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## CORRELATION BETWEEN ENVIRONMENTAL EVOLUTION, HISTORICAL SETTLEMENT AND CULTURAL HERITAGE UPGRADING IN VALLE UMBRA (CENTRAL ITALY)

**ABSTRACT:** COLACICCHI R. & BIZZARRI R., *Correlation between environmental evolution, historical settlement and cultural heritage upgrading in Valle Umbra (Central Italy)*. (IT ISSN 0391-9838, 2008).

In Central Italy, the «Valle Umbra» (remnant of the south-eastern arm of the plio-pleistocene Tiberino basin) is a wide depression characterized by a very low declivity causing difficult drainage. During three millennia the zone became alternately partially or totally flooded, with lakes, swamps, and marshland, or sometimes quite dry and easily accessible and exploitable by man. The variation was caused by: a) climate changes, with rainfall increase or decrease; b) tectonic movements tending to rise or to lower the outflow threshold; c) Man who attempted to lower the outflow threshold and canalize streams and creeks for land reclaiming.

From the first millennium BC, the Umbrians, Etruscans, Romans, Goths, Byzantines, Longobards and Franks lived at different times in this valley and left traces in various places depending on the environment.

From the 7th to the 3rd Century BC, traces of Etruscan and Roman settlements have been found on the surrounding hills or on slightly raised ground (*Mevania*). It is probable that the lowlands were swampy and so not easy to traverse. In the 3rd Century BC a huge lake is documented (*Lacus UMBER*) which covered a great part of the valley bottom, where there were also numerous meandering streams.

On the plain (at Aisillo) the ruins of a Roman temple have recently been discovered which was in use from the 2nd Century BC to the 3rd Century AD. This corresponds to the period of Roman domination. There is also much evidence of human dwellings in the plain which was easily accessible in Roman times. In 220 BC the most important road which crossed the zone (the Via Flaminia) was built. Traces of a Roman centuriation, for agricultural purposes, but also carried out in order to drain the swamps, have been discovered. We know that the valley was well organized, with plenty of well channelled water courses. In Bevagna

a Roman mosaic testifies to a thermal establishment here. A river (the *Clitumnus*) was navigable as far as the Tiber and Rome, and there were some river ports near the towns. In this healthy environment there were several villas and temples alongside the river some of which are still preserved.

The Aisillo temple is now covered by about 2 meters of marshy, clayey and peaty sediments indicating that from the 4th Century AD onwards the valley plain became an impassable swamp. This is also confirmed by signs of a climatic deterioration with increased rainfall and decreasing temperatures, which lasted right up to the Middle Ages. Close to the end of the 5th Century AD Teodoricus reclaimed part of the Valle Umbra but during the subsequent Longobard invasion, lack of maintenance caused the valley to become a swamp once again.

Later history is characterized by various attempts at reclamations attempted by different municipalities, but lacking coordination. These often led to disputes and fights between neighbouring communities since they sometimes caused damage to the land nearby. In conclusion, in each period it is possible to trace the influence of the environment on inhabited areas and on the activities of the local populations. An historical reconstruction can provide the foundation for our knowledge of the territory and if properly used can help to develop knowledge of our cultural heritage and thereby the development of tourism.

**KEY WORDS:** Climate changes, Cultural heritage, Umbrians, Romans, Barbarian invasions.

### INTRODUCTION AND GEOLOGICAL OUTLOOK

During Late Miocene-Pliocene the Central Italy tectonics was characterized by compressive phases that caused the uplifting of several NNW-SSE mountain ridges, progressively younger from West to East. Each phase was followed by tensile-relaxing movements which created grabens and depressions stretching parallel to the ridges (Ambrosetti & *alii*, 1987, 1994; Basilici, 1992; Barchi & *alii*, 1991; Coltorti & Pieruccini, 1997; Martini & Sagri, 1993; Petronio & *alii*, 2000-2002).

