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Andrei STAVILĂ
Dorel MICLE
Adrian CÎNTAR
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și Sorin FORȚIU

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A METHOD FOR THE EVALUATION OF THE DYKES. 
CASE STUDY FOR “ATHANARIC’S WALL”

Eugen S. Teodor*, Costin Croitoru**

* Muzeul Național de Istorie a României; esteo60@yahoo.co.uk
** Muzeul Brăilei; costin_croitoru1@yahoo.com


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1. Briefing historiography

The concerns beyond this study are not about theoretical archaeology; stimulus is the unfinished debate on a dyke stretching out in the landscape for almost one hundred kilometres, in southern Moldavia, west of Prut River, known as “Athanaric Wall”. Along time it was ascribed to both Roman and barbarians from the area of Lower Prut.

Carl Schuchhardt (1885) was the first who made a systematic research along the dyke, beginning with its western end, south of the village Ploscuțeni, on the high terrace of Siret River; in fact, it is still the only archaeologist who ever saw this sector of the embankment, about three kilometres long. Unfortunately, Schuchhardt lost its patience in the eastern half of the monument, “ deducting” that it should end in Foltești, near Prut, and being therefore a continuation of the vallum between Vadul lui Isac (a ford of the Prut River) and the Lake Sasik, in southern Bessarabia. Consequently, although knowing that the dyke between Siret and Prut has its ditch looking south (to the Roman Empire), he concluded that it was made by the Empire. This vision, of an outstanding strategic plan, developed from the Carpathian Mountains to the proximity of Nistru (Dniestre) River, was seductive, being followed by lots of Romanian historians, including lots of famous scholars1. The contradiction between the real position of the Roman army, in the bridge-head from Barboși, near the mouth of Siret River, and the dyke placed some dozens kilometres north, but

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1 Xenopol, 1985, p. 196 (first edition 1888); Pârvan, 1913, p. 119; Iorga, 1936, p. 72; Ștefan, 1938, p. 348.
with the ditch to the south, was amended several times\(^2\), without changing the common opinion of the archaeologists before the WW2.

Radu Vulpe, who was the leader of the team in charge for Poiana-Piroboridava, the most impressive archaeological site from southern Moldavia, located just 6 km from the western wing of the dyke, resumed the field research, in the years after the war. He stepped on Schuchhardt footprints, on the western segments of the dyke, but was also concerned about its eastern end. Finally, he established the fact that the monument finishes in the village of Stoicani, about five km south of Foltești, and thus between the dykes from southern Moldova and southern Bessarabia there is no functional connection\(^3\). Commenting a text from Ammianus Marcellinus\(^4\), referring to the hard days of the invasion made by the Huns (376), Radu Vulpe ascribed the monument to the desperate Athanaric, the king of the western Goths, although a strategic demonstration, on a map, is an impossible task. From then, thereby, the dyke is better known as “Athanaric’s Wall”.

The next relevant step in the matter was made by Mihalache Brudiu (1979), which inspected again the field for the eastern half, making the first correct description for the segment between the villages Cuca (east) and Cudalbi (west), a section located about half way\(^5\). Those about 22 km where lost by Radu Vulpe, mainly because of the poor conservation status of the monument – but not because the ditch was made in hurry, as the scholar believed, deforesting and agriculture being to blame...

We should cite here another influential review of the facts related to the dyke Ploscuțeni-Stoicani\(^6\), made by Ion Ioniță (1982), in a book concerning the Roman age history of Moldavia\(^7\). His advice is that the dyke-line was marked, on the field, by the Romans, delimiting a buffer zone between their vital interests along the communication line Barboși-Piroboridava (driving, through the Oituz pass, in Transylvania, where the Province of Dacia lay), and barbarian land. The dyke itself was erected much later, probably in the mid third century, by the warriors Carpi, of Dacian origin, on that older borderline.

Mihalache Brudiu took over the chronology and the author, but changed the historical scene, claiming that the wall was erected by Carpi, being intended to limit Sarmatians’ wanderings\(^8\). Nevertheless, the main cluster of Sarmatian cemeteries one can find on the upper and middle course of Bârlad Valley\(^9\), thus north of the

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\(^2\) Fabricius, 1926; Uhlig, 1928, p. 223.
\(^3\) Vulpe, 1950; Vulpe, 1957.
\(^4\) Ammianus Marcellinus, XXXI, 3, 7.
\(^5\) Brudiu, 1979.
\(^6\) Usually nominated as the dyke “Stoicani-Ploscuțeni”. We chose here reversing the order of the names for the sake of symmetry, with toponyms from west to east, likewise Traian-Tulucești dyke (known also as “Trajan’s Wall” or the Dyke from Galați). Historically speaking, it was studied also from west to east, from Ploscuțeni to Stoicani.
\(^7\) Ioniță, 1982, p. 47-49.
\(^8\) Brudiu, 2001, p. 277.
\(^9\) Ioniță, 1982, fig. 18.
central sector of the dyke; of course, we don’t know the events from Barbaricum in the third century, such as a potential conflict between neighboured Carpi and Roxolani, thus Brudiu’s rationale cannot be safely dismissed.

In some recent commentaries attention was drawn by some features of the dyke Ploscuţeni-Stoicani which possibly could recall the Roman monuments of the same kind. In this regard there were made as arguments the palisade, the traps placed in the front of it, the passing points – still hypothetical\(^{10}\). The fact that the dyke splits the landscape in two separate areas, one completely dry, in the south, the other – with springs at the daylight, was found as similar to the elaborate strategies made by Romans\(^{11}\); the argument is anyway valid only for the eastern third.

It looks now that the historical commentary went empty in fresh ideas, able to solve the puzzle. We are going to test, in this study, if any technical parameters can be helpful for ascribing the linear defence to one or to another.

2. Basics about designing linear projects

Making earthen dykes supposes the dislocation of a huge mass of earth, as well as building an elaborated timber infrastructure on a scale difficult to imagine, especially when it is not preserved, as usually comes in the dry soils. The estimations made for dikes from Romania usually vary between 15 and 20 cubic metres for one linear\(^{12}\), which means between 15000 and 20000 cubic metres at each kilometres, or 27000 to 36000 tons of matter, or the equivalent of 1000 heavy trucks, or 1000 railway wagons. For a society in which the transportation was limited to baskets or carts, the effort would be excruciating, speaking here about works lengthen on some dozens of kilometres.

We tried first an approximation of the difficulty of the task just for a better intuition of the fact that nobody would make it randomly, risking to waste such a valuable social work. A defensive dyke is meant to fulfil a need for protection, to

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\(^{10}\) Brudiu, 1995, p. 158-160.

