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CANNAE BATTLEFIELD: A GEOMORPHIC-GEOARCHAEOLOGIC PERSPECTIVE

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Abstract:
The Cannae Battlefield (216 BC), a pivotal engagement during the Second Punic War, led to the destruction of one of the largest consular armies ever raised by the Republic. Historians have for centuries paid the utmost attention to unit-by-unit dispositions and tactical maneuvers without studying the local geology and particularly the geomorphology of the battle site. A brief traverse over the battle site, adjacent to the museum in 2004, led to a hidden defile, heretofore not mentioned in the literature, one which may have helped turn the tide for the Carthaginians, and offering prospect of further geoarchaeological investigation.

Key words: Cannae battle, Hannibal, Geomorphic background, Hidden defile.

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INTRODUCTION

The Cannae Battlefield (216 BC), a pivotal engagement during the Second Punic War, led to the destruction of one of the largest consular armies ever raised by the Republic. Led by co-consuls Paulus and Varro, a force of ~75,000 legionnaires were routed, eight to ten entire legions totally or partially decimated, all in the space of a few hours. Much has been written about troop dispositions, the Roman force packed cohorts deep between a limestone ridge and the Aufidus River, the Roman line more than a km in length facing into the wind, i.e. to the west-southwest. Lazenby (1998) uses head counts to estimate the Punic battle line was 1.5 km in length. The Punic Army under Hannibal, having twice crossed the river was arrayed against the Romans, disposed as a crescent or parabola with its apex facing the Roman center, wings comprising Spanish and African infantry, Celt-Iberians in center. Cavalry, dispersed-heavy horse formed to the left against the river, Numidian light cavalry to the right (Lazenby, 1998, p. 82–83). While the Romans are said to have pondered the Carthaginian battle formation, Hannibal, ordered wings to hold, center to fall back forming a funnel into which he hoped the Romans would pour. Historians have for centuries paid the utmost attention to unit-by-unit dispositions and tactical maneuvers (Lazenby, 1998; McCall, 2002) without studying the local geology and particularly the geomorphology of the battle site. From the Aufidus (now Ofanto) River to the southeastern highlands, strand terraces alone carry a record of previous erosional episodes stretching back into the Neogene, their conformable or unconformable soil/paleosol covers alone offer paleoclimatic reconstruction on a grand scale to anyone wishing to undertake a most interesting project. It is the floodplain, however, where most artifacts from the engagement have been collected and displayed in the Cannae Museum. A later brief discussion with the curator and staff led to a brief traverse over the battle site, and escarpment adjacent to the museum in 2004, which led to a hidden defile, heretofore not mentioned in the literature, one which may have helped turn the tide for the Carthaginians, and one offering prospect of further geoarchaeological investigation. If so, not the only time Hannibal made the land (and weather) work for him, his troops with their backs to the wind withstood a dust storm (probably a sirocco) that came up as the battle progressed.

Historians who have studied the Battle of Cannae (Dodge, 1891; Lamb, 1958; Brown, 1963; Appian viz White, 2002; de Beer, 1969; Proctor, 1971; Livy, 1972; Polybius, trans. 1979; Walbank, 1990; Cottrell, 1992; Lazenby, 1998; Bagnall, 1999; Lancel, 1999; Mosig and Belhausen, 2006; O'Connell, 2010; Goldsworthy, 2019, among others), and there have been legions alone who have been overly pre-