In Umbria, the compression-tension sequence occurs from the Late Miocene/Pliocene up to Pleistocene age. It created a depression (now 140 km long), which crosses al-

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The Authors are highly indebted to the Italian Embassy in Malta for their kind hospitality during the Italo-Maltese Workshop. We are also grateful to Dr. P. Argenti and A. Baldanza for their advices, to Dr. P. Camerieri for the map of the centuriation, to W. Cruciani for the drawing of the port of Mevania, to M.R. Tralbalza for help in collating the reference sources, and finally warm thanks to Dr. M. Salari and to Dr. A. Macadam for the correction and improvement of the text.

most the entire region from north to south and is still evident today. To the east, a very high ridge (Mt. Nerone, Mt. Catria and Mt. Brunette), prevented the water outflow towards the Adriatic Sea. To the west, the Mts. Martani, the Mts. Amerini and Perugini ridges prevented the runoff to the Tyrrhenian Sea. Thus the Umbrian depression began to flood and became a lake basin, known in geological literature as the «Grande Lago Tiberino» or more properly as the «Tiberino Basin», which was at times a lake, at times a marsh and at other times a swamp (fig. 1).

Close to Perugia, the basin splits in two arms, the western one is the Valle Amerina and the eastern one the Valle Umbra. The latter has been the theatre of successive waves of human settlement since the 1st millennium BC.

The purpose of the present paper is to attempt to correlate and reveal the mutual influences between historical events in the Valle Umbra and the environment changes induced by climate variations, during three millennia, from 1000 BC up until the present day. The Valle Umbra has been selected because it is a confined zone, flat, highly conditioned by climate change and the site of great many historical events.

The morphological situation of the valley was, and still is, peculiar: it is a SSE-NNW trending depression with a flat bottom and steep sides due to fault. Mt. Suba-

sio and a ridge with Mt. Brunette and Mt. Serano are on the east, and the Mts. Martani chain on the west. To the south the valley rises close to Spoleto in a kind of shell. Here the drainage is operated by a number of torrents (Tatarena, Marroggia, Tessino etc.) which converge towards the centre of the depression and progressively merge to form the main streams (Timia and Topino) draining the Valley northward. The hydrographical basin is around 170 km<sup>2</sup> (excluding the part pertaining to the Chiascio river). The only water outflow is towards the Chiascio river and the Tiber confluence at the Torgiano threshold. The declivity of the plain is very weak: from the Clitumno springs, to the Tiber confluence, the rise is 45 meters and the distance is 40 km, so the mean is around 1,2‰. Furthermore, the dip is not continuous, there are entirely flat or basin shaped zones, as well as slightly raised ridges due to the sand settling tributaries (fig. 2).

On the valley bottom the lacustrine and fluvial deposits, made of clay interbedded with sandy levels, lignite beds, scattered conglomerates and palaeosoils, are some hundreds of meters thick, and are evidence of tectonic subsidence as well as lacustrine environment with lateral tributaries carrying sediments, alternating with swampy phases with peat and lignite deposition, and