\(^{11}\) The arguments have been produces several times (Croitoru, 2002; 2004, p. 107-113; 2007) and shall be not repeated here.

\(^{12}\) For volume estimations on some archaeological sections along Limes Transalutanus see Teodor, 2013, p. 108-110, ranging from 15 to 18.5 m\(^3\) for each linear meter. Ion Ioniţă have raised the estimation made by Vulpe for “Athanaric Wall” from 10 to at least 15 m\(^3\) (Ioniţă, 1982, p. 56), relaying exactly on Vulpe’s test-trench from the Wood Prisaca (Vulpe, 1957, p. 13, fig. 2); in fact, beyond our doubts concerning the accuracy of the representation (already contested before by Mihalache Brudiu; Brudiu, 2001, p. 259 and 263), Vulpe’s section through the ditch measures no less than 23.65 m\(^3\) for each linear meter (AutoCAD calculation). The digging made by Brudiu on the spot La Cruci (Brudiu, 1979, p. 153-154 and the plate) is not useful for calculations, the geometrical relationship between the monument and those improvised sections being not clear enough; the only useful observation related to that research is that the shape of the ditch seems considerably different compared with Vulpe’s section. A second test-trench made by Brudiu (Brudiu, 2001, p. 262, Fig. 3), at Bujoreşti-Corni, with an estimation over 16 m\(^3\) (Brudiu, 2001, p. 263) has only under 11 m\(^3\); nevertheless, the context from the Hill Bujoreşti (on the spot Movila Săpată) is interesting, but not simple, requiring too large commentaries and far away from the aims of this study.
spare lives and goods, being the geography of danger, placing the enemy beyond the
ditch and the goods behind the dyke. The question if such a construction is more
useful at war, or in peace time, is indeed a very good one, but we are not going to
answer that for now; one need anyway to investigate the relationship between the
defended area and the defensive line, to ask himself where are to people supposed to
stand at the palisade.

We did not acknowledge at this time a study concerned with designing
issues of the linear dykes in the Roman world; we know, for a change, such a pursuit
for road engineering. The problems raised for conceiving a route for both, dykes and
roads, are quite similar, and can be resumed as follows: one need, first of all, a task,
like connecting the points A and B. Second – the project must be complying with the
economic strength of the builder. Third – the project will be guided by some military
rules, as staying as much as possible on higher positions, with good visibility. We
made a developed presentation of those issues in a recent book\textsuperscript{13}, resuming here just
some essentials.

The theory provided by Hugh E. H. Davies (1998) says, briefly, that designing
a Roman road is a task in many similar with designing a motorway of our days; it is
not just a road, as a natural path in the landscape, but much more:
- defining the task (as connecting the points A and B);
- defining a strategy, as linking also some vital points, as C and D;
- defining the width of the corridor on which the construction will be
  implemented;
- making a survey of the main natural features of the landscape inside that
corridor, like hills and rivers;
- making the project (on a... brick floor) and writing down (on wax
tables, for instance) the main traits, as a sequence of lines defined by a
length and an angle, notes used in the field\textsuperscript{14};
- field building activities.

\textsuperscript{13} Teodor, 2013, p. 103-105.
\textsuperscript{14} An oversimplified explanation, easy to follow! In fact, Davies is describing a more
complicated process: there is a topographical line, separately of the construction line (which
is true for any road project, till today). The topographic alignment is made by fixed landmarks,
with known relationships (distances, angles), playing the role of the “survey stations”. We
would comment here only that the angular correction between two successive stations
implied at least some trigonometric tables, in the field, but also the necessary skill to use
them. From the topographic alignment were made measurements to establish the position of
the construction line (the mid-line of the future road), only in right angles (left or right from
the topographic line), at a previously established distance. If these explanations could appear
intricate, the notes taken into the field by gromatici were probably very simple, as C-S-LXI
(100 units – feet or passes? – on the topographic alignment and 61 units to left). The con-
sequence of these facts is that a straight line of the road, in the field, is not the result of
stretching a string, as expected, but by calculations related to the topographic line... and some
improvisation on the field.
One should consider that the sketched process above supposes, before the building action, no less than five stages of preparation. There is a lot of “premeditation” for a typical Roman road, tasks requiring certain engineering expertise, and here we can find the specific difference between a Roman project and a barbarian one. The fulfilment of all steps depicted above, in the right order and with necessary skills, is a compelling condition for a good result. For a road, it should be as short as possible, thus not expensive and easy to use; it has to take great loads without being quickly damaged; it should have gentle slopes for transporting heavy carts; a route made on heights with excellent visibility, preventing ambushes. Giving the fact that a linear dyke is always paralleled by a road – at least in the Roman world – most of the technical traits defined for a road should apply also for dykes, isn’t it?

Following so many rules for the same project cannot be simple; some rules are easily inflicting each other, like the shortest length and the gentler slope. For each problem there are many different solutions, and one should expect that the beneficiary (as the military commanders) were actively involved solving each dilemma occurred in designing; they could responsibly ask for a shorter route, taking risks for low visibility or harsh slopes, or the other way around.

### 3. Designing corridor

The theory briefly presented could be perfectly illustrated with some parameters collected on *Limes Transalutanus* (the border beyond *Alutus* River, Olt in our days), recently analyzed\(^\text{15}\). Starting from the Danube and going over the Southern Carpathians, it has, therefore, a plain section (roughly 150 km) and a mountain section, not analyzed, being too dependent on natural conditions. The border begins on the banks of the Danube, at the camp from Flămânda (today Poiana, Teleorman County) and ends its lower section at the river Argeș, where the city of Pitești is standing now. This plain section can be divided in three major segments\(^\text{16}\), with two major passing points, Gresia and Urlueni. Figure 1 is a sketch for those three segments, as follows: (1) crossing several small rivers, behind a dyke; (2) a *limes* road behind larger rivers (Vedea and Cotmeana, from south to north); (3) crossing other rivers, including Teleorman, behind a *vallum* only partially documented.

Looking at Fig. 1 one can see that the route between Danube and Argeș is relatively straight, with only one relevant bent, between Gresia and Urlueni, for the very good reason of a natural defense on steep and high terraces (15-20 m); this is a good choice, more effective than a manmade obstacle, thus a border arrangement.

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\(^{15}\) Teodor, 2013.

\(^{16}\) In a recent book (Teodor, 2013) the *limes* between Danube and Argeș was divided in four major segments. The third one, in this study, was divided there in two, with an intermediary stop to the forts from Sâpata de Jos; the arguments used there are rather complicated, with tactical grounds, not such important in this context, dealing with designing strategic corridors.
easier and cheaper to build and defend\textsuperscript{17}, but longer to travel. Even so, the ratio between the width of the corridor (13.7 km) and the length of the project, from Flămânda to Pitești (123.7 km as the crow flies), is close to a theoretical optimum of 10\%\textsuperscript{18}.