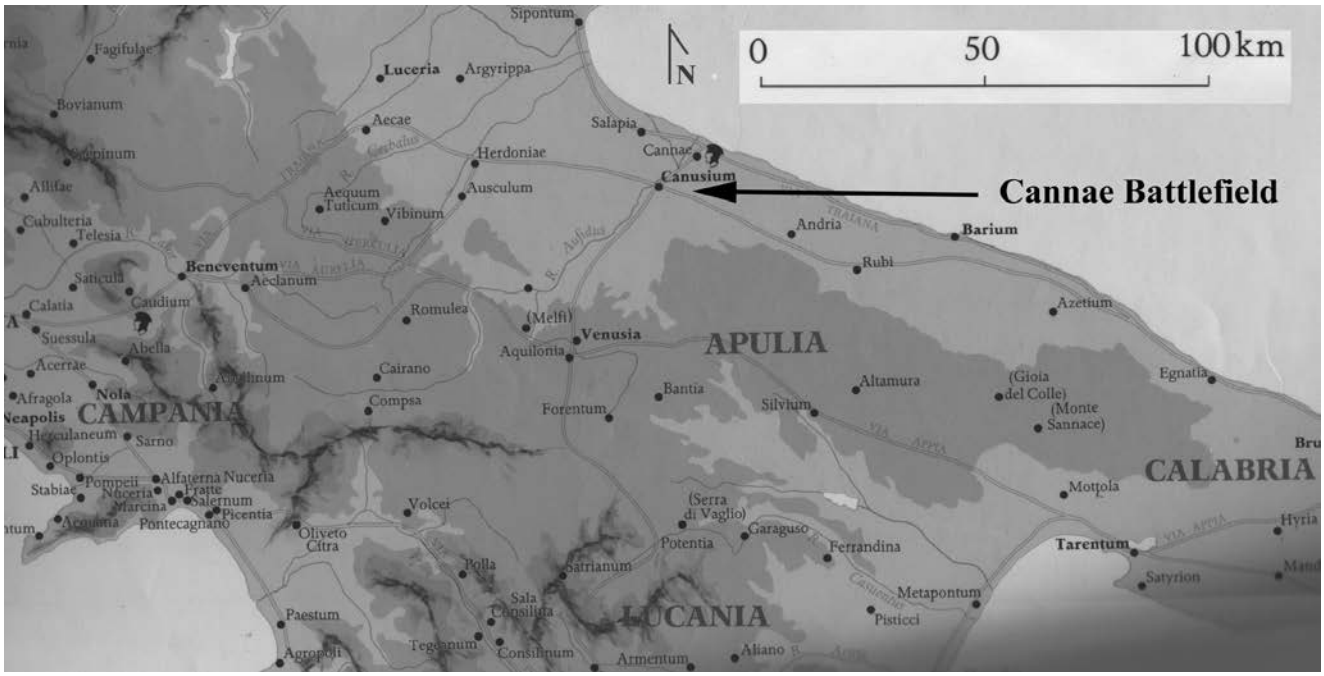

Fig. 1. Location of the Cannae Battlefield inland from the Adriatic Sea.

occupied with events leading up to the battle. Chief among these events are lack of support for the Fabian strategy of attrition following the Lake Trasimene debacle of 217 BC, Hannibal's destruction of the Apulian Plain (Fig. 1), Punic seizure of the granary at Cannae, and the disposition of units of both armies prior to the onset of battle and the ensuing mayhem. What many have failed to do, outlined by Seibert (1993), is visit the battlefield itself, and the nearby *Museo Cannensa* which contains rich displays of the history leading up to the battle and dioramas of the opposing forces. The museum collection is focused on the battlefield, lying north of a prominent escarpment, oriented northeast in line with the meandering course of the Ofanto River (named Aufidus in Roman times). The defile in which the museum is located is not mentioned as important in any displays and seems to have escaped notice by historians. Leading to the northeast, the defile leads around the prominent escarpment issuing out beyond the Roman lines, its topographic setting ideal for encirclement of the Roman forces. Assuming the Romans, as usual, did not cast reconnaissance troops to scour the landscape prior to engagement, and further assuming Hannibal did just that, his cavalry scouts may have discovered the defile, a perfect encirclement route.