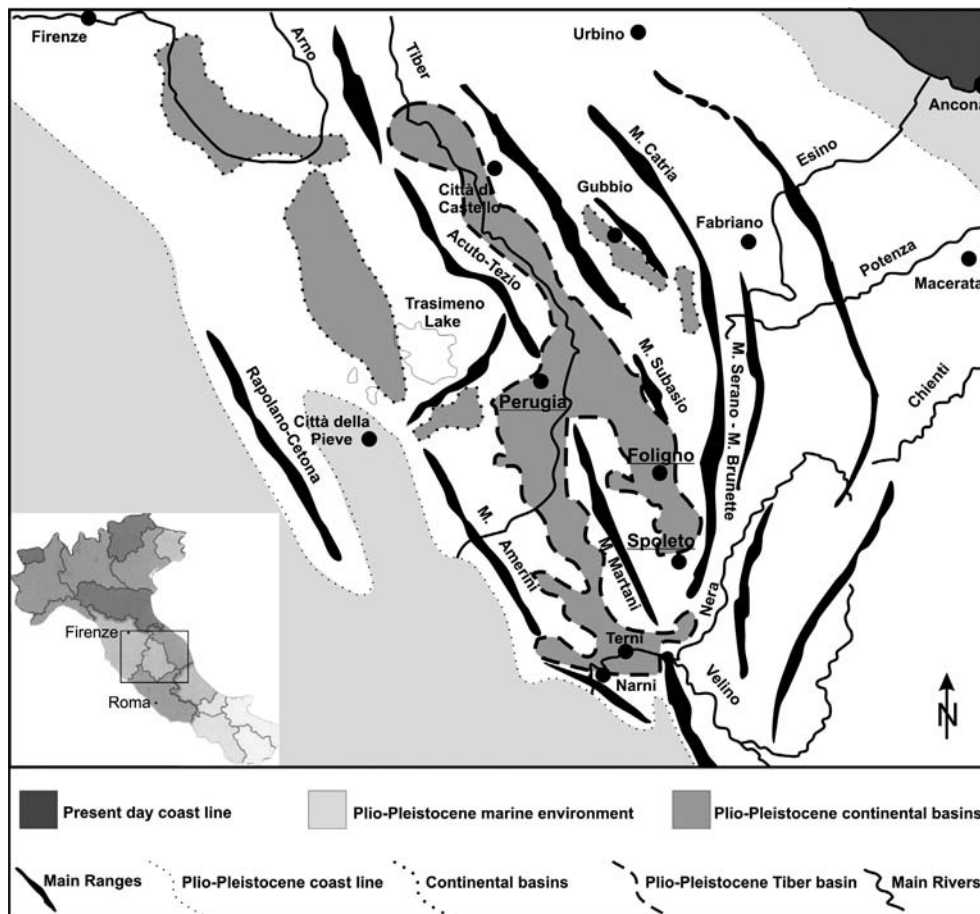
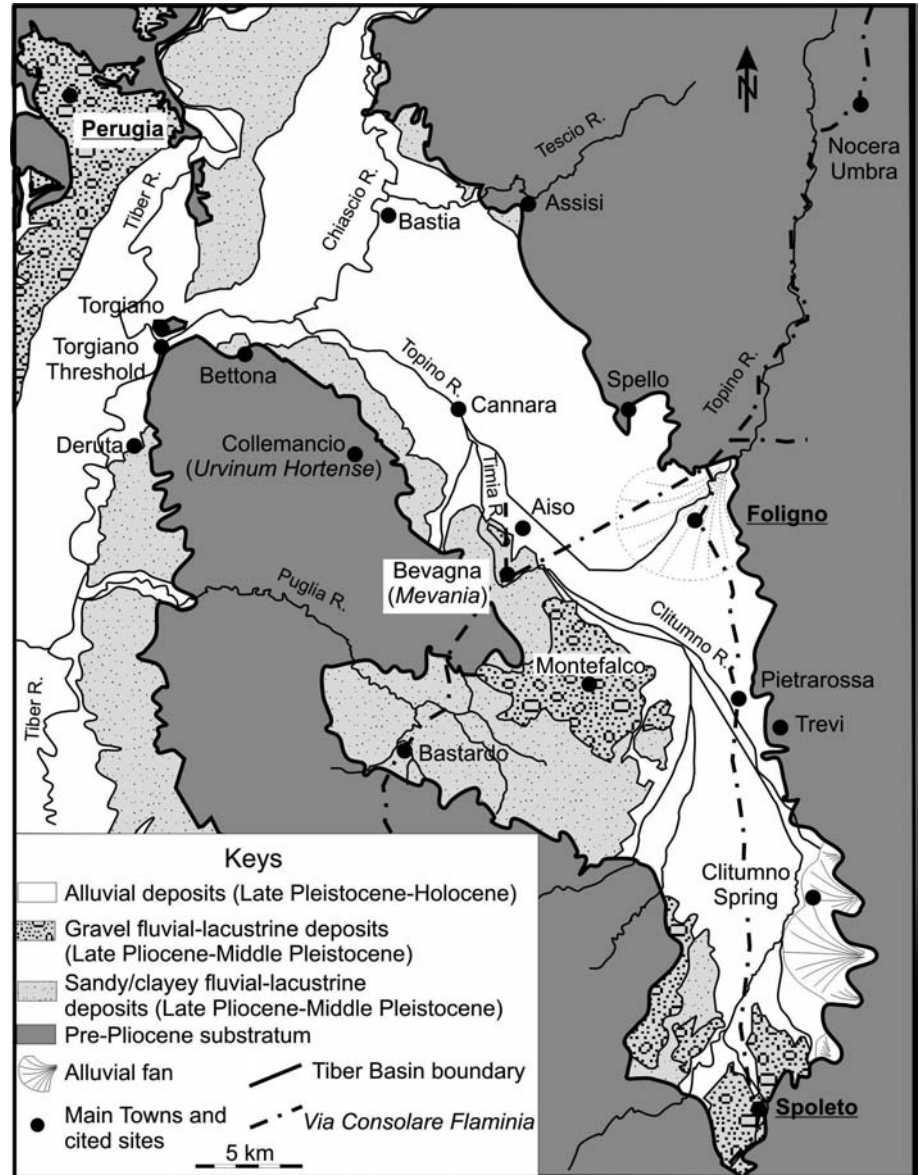