![Essential sketch of Limes Transalutanus crossing the Romanian Plain, with its main directions between relevant passage points. The red (southern) line is a continuous dyke; the blue (central) line is a ripa; the green (northern) line has some documented dykes, but only for its both ends; altimetric scale on the route: between 26 and 310 m.]

Analysing particular segments, where the \textit{limes} is crossing the plain without a natural defence, drives to even better results. The clearest case is made on the southern segment, the best documented. Figure 2 is depicting a more detailed view, a partial reproduction of one of the maps made by the pioneer of the archaeological

\textsuperscript{17} The need for troops in an area with natural defence is lower compared to plain landscapes, protected only by a dyke (Teodor, 2013, chapter 8).

\textsuperscript{18} Davies was writing about a first instance corridor, a designing one, defining the width where the major landmarks are, which is larger, about one third of the gap between the both ends of the project (Davies, 1998, p. 5). In the process, in the next phase, the designing corridor is optimised and narrowed, establishing new – secondary – landmarks, closer to the future road, when the route is already established. In the final stage, the corridor is again narrowed, as a \textit{construction} corridor, the optimum being estimated to 10\% (Teodor, 2013, p. 104, fig. 39).
topography in Romania, Pamfil Polonic\textsuperscript{19} (late XIX\textsuperscript{th} Century), rendering the segment between Flămânda and Gresia. A straight line between the end points is stretching on a length of 48.76 km; the width of the corridor is only 887 m to the west, and about 2200 m to the east, giving a sum of 3087 m, meaning a ratio of only 6.3\%, thus much better than the theoretical standard. The figure is yet normal, as long as the terrain did not raise any special difficulty.

Fig. 2.
An example of design corridor: the dyke between the villages Flămânda (today Poiana) and Gresia, on a map made by Pamfil Polonic (crop from Teodor, 2013, fig. 11). Red line: the limes track; squares: Roman forts; combed line: railways in the late XIX\textsuperscript{th} Century.

We just brought here some examples to show that such parameters wouldn’t be possible without a tight survey of the terrain, in pure topographical terms, or without professional designing skills. The builders of a strategic road or a military dyke did not go to work enthusiastic but unprepared, unless dramatic events could happen, possibly to be mentioned in some cases, as “Athanaric’s Wall” allegedly could be.

The case of the dyke built between the villages Traian and Tulucești, in southern-eastern Moldavia (Fig. 3) is a particular one. The strategic task was here to

\textsuperscript{19} Adapted from Teodor, 2013, p. 36, fig. 11, which is a redrawing of the original map of Polonic. In the outskirts of the town Roșiori one can find, at least apparently, more than one route of the dyke, result of a later alteration of the project. The best visible today seems the younger route and it is longer (Teodor, 2013, p. 158-160, with fig. 63). We have chosen here the original Polonic sketch, with the shorter route, because we are dealing with designing routes, not with their alteration.
make a defensive line around the bridge-head fort from Barboşi-Tirighina\textsuperscript{20}. The basic project is thus an arc running along a quarter of a circle, with end points based on large water courses, Siret on south-west, and Prut on north-east.

At a closer look, the arc is made by three segments relatively straight, unequal in length: (1) from the Siret River to the spot named \textit{La Cruci} (10.3 km, azimuth 16.5\textdegree); (2) \textit{La Cruci} – Gârbova (10.1 km, azimuth 55.3\textdegree); (3) Gârbova –

\textsuperscript{20} The absence of some typical features for a \textit{limes}, as forts, fortlets and turrets, drove the current explanation to a \textit{limitibus}, a line boldly drawn in the flat landscape (Napoli, 1997, p. 104, about the dyke from southern Bessarabia, considered similar to that near Galați), as a sign of an imperial interdiction for barbarians, and not as a military defensible line (see Croitoru, 2001, p. 58, about the “bureaucratic frontier”). The dyke, then, is just the outskirt of the fort from Tirighina, close enough to be surveyed by infantry in one day march. At a closer look, Roman interests were stretching out far in the west, much beyond this limited hinterland. As for the dimension of this quarter of a circle, it could be probably related with the need of controlling a major ford at lower Siret, near the mouth, but the tentative demonstration is far too long for this paper.
Tulucești (2.65 km, azimuth 77.6°)\textsuperscript{21}.

One of the most useful observations is that Roman roads have no curved turns, but angular corrections, most of the time on heights\textsuperscript{22}. The fact is easy to understand looking at the technology available at the time. The design projects were customary initiated by collecting data (position, altitude) about the heights along the route – essential landmarks for a Roman road. Between two such points the route should be, theoretically, a straight one, and corrections below two degrees (or even more) would be preferable rendered as execution errors; but the relationship between the next two landmarks is different, thus on the next hilltop one will find a real correction, heading the new target.

\textbf{Fig. 4.} “Trajan’s Wall” altimetric profile on the spot named La Cruci. Combined elevation grid between a SRTM image and an elevation file from the U.S. Geological Survey (http://www.usgs.gov/), resolution 66 m (W-E) × 95 m (N-S). Slats are for every vertex of the vector; figures above are for the values of the azimuth correction (decimal degrees, all clockwise); asterisk: presumptive (and theoretical) positions for landmarks used by gromatici as guidance.

On the route of the dyke sometimes named “Valul lui Traian” (Traian-Tulucești) there is only one major turn, at the spot named La Cruci (At the Crosses), where the direction approximately north is corrected for north-east. A detailed study of that turn is a good materialisation of the general theory, but with relevant shades (Fig. 4). All the section analyzed there is positioned on the top of the landscape, 20 meters higher than the valleys from west and east, which is a lot in the plain. On the altimetric detail from the Fig. 4, the major corrections are done not on the highest positions available, but somewhere in their proximity, allowing a good visibility of it, a place which let the surveyor to see the landmark, with the naked eyes\textsuperscript{23}; this could occur, naturally, somewhere on the hill, not in a deep valley. The outcome is

\textsuperscript{21} The route of the dyke is obvious only west of the village Tulucești, and there is an important clue at the intersection with the National Road, but further eastward is not known exactly (the edge of the terrace is about 500 m east of the road).

\textsuperscript{22} Davies, 1998, p. 14; another way to say the same, less analytical, is that the Roman roads have long straight lines (400-500 m) and mild turns (Fodorean, 2006, p. 35, with references).