When I visited the *Museo Cannensa*, and hiked the high escarpment nearby, I quickly focused on the defile and wondered if Hannibal had used it to flank the Romans. At the time, and thereafter, I searched the literature with the defile in mind and came up blank, so my confidence level is above 95% that previous mention of this favorable topography has not previously appeared in print. This planning hypothesis is within the assessments of Punic historians that Hannibal picked his ground with great care. Even when faced with the right ground for his cavalry to operate, as at the Rhône Crossing in 218, when he had nearly 2:1 odds against Scipio (Mahaney, 2008a), he moved north along the Rhône toward his objective—Orange, the lowland Gauls and the high Traversette Pass. I wonder now, and wondered in 2004, how the ultimate tactical chess master could have missed this one opportunity to break the Roman opposition—A Roman Consular Army with favorable odds: at least 2:1. According to Hart (1967) Hannibal never deviated from his strategy—to destroy Rome where it lived.

One postulated battlefield

The Vicus monument on a limestone bluff (Fig. 2A) above the battlefield, at 59 m a.s.l., gives an unobstructed view of the field to the west and north. The young terra rosa soils with Ah/C/Cox/Cu profiles on the floodplain and low terraces around the battlefield provide a repository for the blood spilt that day in August, 216, when hemoglobin saturated clays adsorbed iron that may still recycle amongst the olive trees that populate the site. The red color of these profiles reveals 10YR 2/4 colors occasionally reaching the strength of 7.5YR 4/4 quite red for such a young age, possibly due to recycling of human blood from the ~2200 yr old battle.

A visit to the site brings out the character of the landscape (Fig. 2A–C) that would have been viewed by both Romans and Carthaginians. What must have stood out to the Romans was Punic superiority in cavalry, particularly heavy cavalry, that if let loose against their infantry would decimate them. Hence, the Roman decision to form up in an unusually thick line of infantry with cavalry on the wings, a disposition that may have caused Hannibal to reform into a crescent (Fig. 3) with orders for his heavy cavalry on the left

