four 1000 cm^2 zones of thinner grass cover, potentially favoring soil adhesion to objects, were selected. Representative samples of some tens of grams were collected from different spots in the surface layer of the garden. Another soil sample was picked from a ledge which lay beyond the parapet bordering the eastern side of the garden on the cliff edge.

The composition of the size fractions of a soil may significantly differ. Thus, attention was focused on the study of the finer fractions of the samples which were assumed to be comparable with the traces of soil on the slippers. Results may be summarized as follows: the composition of the analyzed samples was very similar and differences lay in the relative abundance of the same components and in the presence/absence of minor components. In all the samples, plant fragments were volumetrically dominant. In the soils from the cliff, *gramineae* were found to be abundant and associated with caryopses of *Poa annua,* of wild olive (*Olea europea* var. *sylvestris*), and of holm oak (*Quercus ilex*). The garden soils

FIG. 4—*From the right, the lawn in front of the villa sitting rooms, the parapet and below the cliff. At the far right the trees growing on the verge of the cliff where is the ledge of Fig. 6.*

showed a wider assortment of vegetal structures. Nonetheless, they included all the vegetal observed in the soil adhering to the slipper soles. Minor amounts of charred vegetal matter were detected in all the samples. Parts of terrestrial gastropod shells and limbs of arthropods and insects were recognized.

The rock fragments and minerals found in the residues remaining on the slippers were also determined to be part of the inorganic fraction of the garden soils, which also contain schists, and among minerals, garnet and glauconite. Mineral grains in the soil adhering to the slippers and in the control soil samples demonstrated to be morphologically similar, with mainly angular shapes. The findings from these analyses inferred that the mineral fraction of the control soils (and of the questioned soils) derived from the rock formations constituting the cliff (Fig. 5).

Among the anthropic elements, only few fibers were found in the soil from the cliff. In the samples from the garden, fibers of diverse color and morphology were associated with occasional small fragments of bricks. One soil sample was collected on a small ledge, just beyond the parapet bordering the garden, protected from the overhanging cliff by the trunk of a large holm oak (Fig. 6). Glass fragments were identified on this ledge. The fragments were traced to the broken cover of a spotlight lighting the tree and mounted on the outer lower part of the parapet. At the time of the survey (8 February 2001), these fragments were exposed on the surface, with no cover of leaves, soil, or other matter. Very small glass chips were identified under the sole of the slippers and therefore analyses were carried out to establish possible analogies.

The Glass Chips

Glass chips (maximum size: 0.6 mm) were picked from the slipper soles, three from the blue and four from the black one, with a total calculated weight of slightly more than 1.5 mg. Their characteristics were compared with same-size fragments found in the soil from the ledge.

Under the stereoscopic microscope, both sets of grains proved to have similar color, transparency, and shape (Fig. 7). SEM observation of glass samples from the slippers and the ledge revealed an even morphology of their surface and edges, with many features in common (Fig. 8).

Refractive index and trace element contents are used to distinguish glass of diverse origin and recent reports have provided a good review of the state of the art (6–8). At the time of the