\textsuperscript{23} The Roman topographic implements had no lenses, thus no zoom at the target, all depending on the eye accuracy of the gromatici.
Figure 5. Athanaric’s Wall. Stereo 70 projection but geographical coordinates (the meridians are heading north). There are marked only the main rivers, the streams network being obvious from the profiled landscape. Dots: relevant villages near the dyke’s track; splats: important toponyms; continuous lines: good resolution, certain dyke trail; dashed lines: visible trail, but difficult; dash and dot: dyke route superposed by a dirt road (uncertainties connected with details, like the exact azimuth all along the trail); dash and double dot: trail attested historically (Schuchhardt, 1885), but not found again (forested area).
that errors happen and that they were corrected as soon as the next landmark became
visible. The conjecture from the Fig. 4 is also suggesting that the building project
was completed from southwest to northeast.

Similar facts one will find for the major azimuth correction from the high plateau
facing the forest Gârbova, between the villages Odaia Manolache and Tulu-
ceşti, where the general direction is diverted with 22°. This is made smooth, almost
imperceptible in the field, in two successive corrections, stretching along 400 m, in
the highest positions available, at 115 m altitude, compared to 103 m (400 m
westward) and 109 m (500 m eastward).

Azimuth changes of less than three degrees should be rationalized as
execution errors and their corrections, the last usually made on higher positions,
with fair visibility. Such a situation occurs between the valleys Mălină and Jorea, or
on the hill east of Odăbăscu Valley, north of the village Traian.

We finally reach the dyke known as “Athanaric’s Wall”. The map presented
in the Figure 5 is integrally a result of orthophotos’ study, from at least three
different sources. First would be our own explorations on Google Earth; the second
are some vectors made on a commercial map, RO.A.D., useful at the beginning,
with many amendments after that; the third set of data was collected on the
orthophotoplans released by ANCPI, making the final version for the application.
We made also a comparison with other published maps, first of all with the most
complete one, the differences being only technological (projection, precision etc.).

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24 Or even design faults, considering the rudimentary means of the Roman topographers and
the distances between the triangulation stations, probably too far for a good estimation.
25 We have here the only obvious design shortcoming: the dyke goes parallel with a valley
(Odăbăscu), east of it, than crosses it, with no direction alteration, in a long diagonal,
exposing the defensive to an enemy in the upper position, for about 600 m. The reason could
be the desire to keep also the western part of the valley mouth, probably connected with an
active ford to Siret River (?). The “solution” is anyway debatable, no matter the reason, and
is suggesting too much confidence in the self-strength and a “good” age, probably Hadrianus,
following his first years of rule.
26 Saved as kmz file and imported in the main GIS file.
27 Map made within the project Digitally Romania (led by Bogdan Condurăteanu), version
available in the spring of 2013. The route proposed by this product is fair, but we made a
complete verification. Some doubts could arise for the north-western limits of the dyke, but
that area is very difficult anyway.
28 The abbreviation ANCPI stands for Agenția Națională pentru Cadastru și Publicitate
Imobiliară, the national authority in real estate. As a general observation, the vectors made in
Google Earth were compatible with things seen in the autochthonous orthophotoplans. In
some situations the images in GE are better than the Romanian available orthophotos, or the
other way around, the two sets being complementary and both useful. The comparison made
on different image supports is desirable as many times as possible. We haven’t noticed any
relevant troubles about the conversion of data between the two projection systems
(geographical for GE and Stereo 70 for the national documentation).
29 Brudiu, 1979, plate.
due to the “handmade craft”, usual in Romanian archaeology\textsuperscript{30}. Our map, displayed on the Fig. 5, is anyway the first neat geographical representation, with an estimated accuracy of 5 m.

Going back to the Fig. 5, one can easily see some peculiarities of the “Athanaric Wall”, not encountered in the comparative set. The most striking fact is the frequency of some major turns, about as a right angle. From west onward: there is one east of Ploscuţeni\textsuperscript{31}; one on the spot labelled as \textit{La Troian}\textsuperscript{32}; one at the crossing of the Corozel River; one east of the village Cuca, south-east from the toponym Arcanu\textsuperscript{33}; one on the hill Chelbosu\textsuperscript{34}; possibly at least one more time, but the quality of the available pictures makes difficult a net conclusion. A supplementary comment would be that, except maybe the case from Corozel, not the landscape is the reason for such strong corrections, but other facts, more difficult to understand.

We are not going to dissect all those cases of major turns, because the space

\textsuperscript{30} One single problem was identified, in the eastern end of the dyke, near the village Stoicani. Brudiu (1979, p. 152-153) gives it in northern half of the village, north of the archaeological site Cetăţuia, but on the ANCPI images the suggestion would be rather that it is driving to the southern half. The issue can’t be fixed without pictures with a better resolution, or at least older.

\textsuperscript{31} Schuchhardt (1885, \textit{apud} Vulpe, 1950, p. 165; Vulpe 1957, p. 7) is the only archaeologist ever saw this western end of the dyke, in a forested area southeast of the village, claiming that it was ending on the high terrace of the Siret River. What can today one see, on the aerial images collection, is a little segment north-west of the village Toflia (with doubts added within the Fig. 5. As a consequence, east of Ploscuţeni the dyke would have made a right angle.

\textsuperscript{32} In this area Radu Vulpe made a test-trench, giving the name of the forest Prisaca-Cincu (or Ţigăneşti), where “Prisaca” means a (palisade) stronghold, and “Ţigăneşti” – Gypsy’s (forest); except for the name Cincu, the others can be found on the maps from the twentieth Century, with the amendment that Prisaca Forest is located some three kilometres away from the spot of the digging (Vulpe, 1957, p. 12); for this spot the right name would have had been the Gypsy’s Forest, probably avoided... The spot was chosen by Vulpe due to the good conservation status of the monument, in a forested area, a fact probably true in 1949, because in a map released in 1957 (Planul Director de Tragere no. 4960) the forest was already pushed about one km northward (today about three...). The closest toponym we have found the maps, for Vulpe’s test-trench, is \textit{La Troian} (“At the Dyke”), as in our Fig. 5.

\textsuperscript{33} Or Arcani. The right angle from Arcanu is marked to the Fig. 5 as a partially reliable support image, but the right angle near Arcanu is confirmed by Brudiu (1979, p. 155 and the plate), which have checked it in the field.