FIG. 1 - Central Italy structural scheme during Pliocene. The NW-SE trending ridges and the interposed basins are evident. Scale 1:1.400.000

FIG. 2 - Present day schematic geological map of the Valle Umbra from Perugia to Spoleto evidencing Plio-Pleistocene fluvial-lacustrine and lake sediments, the rivers draining the valley (Clitumno, Timia and Topino) and the *Recens* Via Flaminia leading straight from Spoleto to Foligno.



with dry periods in which the valley was accessible and exploitable.

The morphological aspect of the valley was mostly controlled by benign periods, characterized by high temperature and limited rainfall, alternating with critical periods with low temperature and high precipitation. Other factors were: a) tectonic movements, active up to Late Pleistocene, causing the depression of the valley flat and raising both the valley sides, and the outflow threshold (Torgiano threshold) placed on the alignment of the Mts. Martani anticline; b) the activity of the inhabitants who tried to deepen the outflow threshold to accelerate the water's drain off, to dig channels, to reclaim swamps and to build embankments in order to control streams and creeks.

## CLIMATE VARIATIONS

A scheme of climate variations has been drawn for the last three thousand years (fig. 3) comparing and integrating data on the oscillations of lake levels in central Italy (Brugiapaglia, 1995; Brugiapaglia & De Beaulieu, 1995; Dragoni, 1996, 1998), data from pollen analyses of peat-bog (Bertolani Marchetti, 1985; Alessio & alii, 1986; Follieri & alii, 1988; Magri & Follieri, 1989; Paganelli, 1993), data on the expansion and recession of ice-caps (Bertolani Marchetti, 1973; Le Roy Ladurie, 1982), together with some historical data post 1000 AD.

In the period before 1000 BC the climate was warm and dry – a «climatic optimum» following the last