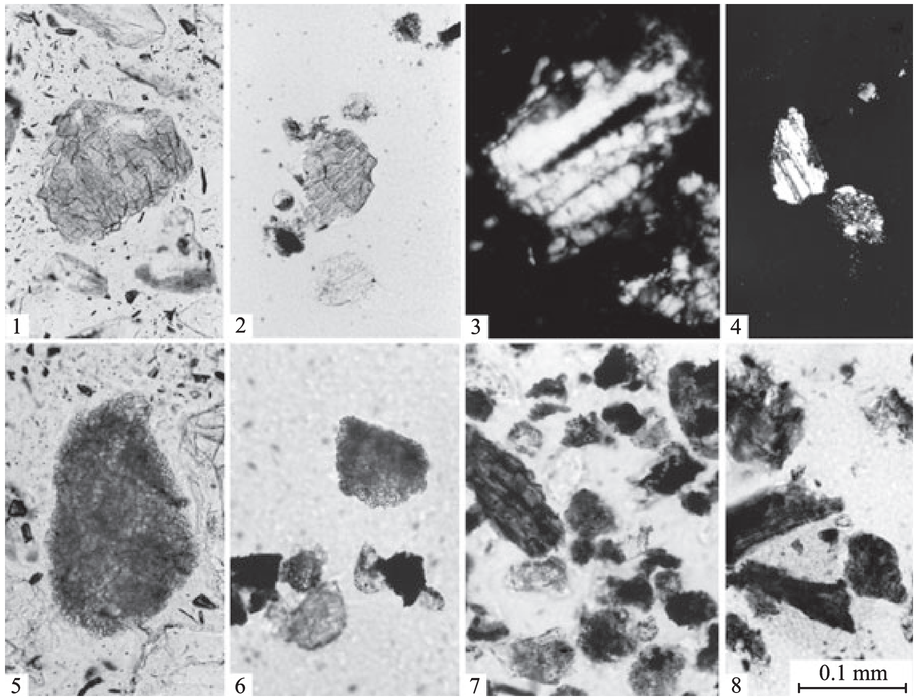

FIG. 5—*Under the microscope in thin section (no. 3 and 4 with crossed polars). Analogies of the morphology of the same components present in the garden soils (odd numbers) and under the slippers (even numbers). 1 and 2 = amphiboles; 3 and 4 = quartzites; 5 and 6 = limestones; 7 and 8 = plant fragments.*

FIG. 6—*Beyond the parapet bordering the villa garden, the small ledge on the cliff protected by tree trunks, where glass fragments from a broken spotlight were found.*

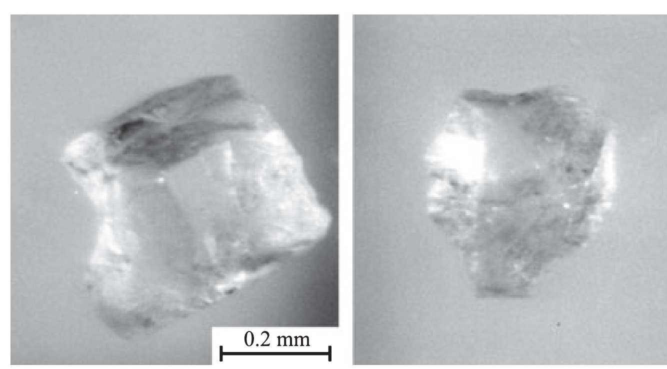

FIG. 7—*Left: Glass chip from the ledge; right: glass chip from the blue slipper.*

investigation, no refractive index system capable of measuring fragments of less than 300 μm in a nondestructive way was available. The amount of glass chips from the slippers (*c.* 1 mg) was too small to afford multi-element analysis by ICP-MS.

A quantitative major element analysis was made by means of a CAMECA SX50 microprobe. Two chips from the black slipper and two from the ledge were glued to a glass slide, flattened, polished, and carbon-covered. Twenty measures were taken on each sample using a defocused spot size (10 μm). The discriminating power of the analyzed elements was limited. Nevertheless, the results (Table 1) did not rule out that they might come from the same piece of glass. As no glass chips were found in the other samples from the garden or inside the villa, the body of results (color, morphology, and chemical data) reasonably supported a common origin of the glass chips from the slippers and from the ledge.

Conclusions

The soils of the garden and collected on the cliff are compositionally very similar, with only minor differences. All the rocks, minerals, and plant fragments that were found in the residues adhering to the slippers are also contained in the soils of the garden. The two slippers, one blue and one black, came from two different pairs. Their counterparts found inside the villa had no soil on them and were presumably used in the house only. It is unlikely that the countess normally wore mismatched slippers. Hence, it is reasonable to assume that most of the questioned soil adhered to her slippers at a time close to the evening of her death, but no specific source point for such soil was identified in the garden.

On both soles, the naps were in part aligned and modified by a strong strain, such as the one imparted by a body wearing them and sliding along the cliff. This scenario may suggest a suicidal jump, somebody throwing the countess down the cliff, or an accidental fall. In the first two cases, the natural choice would have