\textsuperscript{34} As that on Brudiu (1979, p. 153), the provider of the most detailed description, but Dealul Galaţiului (“The hill which drive to Galaţi”) on the available maps. The closest analogy on \textit{Limes Transalutanus} is the situation east of Urleni, where the correction of azimuth is about 60°, uncertain as value, as long as, from that turn northward the dyke is not visible anymore; the route has been restored following older accounts, as Pamfil Polonic or Ioana Bogdan Cătănicu (Teodor, 2013, p. 67-70). A second major turn is recorded at the western edge of the town Roşiori, but, as already stated, it is a part of an altered section of the dyke, and not an original project.
required is too large; for now, we are restraining ourselves to mention this rather odd fact. The motivations need still some research, but it could eventually be connected with the location of the settlements, which is not typical for a Roman design (which develops settlements depending on the road and not vice-versa, as the distribution of the towns in Roman Dacia eloquently proves).\textsuperscript{35}

Looking after comparison terms already used in this study, we will proceed looking at the parameters taken for the design corridor of the dyke Ploscuţeni-Stoicani. The straight line distance between the ends is about 74 km (we don’t know exactly any of them...). The enlargement of the corridor is made almost only to the south, the maximum deviation being of 9.29 km, at the bent from \textit{La Trojan}, which is 12.55\%, close enough to the figure seen on \textit{Limes Transalutanus}, but without a good reason (none of the segments of the dyke was made behind a river or torrent, which is another odd fact for a Roman design...).

The attempt to establish some designing segments, along the so-called “Athanaric Wall”, is pretty difficult; in other words, we are looking after some major landmarks that tentatively have had been used as intermediary targets. The possible solutions are plenty, but we have chosen the next:

1. Ploscuţeni to the bent near Toflea (environ 2.6 km);
2. Toflea – \textit{La Trojan} (18.81 km in a straight line);
3. \textit{La Trojan} – Dealul Ciungilor (29 km in a straight line);
4. Dealul Ciungilor – Dealul Chelbosu (24.93 km in a straight line);
5. Dealul Chelbosu – Stoicani (environ 6.53 km in a straight line).

The first sector, short and deprived by a factual route, is not analysable. One of the segments which looks good on the map (Fig. 5), at the glance, is number 2 from the list above. Unfortunately, along it there are many troubles with the visibility of the track and makes figures somehow relative. Another segment apparently fair is number 4, for which the width of the corridor is 12.71\% from its length; for a change, the segment number 3 has the same parameter of 16.56\%.

The evaluation procedure, as simple as the report between the width of the construction corridor and its length (as the crow flies), has a fundamental shortcoming: the analyst can manipulate data, choosing shorter segments and gaining better reports... From this reason, we brought in a correction factor, accounting the length of the segment. The results are displayed into the Table 1, comparing all the three dykes studied through the paper. As anyone can see, the correction factor (last column; good results are lower!) changes things a lot and proves – again – that an evaluation made just with the naked eye is not good enough. The first three analyzed sectors from the “Athanaric Wall” (2-4 in the list above), although have such different reports (width versus length), have in fact very similar correction scores. For a change, the eastern segment, from the hill Chelbosu to the village Stoicani, although it has the best report, it has a catastrophic correction score;

\textsuperscript{35} See further Campbell, 1996, esp. 82-83, for the relationships between road, town and rural settlement.
one can ask, therefore, if the last sector has the same designer as the rest... The problem is yet much difficult than that. The eastern sector traverses a much difficult terrain as the middle sectors, crossing no less than six deep valleys, and not climbing smooth on a watershed, as the western sector do (no. 2). As we shall see, the detour from the hill Chelbosu could not be from the original design; and specifically that is to blame for such a bad correction score! The remaking of the calculations without the hill Chelbosu brings far better figures (see the last row of the Tab. 1).

As for the overall scores at the dyke from southern Moldavia, they are far away to the terms of comparison.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Length</th>
<th>Width</th>
<th>Proportion</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLĂMÂNDA – GRESIA (with Roșiori)</td>
<td>48.818</td>
<td>4.315</td>
<td>8.84%</td>
<td>1.81</td>
</tr>
<tr>
<td>FLĂMÂNDA – GRESIA (without Roșiori)</td>
<td>48.818</td>
<td>3.081</td>
<td>6.31%</td>
<td>1.29</td>
</tr>
<tr>
<td>GRESIA – URLUENI</td>
<td>natural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URLUENI – PITEȘTI (with Săpata)</td>
<td>43.508</td>
<td>7.816</td>
<td>17.96%</td>
<td>4.13</td>
</tr>
<tr>
<td>URLUENI – PITEȘTI (without Săpata)</td>
<td>43.508</td>
<td>6.194</td>
<td>14.24%</td>
<td>3.27</td>
</tr>
<tr>
<td>TRAIAN-TULUCEȘTI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traian – La Cruci</td>
<td>10.305</td>
<td>0.236</td>
<td>2.29%</td>
<td>2.22</td>
</tr>
<tr>
<td>La Cruci – Tulucești (without the village)</td>
<td>10.761</td>
<td>0.359</td>
<td>3.34%</td>
<td>3.10</td>
</tr>
<tr>
<td>ATHANARIC’S WALL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toflea – La Trojan</td>
<td>18.491</td>
<td>1.774</td>
<td>9.59%</td>
<td>5.19</td>
</tr>
<tr>
<td>La Trojan – Ciungilor Hill</td>
<td>29.004</td>
<td>4.803</td>
<td>16.56%</td>
<td>5.71</td>
</tr>
<tr>
<td>Ciungilor Hill – Chelbosu Hill</td>
<td>24.93</td>
<td>3.169</td>
<td>12.71%</td>
<td>5.10</td>
</tr>
<tr>
<td>Chelbosu Hill – Stoicani village</td>
<td>6.733</td>
<td>0.622</td>
<td>9.24%</td>
<td>13.72</td>
</tr>
<tr>
<td>(variant) Fântânele – Stoicani village</td>
<td>6.303</td>
<td>0.307</td>
<td>4.87%</td>
<td>7.73</td>
</tr>
</tbody>
</table>

Tab. 1. Evaluation of successful design at the level of defined segments.

36 Calculation is ((W / L) / L)*1000 (where “/” is “devided” and “*” – “multiplied”); the parentheses are logical, not effective in calculation. We have then a proportion (imbricated parentheses) and its report to the length of the segment. The multiplying factor is meant just to avoid a reading with lots of leading zeros.

37 This is, probably, the original project.

38 As detailed with a previous occasion (Teodor, 2013, p. 188), the forts from Săpata de Jos are not located on the main limes line, but about two kilometres in side, connected by a secondary road. This side connection enlarges artificially the width of the corridor, therefore the calculation is made both ways, with and without it.

39 It is measured the location given by Brudiu for the eastern end of the dyke (Brudiu, 1979), not ours, from the orthophotoplans (as in the Fig. 5), to get a better report; same for the next row.
4. Towards a statistic evaluation model

We have already a basic idea about the results of the comparison between certain Roman building projects (like *Limes Transalutanus* and the so-called “Trajan’s Wall”40) and “Athanaric’s Wall”. We tried to test the “corridor theory” outcomes using a second method of comparison. This is a brand new idea, first time applied for this paper; therefore, it needs some directions of use.