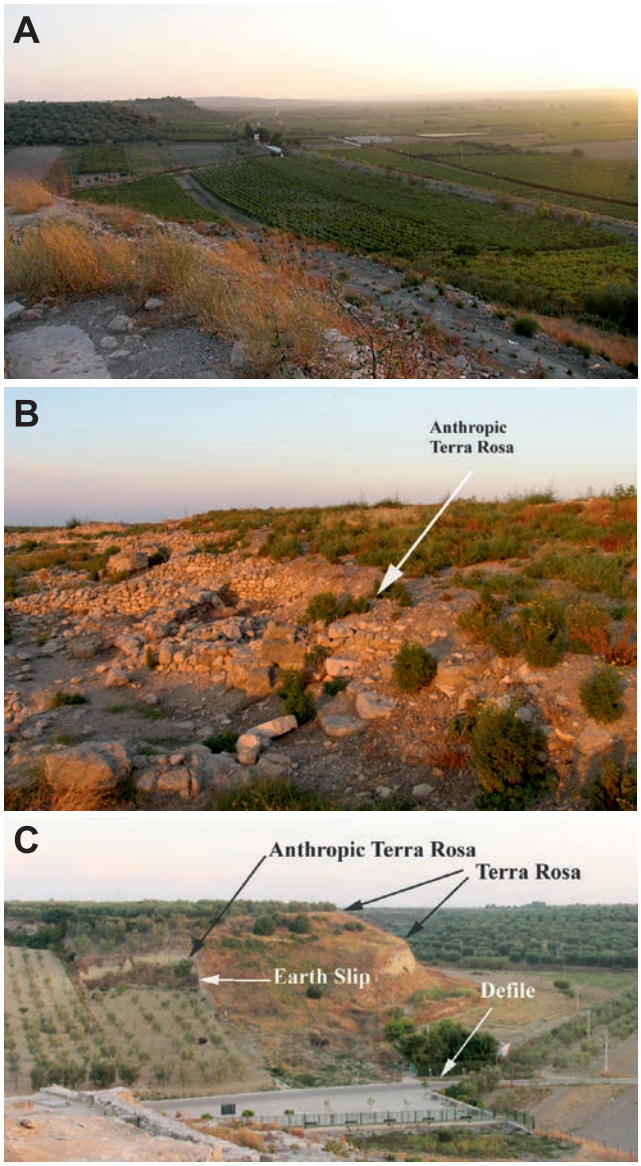

Fig. 2. A, Low terrace with olive clusters; B, Escarpment surface, greatly disturbed, with a mix of carbonate and terra rosa remnants; C, View to the south across the defile and parking lot of the Museo Cannense with high bluffs beyond showing (to right) remnants of deep terra rosa paleosol with irregular lower boundary. To the left, part of the land surface looks to have undergone land slippage, the soil (viz paleosol) having been eroded leaving carbonate plus organics (Ah material) behind, a typical anthropic profile.

to break the weakest link in the Roman line, their right flank of heavy horse against the Aufidus River. The very fact that the Romans preferred the floodplain and low terrace, as the site of engagement must have come from their confidence in superior numbers bringing a positive outcome, and a belief their cavalry could hold its own against the Carthaginians (Healy, 1994). Hannibal must have been overjoyed at the prospect that his cavalry would have the low-lying terraces on which to operate, prime topography for them. But what of the higher terraces, and in particular the prominent defile to the southeast of the battle site (Figs 2C and 3), a valley obscured by a bluff to the north, and situated so that it leads around the battle site allowing a small force to lay concealed until the battle was joined. It is the character of the higher terraces and bluffs (Fig. 2B, C) and the presence of the northeast-southwest defile that surely did not escape Hannibal's notice. With his proclivity for deception and surprise, Hannibal must surely have considered the effect of a small cavalry force, hidden in an obscure declivity, let loose as the battle was joined with the Roman force. The effect would be not unlike the Punic cavalry attack at the Trebbia in 218, when Mago (Hannibal's brother and Punic general) led 1500 cavalry onto the Roman rear after the battle had been joined with Hannibal's main army (Polybius, trans. 1979, III, 72–74). The result was sure panic and derision among the Romans, their entire consular army decimated.

It is the nature of the Cannae landscape, its age and tractability for cavalry, and in particular, the lone 2-km long defile, that is the main subject of this paper. When considering the disposition of troops, one caveat rears itself considering the river has changed position in the last 2200-odd years, its present location farther to the southeast than when the confrontation occurred. The difference is to the order of ~500 m (~0.5 km), which enlarges the actual conflict zone with all other topographical obstacles remaining static. Because there are several versions of the battlefield location, all referenced above, I prefer to follow the approximate location based upon the artifact collection in the Cannae Museum along with guidance from Museum Staff. There is no intention here to debate locations, only to pres-