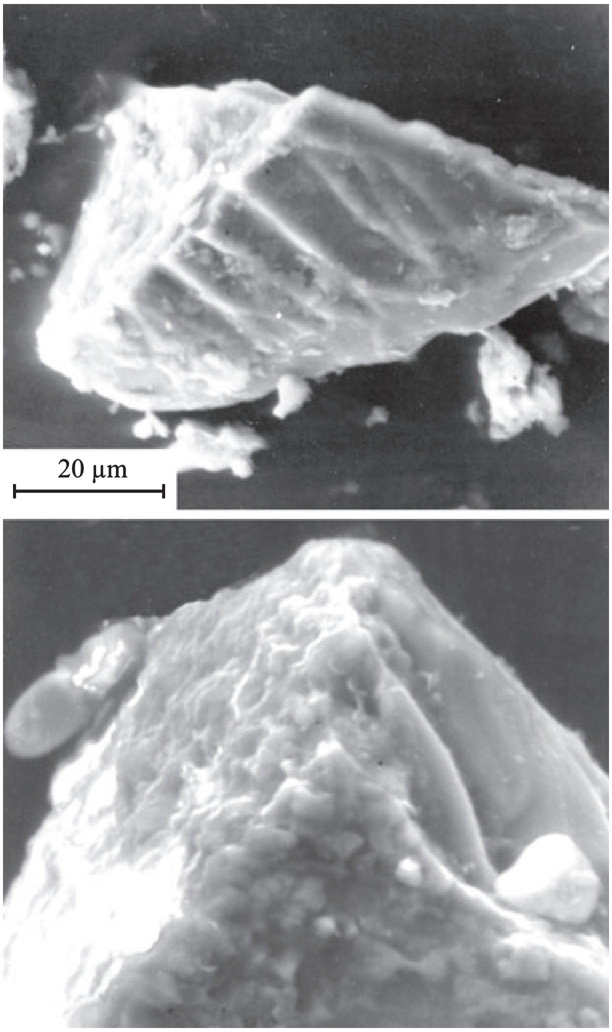

FIG. 8—*Scanning electron microscopic image of the surfaces of the glass chips from the garden (upper) and from the black slipper.*

TABLE 1—*Average of 20 microprobe spot analyses on glass chips from one of the slippers and from a soil sample from the ledge.*

	Two glass chips from under the black slipper sole				Two glass chips in a soil sample from the ledge			
Oxides	No. 1	SD	No. 2	SD	CH8 a	SD	CH8 b	SD
SiO_2	71.41	0.33	71.39	0.36	71.60	0.18	71.69	0.14
Al_2O_3	1.81	0.05	1.81	0.03	1.81	0.03	1.80	0.03
FeO	0.10	0.02	0.11	0.03	0.10	0.02	0.10	0.03
MgO	3.93	0.05	3.94	0.05	3.97	0.04	3.97	0.03
CaO	8.95	0.08	8.99	0.08	8.96	0.08	8.98	0.07
K_2O	1.09	0.02	1.10	0.03	1.11	0.03	1.10	0.02
Na_2O	12.67	0.11	12.69	0.08	12.74	0.09	12.73	0.06

been the parapet in front of the villa's living room windows, free of trees and with an abrupt precipice. But no glass chips from the ledge would have remained attached to the slipper soles and no glass chips were detected in the control samples.

The irregularly shaped ledge (Fig. 6) had a firm platform of only 1 m^2 or so. It was in part protected by the trunks of a tree and had a mat of plant residues from garden pruning. It is conceivable that the countess found a temporary hideout on this ledge. Then, moving laterally and not realizing in the dark that the side of her platform on the cliff edge consisted of a mat of leaves and branches, she must have fallen to her death. The fall trajectory from the ledge is consistent with the location of the slippers on the cliff face.

One may wonder why a rich lady would walk out in slippers and bathrobe in the dark of a cold January evening and remain in hiding behind the garden parapet. A postmortem psychiatric assessment of her personality, ordered by the Court, concluded that she had symptoms of infantile regression and an agonizing need for attention. This point was substantiated by episodes of disappearance in the park and of hide-and-seek playing with her friends. The same might have happened during that tragic evening. In the dark, she hid behind the parapet, stepping on the soil and leaves (and glass fragments) of the above-mentioned ledge. The unstable makeshift platform gave way and she crashed down the cliff, heavily hitting her head, ripping, and losing her bathrobe and slippers.

The survey in the villa, garden, and cliff offered no evidence of acts of violence. The fractures and injuries to the countess's body revealed by the postmortem were compatible with the 80-m fall along the cliff. In spite of the small weight of available evidence, the presence of glass chips in a soil made it possible to define a micro-environment. These findings combined with those from other scientific investigations conducted by the Carabinieri's scientific team (RIS of Parma), helped trace Countess Agusta's death to accidental fall.

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