From the vectors made over the orthophotos are collected data about the length between two vertices, and the angle made at the intersection. For the statistic evaluation we have taken only data from segments of dyke with good visibility on orthophotos, for at least 1.5 km, to get relevant figures for the average length of the straight lines. One exception was made, for the section from the hill Chelbosu, southwest of the village Fântânele, along the “Athanaric Wall”, to get comparative data about a work unusual clumsy.

The vectors made on Global Mapper were imported in AutoCAD, for which the procedure of reading line parameters and transfer it to an Excel sheet is handy. The structure of data is sampled in the Table 2 below.

<table>
<thead>
<tr>
<th>Area</th>
<th>Length</th>
<th>Angle (dec.)</th>
<th>Angular correction</th>
<th>Summed lengths</th>
<th>Angle &gt;1</th>
</tr>
</thead>
<tbody>
<tr>
<td>S of the mound Traian Sud</td>
<td>984.7</td>
<td>109.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of the mound Traian Sud</td>
<td>832.3</td>
<td>109.4</td>
<td>0.3</td>
<td>1817.0</td>
<td></td>
</tr>
<tr>
<td><em>idem</em></td>
<td>376.2</td>
<td>105.4</td>
<td>4</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td><em>idem</em></td>
<td>278.2</td>
<td>105.1</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>idem</em></td>
<td>363.6</td>
<td>104.4</td>
<td>0.7</td>
<td>1018.0</td>
<td></td>
</tr>
<tr>
<td>S. of the mound Traian Nord</td>
<td>302.2</td>
<td>100.9</td>
<td>3.5</td>
<td>302.2</td>
<td>3.5</td>
</tr>
<tr>
<td>mound Traian Nord</td>
<td>464.2</td>
<td>103.8</td>
<td>-2.9</td>
<td>464.2</td>
<td>2.9</td>
</tr>
<tr>
<td>N. of the mound Traian Nord</td>
<td>231.2</td>
<td>102.6</td>
<td>1.2</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td><em>Idem</em></td>
<td>391.9</td>
<td>102.1</td>
<td>0.5</td>
<td>623.1</td>
<td></td>
</tr>
<tr>
<td>S of the mound Ciuperceni</td>
<td>533.0</td>
<td>104.6</td>
<td>-2.5</td>
<td>924.9</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**Tab. 2. Raw and processed data for a segment characterisation (sample).**

Data within Tab. 2 belongs to the southern end of *Limes Transalutanus*. The length is in metres, and angles are decimal41. The angular difference is calculated between two consecutive values from the third column. The results less than one

---

40 The name is sometimes used for the dyke between the villages Traian and Tulucești, although the expression was sometimes used, mostly in the past, also for the defensive line Ploscuțeni-Stoicani (Vulpe, 1957, p. 6) or for the *valli* from southern Bessarabia (Uhlig, 1928, right in the title!) and it is frequently used in our days for the dykes from Dobrogea. We make these specifications in the benefit of foreign historians, because Romanian archaeologists are used to read the name contextually and they are not unhappy.

41 The values of those angles are probably not the expected. Values are collected with AutoCAD defaults, where zero is rightward (east) and the rotation is counter-clockwise. The
degree are neglected, as possible influence of the imperfect vectorisation; in this case (pink shadow) – the successive lengths are summed. On the last column all values smaller than -1 are turned positive, because not the direction, but the amplitude of correction is at stake; this makes possible, at the end, to get an average angle (see the next table).

At the end of each segment of a dyke it is calculated an average summed length (fifth column), and an average angle (for the data in the last column). The basic outcome is that a Roman project can be defined as having long straight lines and small average values for azimuth corrections. Table 3 contains aggregated data for all three analyzed dykes – Limes Transalutanus, Traian-Tulucești and the “Athanaric’s Wall”\(^4\). Some directions about the content of the table would be useful; from left to right, in black, there is a total length per segment, an average of the lengths for the straight lines, and an average value for azimuth corrections. Two other columns, in blue, are converting data in performance scores, where the best figures from the table have 50 points for each parameter, and the worst – nothing, the third blue column being the sum.

Beyond the dry language of the numbers – on which our readers can make their own evaluations – there are some specific commentaries to make, regarding some particular situations encountered. The relatively low score for the segment from the Bratcov Valley, on Limes Transalutanus, mainly for the angle, is due to an interesting situation. Somewhere in the middle course, the dyke bypasses a torrent (probably neglected on the original design) making a double and strong correction, in zigzag. First correction is 33.1° north, the second is 32.3° east, continuing after the torrent with the virtually the same direction as before it. This is an excellent example that the design could have shortcomings, but also that the Roman engineers had the necessary skills to give solutions in the field and had the proper tools to do it; drawing in the field a double correction of the same value, but of opposite direction, cannot be the work of chance. This is the situation that ruins the average of the angles, in the Table 3, proving, in the same time, certain topographic expertise.

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\(^{42}\) The long lines are the main clue in searching Roman roads on aerial photographs; one of the reasons would be the fact that it was the main landmark in defining the properties, as centuriatio (Bekker-Nielsen, 2000). The feature is stressed by many others, like Campbell (1996, p. 84) or van Tilburg (2007, p. 15).

\(^{43}\) In order to identify the reference toponyms for segmenting the dykes – see the maps from our illustration.