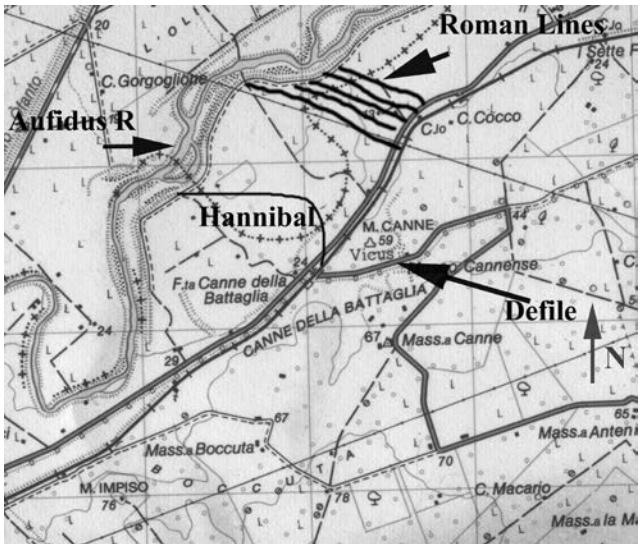

Fig. 3. Topography of the Cannae Battlefield showing the hidden defile. Contour interval not defined on the Barletta quadrangle, 1:50000, but working down from Mt. Cannae (59 m), to the Aufidus (now Ofanto River), the CI appears to be 10 m, all very faint on the print. Proposed disposition of Punic Cavalry, heavy horse to the left of the parabola, Numidian Cavalry to the right, mercenaries in center with African and Spanish infantry astride, with orders to hold with mercenaries to fall back creating a funnel. Roman deployment (thick lines) with ~70,000 troops packed between the escarpment and the Aufidus River, a 1.3 km wide line. Based on historical sources, the odds were 2.5: 1 with Roman superiority in numbers. Roman heavy horse populated by older senators, long away from combat, formed up on the Roman right. The parabolic line apparently mystified Roman consuls Paulus and Varro, Carthaginian units changing position when ordered with little difficulty, the product of previous drill.

ent a geomorphic entity—the defile—that may lead to a new hypothetical description as to how the battle unfolded. Such is little different than other postulated battle positions offered by other authorities such as Goldsworthy (2019).

FIELD AREA

The climate and soil climate of the area is Mediterranean subcontinental to continental, with a mean annual air temperature of 14–20°C, and mean annual precipitation amounting to between 420 and 700 mm. The heaviest precipitation occurs in late fall (October to November), the least in summer from June to August. Mean monthly temperatures are always above 0ºC. The soil moisture regime is xeric in most sites, dry xeric in others; the thermal regime is thermic (Bini, 2013). The precipitation is sufficient, even with interludes of climatic change to insure slow weathering of bedrock to remove soluble constituents like Ca leaving slow evolving residues of Fe, which in a weathering environment would be Fe^{+3}.

The area, underlain with Mesozoic limestone and marl, contains thin covers of residual fluvial, aeolian and mass wasted deposits, the latter thickest on the higher terraces. The land surface is level near the Aufidus River, moderately sloping away to the south. The carbonate bedrock and associated terra rosa soils and paleosols cover a vast area in Italia; here, the mean slope is 3% on the Aufidus Plain, ideal almost for cavalry operations (Bini in Constantini et al., 2013). The Constantini et al. report is part of the publication title—"Pedological Methodologies: criteria and procedures for the creation and up-dating of the soil map of Italy (scale 1:250,000)" promoted by the Italian National Observatory for Pedology and Soil Quality, financed by the Italian Ministry for Agricultural and Forestry. This source would be invaluable to anyone starting up a major project involving the defile exploration.

METHODS

Field observations follow Birkeland (1999) and Mahaney (1990). Shallow pits (<20 cm) were excavated and described but no samples were collected as the site is under archaeological exploration by the *Museo Cannense.* Field textures and soil colors were taken across the floodplain and flight of associated terraces from near the river and across the low escarpment and defile to the south of the Ofanto River (cf, Aufidus).

RESULTS

Geology

Bedrock is limestone from the Aufidus River to the escarpment off to the southeast of the battlefield (Fig. 3). Varying thicknesses of calcareous sediment make up the terraces arranged en echelon, with increasing thickness from the river to near the escarpment crest. The few erosional cuts, and the long gulley (defile) near the Museo Cannae (Fig. 3), offer rare exposed sections that indicate the terraces extend back into the Pleistocene, possibly further into the Neogene. Lacking a research permit during my stay in 2004, it proved impossible to open sections and collect samples. Hence, all information is by observation in the field. Six terraces were observed, the two youngest comprising near flat topography, probably of Holocene age, make up the battlefield; the four additional terraces etched into the hillslope most probably relate to erosional episodes into Pleistocene time.

Soils and Paleosols

The main soils in the area, observed from stream cuts, are fluvisols with A/C/Cu profiles that comprise the floodplain of the Ofanto River, formerly the Aufidus. These soils grade off to the south onto a low terrace below the limestone escarpment now covered with olive trees. Slight variations in percentages of clay and strengthening of color from 10YR hues to 7.5YR and 5YR strength (deeper reddish-brown color) attest to greater age on the intermediate level terrace systems. For more on colors visit Mahaney (1990) and to determine how sediment color reveals stages of weathering see Oyama and Takehara (1970) for ranges of color chips (equivalent to the Munsell color charts). True terra rosa soils begin on the lower terraces (elevation 50 m a.s.l. and higher). Soils with higher clay contents and deeper red colors stronger than 7.5YR could be classed as paleosols and many of the higher profiles could have ages dating beyond the Pleistocene/Pliocene boundary.

Terra rosa, the name given to residual soil, also known as terra *rossa* in Italian, is known principally by its relation to carbonate rocks and its distinctive red color (Fig. 2C). Variations in the color of these soils, even in the Cannae Battlefield area, range from orange to reddish brown and shades of deep red hues. Dissolution of muddy limestone and marls produces totally soluble carbonate that washes into the ground water and river leaving a mixture of clay to sand with residual Fe oxides, hues reddening over time as Fe^{+2} weathers to Fe^{+3} giving the soil its distinctive color. Terra rosa is a distinctive red soil found in many regions, including the Adriatic Sea Coast, North Africa, La Mancha (Spain), Coonawarra in Australia, and the Judean Hills in Israel. Around the Mediterranean, terra rosa soils in the field area have been farmed since ancient times and are suitable for agriculture, especially wine and olive production. The interrelations between the soils and carbonate-free remainder of the limestone in Apulia is discussed in Mosing and Belhausen (2006).

In pedology, terra rosa is classified as a chromic luvisol belonging to the older pedons above the battlefield on the higher terraces. These soils, with strong Bt horizons, take longer to form, as calcite is soluble even with an alkaline

pH, and secondary Fe (Fe^{+3}) takes longer to concentrate. The various deposits of terra rosa soil around the world were created over millions of years, as limestone, rich in iron oxides, weathered. In the Ofanto catchment the major question involves the concentration of iron in bedrock and its relationship to weathered residue, i.e. the soils and paleosols. Pedologists believe that frequent changes in climate over the ice ages and longer, especially heavy rains associated with these changes, helped break down the limestone, turning it into terra rosa soil.

The younger soils in the floodplain and low terrace landforms, underpinning the battlefield, are shallow and partly eroded Eutric Cambisols; Calcaric Regosols, nominally with Ah/Cox/Cu profiles. On the higher slopes and terraces soils grade into paleosols carrying designations as calcaric and Rendzic Leptosols, that is pedons with carbonates, clay and iron oxides, and Luvisols with Bt horizons in profiles (Fig. 2C, right of center), many of which are anthropic (Fig. 2C left of center) with long human histories of land use, and in some cases, soils have formed on landfill in place for millennia.

DISCUSSION

The intent here is to present the observations of a reconnaissance, not a full-blown project, and to give background that may be useful to others capable of mounting a project focussed on a paleoenvironmental assessment of the strata and fill terraces that partially encompass the battlefield and adjoining terrace sequence.

Using information from the Barletta sheet, 1:50,000.

The battlefield is at about 25 m a.s.l. elevation. Monument, labeled Vicus is at 59 m elevation above the *Museo Cannae*. The battlefield, now overgrown with olive groves, at the time of the battle resident soils of the floodplain and low terrace were soaked with blood from wounded and dying Romans. Not only the sediment but the river, bridged with corpses ran red with blood according to ancient accounts (Lancel, 1999; Goldsworthy, 2001), all that successional olive groves probably used iron in various forms—amorphous and crystalline—along with plentiful carbonate, as nutrient for growth.