\(^{44}\) The situation is graphically depicted in Teodor, 2013, p. 33, fig. 8.
<table>
<thead>
<tr>
<th>Segment</th>
<th>Length total</th>
<th>Straight line average</th>
<th>Length ’s score</th>
<th>Aver. corr. angle</th>
<th>Angle’ s score</th>
<th>Overall score</th>
<th>Aver. ge slope (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limes Transalutanus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flămândea-Putinei</td>
<td>18498</td>
<td>602.5</td>
<td>37</td>
<td>4.0</td>
<td>44</td>
<td>81</td>
<td>0.65</td>
</tr>
<tr>
<td>Belitori</td>
<td>16157</td>
<td>807.2</td>
<td>50</td>
<td>4.3</td>
<td>43</td>
<td>93</td>
<td>1.20</td>
</tr>
<tr>
<td>V. Bratcov</td>
<td>5755</td>
<td>539.3</td>
<td>32</td>
<td>7.7</td>
<td>29</td>
<td>61</td>
<td>0.62</td>
</tr>
<tr>
<td>D. Sicroştea</td>
<td>3415</td>
<td>288.2</td>
<td>16</td>
<td>5.5</td>
<td>38</td>
<td>54</td>
<td>0.27</td>
</tr>
<tr>
<td>East of Cotmeana</td>
<td>2613</td>
<td>653.2</td>
<td>40</td>
<td>4.5</td>
<td>42</td>
<td>82</td>
<td>0.82</td>
</tr>
<tr>
<td>South of Piteşti</td>
<td>2846</td>
<td>711.4</td>
<td>44</td>
<td>2.5</td>
<td>50</td>
<td>94</td>
<td>0.90</td>
</tr>
<tr>
<td><strong>sum</strong></td>
<td><strong>49282</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>aver. 78</strong></td>
</tr>
<tr>
<td><strong>Traian-Tuluceşti dyke</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odăbășcu Valley</td>
<td>6883</td>
<td>307.8</td>
<td>17</td>
<td>4.3</td>
<td>43</td>
<td>60</td>
<td>0.56</td>
</tr>
<tr>
<td>La Cruci</td>
<td>3015</td>
<td>150.3</td>
<td>7</td>
<td>2.5</td>
<td>50</td>
<td>57</td>
<td>0.40</td>
</tr>
<tr>
<td>Târnăsoaia</td>
<td>3224</td>
<td>322.4</td>
<td>18</td>
<td>2.3</td>
<td>51</td>
<td>69</td>
<td>2.93</td>
</tr>
<tr>
<td>Gârboavele</td>
<td>1670</td>
<td>278.4</td>
<td>15</td>
<td>3.7</td>
<td>45</td>
<td>60</td>
<td>0.85</td>
</tr>
<tr>
<td><strong>sum</strong></td>
<td><strong>14792</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>aver. 62</strong></td>
</tr>
<tr>
<td><strong>Athanaric’s Wall</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Măţului</td>
<td>2103</td>
<td>420.7</td>
<td>25</td>
<td>10.9</td>
<td>16</td>
<td>41</td>
<td>0.49</td>
</tr>
<tr>
<td>Rugineasca</td>
<td>1522</td>
<td>309.5</td>
<td>17</td>
<td>7.5</td>
<td>30</td>
<td>47</td>
<td>0.47</td>
</tr>
<tr>
<td>La Troian</td>
<td>4490</td>
<td>128.3</td>
<td>5</td>
<td>10.7</td>
<td>16</td>
<td>21</td>
<td>1.58</td>
</tr>
<tr>
<td>Iazul Epure</td>
<td>7561</td>
<td>213.5</td>
<td>11</td>
<td>8.7</td>
<td>25</td>
<td>36</td>
<td>0.70</td>
</tr>
<tr>
<td>Lacul Troian</td>
<td>13519</td>
<td>300.4</td>
<td>17</td>
<td>6.3</td>
<td>34</td>
<td>51</td>
<td>0.32</td>
</tr>
<tr>
<td>D. Ciungilor</td>
<td>2676</td>
<td>107.1</td>
<td>4</td>
<td>8.8</td>
<td>24</td>
<td>28</td>
<td>1.53</td>
</tr>
<tr>
<td>D. Rău</td>
<td>5731</td>
<td>272.5</td>
<td>15</td>
<td>8.2</td>
<td>27</td>
<td>42</td>
<td>1.33</td>
</tr>
<tr>
<td>D. Dârzuului</td>
<td>1648</td>
<td>109.9</td>
<td>4</td>
<td>11.4</td>
<td>14</td>
<td>18</td>
<td>1.97</td>
</tr>
<tr>
<td>Gura Rediu</td>
<td>5906</td>
<td>125.6</td>
<td>5</td>
<td>7.1</td>
<td>31</td>
<td>36</td>
<td>1.52</td>
</tr>
<tr>
<td>D. Chelbosu</td>
<td>1112</td>
<td>48.3</td>
<td>0</td>
<td>14.7</td>
<td>0</td>
<td>0</td>
<td>3.83</td>
</tr>
<tr>
<td><strong>sum</strong></td>
<td><strong>46268</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>aver. 32</strong></td>
</tr>
</tbody>
</table>

Tab. 3. Compared statistics for three linear defensive works.
Something similar, about errors and corrections, one can see on the Hill Scrioștea. From the distance, it looks like the dyke climbs the hill on a large curve, developed along two kilometers, making a total of 17° correction of the azimuth; if zooming, four distinct corrections could be seen (with values between 3.3 and 6.5°). As already stated⁴⁵, the large turn from Scrioștea is due to an initial error of azimuth, in the valley, where the landmark from the hill was not visible. In other words, the curve was not in the original plan, it came just as a correction of a wrong execution. As expected, this lowers the score of the segment to 54 points, the worst for Limes Transalutanus. Nevertheless, this error proves the existence of a previous master-plan, with landmarks which had to be reached; the large turn is ending on the top of the hill, from where it took a new azimuth, correcting again, in the opposite direction. To draw a conclusion: the large turns – as labeled by the literature – are not specific for the Roman projects, but it could occur on the field, especially as a result of an error in implementation; a different case is a large turn developed as a result of a general change of azimuth, as that from La Cruci, along the dyke from Traian to Tulucești.

The accuracy of data should be a concern of every statistic trial, as this. We have avoided sometimes using data taken on a segment of dyke used as a dirt road⁴⁶. The tracks of the recent road, highlighted in bright shades, strikingly contrasting in the landscape, made by wagons running left and right on the large, flattened embankment, have many turns which cannot be of the antic monument. Unfortunately, on the available pictures, with such a poor resolution (two pixels for one metre), if the top of the embankment is jammed by recent marks, the real direction of the dyke is only an approximation. Aware of the problem, we still used such data for the western part of the dyke Traian-Tulucești, which is overlapped by a country road for about 10 km, this dyke being anyway the shortest from the comparison set. The conservation status for this segment is anyway better than usual, allowing relatively safe observations.

Another fact that should be considered is the general plan of the dyke around Galați, which is an elliptical arc of about 90°, therefore much of the azimuth correction recorded is not a result of errors in implementing the design, but an expected result of it. In this regard, the gap of scores between Limes Transalutanus (78 points) and the dyke Traian-Tulucești (62 points) should be understood as relative.

For a change, the differences between the comparison terms (above) and the “Athanaric’s Wall”, spear us of developed comments; the last cannot be assimilated as a Roman engineering project. As already mentioned, a segment located on the hill Chelbosu has been also measured – although too short – due to its “extreme”

⁴⁵ Teodor, 2013, p. 104-106.
⁴⁶ We did so especially for the “Athanaric’s Wall”, to defend its score (we had a strong filling about the final result of the experiment...). There is a passage, 2.8 km long, in the side of Prisaca forest, eligible as length (over 1.5 km), but apparently with too many azimuth corrections to be true, at least at the resolution available. The segment was eliminated from analyzed data.
features (both criteria from the table 3 are scored as zero). Now we will take a look on the last column of that table, on which the average slope of the segment is 3.83° (with a peak of almost 15° for 80 m!)\(^{47}\), the greater in the whole table. One should infer a relationship between the slope and the length of a straight line\(^{48}\) and note that the values from the lower part of the table are higher. This fact is yet only in part an explanation for the scores for the “Athanaric Wall”. We can test this on the same segment from the hill Chelbosu; it can be further segmented in an eastern part, 241 m long, with a positive average slope of 8.5°, and a central and western segment, 870 m long, with a negative average slope (descending) of 2.3°. The results for the eastern segment (average length 48.2 m and average correction of 9°) are not worst than the other (average length 45.8 m and average correction of 16°). More, the clumsy design can be seen also on flat terrain (see the first two rows of the “Athanaric Wall”, into Table 3)\(^{49}\).

5. Conclusions

We have tried in this study to find methods able to deal with a vallum relatively obscure, with geographical features still in debate, relaying on old and “classical” surveys. Until now, for over one century, two opposite hypotheses have been stated, many pages have been filled, but no convincing argument was produced about the builder of the dyke. What we desire to achieve here is an objective research mean, easy to understand or to check, far less expensive than a full field survey (aerial, terrestrial, geophysical and so on).

Of course, our statistic essay does not exclude the need for further traditional analysis, connected with literary accounts, field survey or archaeological diggings. Unfortunately, the archaeological trenches made on dykes usually do not uncover artefacts able to drive to a clear diagnostic in terms of chronology\(^{50}\) or paternity. As for the other basic product of an archaeological trench, the stratigraphic profile, it barely would be safely ascribed to a certain army of the Antiquity, as long as barbarians did not have a tradition in linear defence and borrowed it from the Romans; a drawn ditch profile is “Roman” anyway.

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\(^{47}\) It is calculated in Global Mapper, if a DEM file is present. DEM is an acronym for Digital Elevation Model, this one being SRTM (Shuttle Radar Topography Mission), with a resolution of 0.000833 arc degrees, about 66 × 95 m on 45° latitude, in Stereo 70 projection.

\(^{48}\) This is a natural determinism, the difficulty to find a straight line in a rough terrain being stressed also by other authors (for instance Bekker-Nielsen, 2000). In other words, there are further to study the constants that partially determine the linearity; to make this happen is not the simplest thing, if only because better DEMs (than those freely available today) would be preferable.

\(^{49}\) A slope with an average tilt of 4° is not a difficult one. The rules followed by the Roman topographers on the hills were not different from the flat areas, and they systematically tried to have long lines and small declivity in the mountains as well (van Tilburg, 2007, p. 17). Even speaking of dykes, not of roads, one should not forget that any dyke was doubled by a road, used by the troops commissioned to watch it.

\(^{50}\) Yet usually they can sample objects that might be dated by \(^{14}\)C technology.
We tried to exercise an applied approach, using public references (as the orthophotos), with simple evaluation methods, conditioned only by the skills needed to use some basic and not expensive software (at least within the academic discount). This approach, a bit too engineering for – some, especially titled – Romanian archaeologists, could be developed to more sophisticated investigations. We have restrained ourselves, for now, to measure the building corridor and to report it to the length of the route project, to account length of the straight lines and the corrections of azimuth, as primary items for statistics. One could consider further case studies for specific segments of the dykes, to check all the project features against the basic rules of the Roman engineering. Such analyses would be properly named “opportunity trials”, judging the factual route against the best possible route. Far more difficult – at least as a technical approach from the class of Predictive Archaeology\(^\text{51}\) – such applications could better reveal some insides of the building project, which surely will shed a better light on the designer, whoever might be.

Fig. 6. “Athanaric’s Wall”, the segment from the place Dealul Chelbosului (the Bald Hill); 3D model (3x, DEM and orthophoto, vectors for torrent valleys), view towards west-southwest. The dyke trails are rendered in dark lines (dots where not visible); bright lines for two different successful designs.

A glimpse of an “opportunity trial” one can find at the Fig. 6, which is a perspective view of the landscape around the hill Chelbosu. The dyke climbs the height at his half, than descends back in the valley, which is quite weird\(^\text{52}\), because

\(^{52}\) The route is confirmed by Mihalache Brudiu, which made a field survey in the area (Brudiu, 1979, p. 153).
the defensive positions are much below the enemy’s line of attack\textsuperscript{53}. At the same figure the whitish lines are suggesting two versions of good planning defence. The best option is to continue that straight line, outside the village Fântânele, up to the hills from west, behind a torrent (Valea Strâmbilor), in a very good defensive position; this is so obvious that anybody can see, and the builders would have had a very strong reason not to do so... Was it the valley flooded, or marshy?\textsuperscript{54} Or other facts counted more? At the bottom of that hill there was reported a possible settlement of the Late Roman age\textsuperscript{55}, named Boghianu. Was this – not researched yet – settlement so important to divert the project up to the hill? Only one fact is certain: they did not have the resources to make it right and to raise the dyke up to the watershed.

It is difficult to tell now if the dyke built on the half height of the hill Chelbosu is a result of the original project, or (more likely) a later addition made by a small community. Nevertheless, the so-called “Athanaric Wall” is a long list of debateable options, difficult to be explained only by later additions. For an inventory list of the questionable engineering at the dyke in southern Moldavia, there is yet a lot of work to do, including in the field.

\textsuperscript{53} The lowest height (46 m) is in the valley; the best height on the dyke is 87 m; the altitude of 120 m is just 200 m in the front of the ditch.

\textsuperscript{54} The soil is clayey and in a more forested landscape one would expect a wetter soil than today, which is quite dry. Not all agrees. Mihalache Brudiu have considered the historic landscape similar with what can be seen today (Brudiu, 1995, p. 231). He was rightly observing that in a large area (about 30 square km), between “Athanaric’s Wall” and the Roman dyke north of Galați, there is no water source on the ground surface. More, in the same area there are very few archaeological sites (data from Croitoru, 2013), which suggest that the antique vegetation was relatively low, and the drinking water was lacking. Our days villages in the area are absent. Nevertheless, the village near this segment of the dyke is called Fântânele, which means “Springs”, and at the bottom of the hill it was spotted an archaeological site of Roman age, named Boghianu (Croitoru, 2013, p. 140, nr. 48.1.A, with further bibliography).

\textsuperscript{55} This should not push us so far to consider the dyke itself as made in the fourth century, as long as the settlement is not thoroughly investigated!
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