Pre-battle

Historical versions of what led to the battle site vary greatly from author to author but it seems the granary at Cannae was the main target plundered by the Punic Army. Following events vary still but it seems that Hannibal crossed to the east side of the river, crossed again to the west, and deciding the land not suitable for battle, crossed again to the east side. It is quite possible Hannibal found the defile astride the escarpment, and decided to use it to later flank the Romans, if they followed his invitation to engage. He may also have decided to lodge his heavy horse against the river (his left), and input his Numidians on the right against the escarpment, with a splinter group of ~1500 to move along the defile to flank the Roman left if they engaged as expected. Similar use of topographical entities by Hannibal occurs in other instances before and after Cannae, and one in particular occurred when he came up against Consul Marcellus in southern Italy in 208 (Lancel, 1999). Scouting Marcellus's front line, Hannibal focused on a dense copse of forest, and theorized that with his subsequent withdrawal, Marcellus would follow with his usual shadowing of the Punic forces. Hiding an elite unit of cavalry, men and horses lain down in the copse, he withdrew as Marcellus advanced with only a small guard. As expected Marcellus was ultimately surprised and killed.

It is from such maneuvers like this that the Hannibal-landscape co-relation was formed. Starting presumably with Lamb (1958), many authors have focused on Hannibal's acute ability to pick the topography or just march away (Mahaney, 2008a, b).

The Battle-Simplified

Troop dispositions at Cannae have been studied and restudied over time (de Beer, 1969; Proctor, 1971) with most workers attempting to discover how and why the Romans dispersed in multiple ranks with closed-in cohorts (Fig. 3) marking a narrow front—river to escarpment, Hannibal ordering his front dispersed parabolically. One can imagine how the Romans could easily fix their spacing of individual units, unlike the Carthaginian displacement which would have had to be practiced many times beforehand, with prearranged signals—horns and flags perhaps—all readily readable unit-to-unit. If Hannibal's force mustered 30–40,000 soldiers and cavalry as most sources think he did, forming up in short-time frames and in such an unusual spatial arrangement, units had to be used to short-term realignment all carried out with speed and agility. Hannibal, placing his army with their backs to the southwest and wind, opens the question as to whether he had knowledge of winds in southernmost Italia. If he did, and if he realized wind systems often raised strong winds and dust (Volturno wind system), rising to full-fledged dust storms, he may have counted on placing his troops with their backs to the wind-blowing sediment. According to many authors (Goldsworthy, 2019, among them), many repeating what they had read from others, this is what happened. Hannibal's troops fought with the wind behind them; the Romans with the full intensity of rising dust in their faces as the battle wore on.

The Defile

As a Hannibal scholar, having read nearly all ancient, medieval, near present and modern accounts of the

Cannae Battle, and one who has visited the Cannae battlefield, I can say with certainty that Hannibal would not have missed the opportunity to use the defile near the present Museo, the topography offering a precise cavalry envelopment. Previous historical accounts are certain that the Romans watched Hannibal's river crisscrossing maneuvers with amusement, but certainly he sized up the landscape to meet his expectations, and the hidden defile might have been one among many. The defile's importance stems from the fact that artifacts previously collected are from the lower terraces off to the west from the escarpment to the Ofanto River making it likely that significant finds may await discovery along the defile to where Punic cavalry may have worked behind the Roman front lines. Polybius summarizes Hannibal's movements during the battle with the Numidians heavily engaged on his right (Polybius, III, 116) but no mention of the defile and Roman encirclement.

CONCLUSIONS

The defile by itself demands a geoarchaeological survey to determine if artifacts—equestrian pieces, coin, weapons etc.—detailing the battle exist, and if so, a whole new chapter of the Cannae Battle may need to be written. Assuming Hannibal did hide a sizable unit in the defile for a short time, it is possible weapons, coins, equestrian hardware might be recovered, which will require section survey and metal-sweeping at some time in the future. In addition, the morphogenesis of terra rosa soils into paleosols will likely reveal not only information on the paleoclimatology of the valley, but also significant findings pertinent to this much understudied group of soils and paleosols, the Terra Rosa's.

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