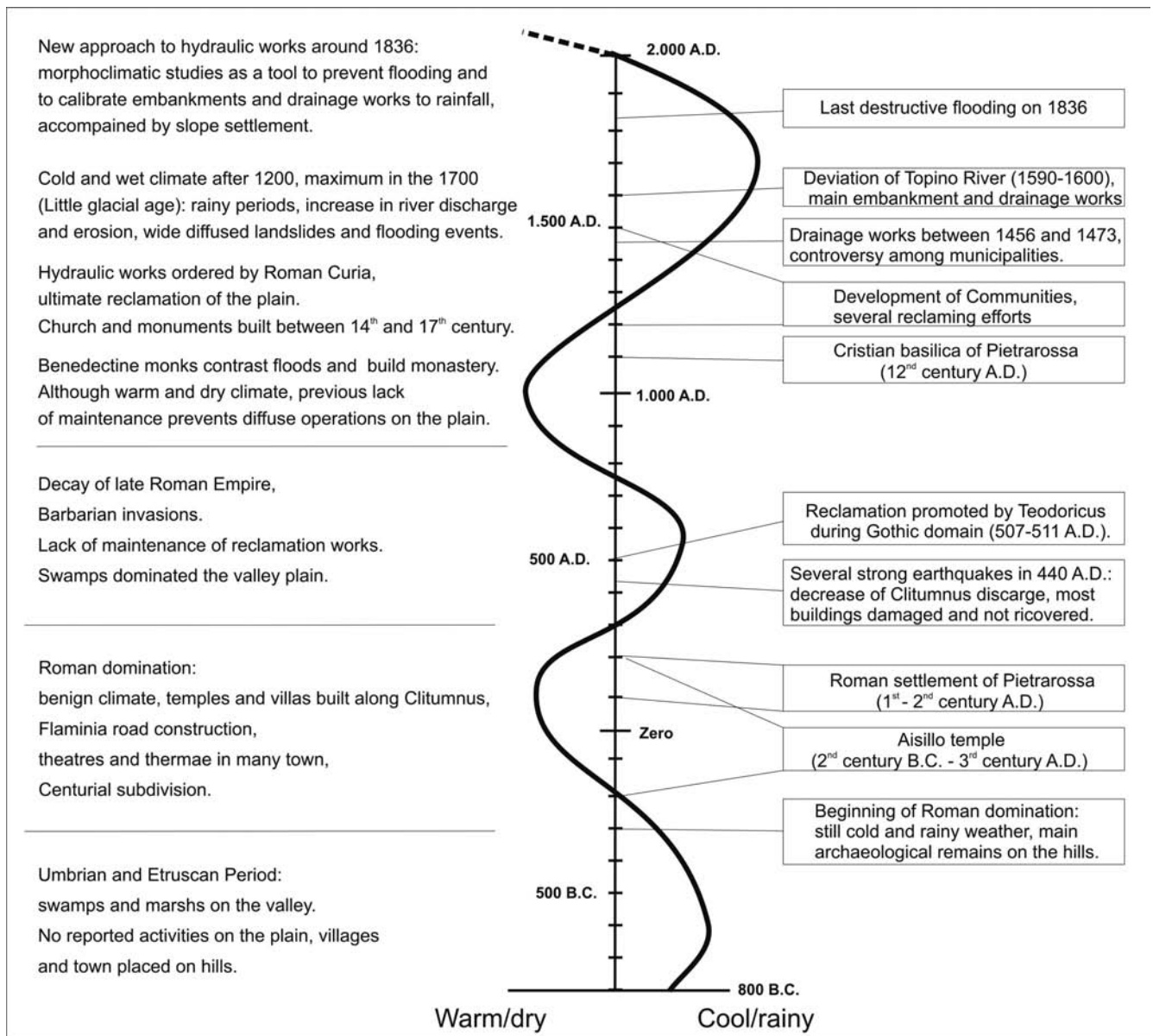


FIG. 3 - Scheme evidencing the climate variations during the last 3000 years. The curve has been synthesized from several data collected from pollen analysis, lake level variation, ice cap oscillations and historical data for the last two millennia.

glaciation – and this continued up to 900 BC. There are no documents or data about the floor of the valley in this period, so these cannot be taken into consideration.

From 900 BC to around 250 BC – the first cold event of the sub Atlantic period occurred – the climate was cold and rainy, with several oscillations documented by glacial expansions and retreats.

The following period was warm and dry and lasted from 250 BC to the 3rd century AD; it coincided with the Roman domination. Information on this period come from archaeological remains, from letters by historians (Plinius

Junior and Tacitus), and from a bustling human activity in the valley plain.

A rainy and cold period known as «cold medieval phase» lasted from 200 to 800 AD, documented by historians, chroniclers etc. (Pinna, 1996).

The next warm phase lasted until around 1250 AD, and is followed by a further and severe cold period, from 1300 to 1850, called «Little Ice Age» (LIA) which leads to the present climate. Climate oscillations controlled the valley morphology and at the same time affected the local population who lived in the valley and left traces of their activity.

## UMBRO-ETRUSCAN PERIOD

Between the 9th and the 3rd Century BC, the Umbrians generally lived on the left side of the Tiber in scattered villages (*Pagus*) on the mountains and hills (Colfiorito) (Feruglio & alii, 1991). The Etruscans lived mostly on the right side, but they were present also on the left side, and contacts and fights between the two peoples are documented. It was usually the Etruscans who crossed the Tiber and came into conflict with the Umbrians.

There are no documents concerning the Valle Umbra that testify to any active human dwelling on the floor of the valley. Archaeological remains come from mountain areas (*Hurvinium Hortense*), hills (Bettona, Trevi) or at least from slightly elevated areas (*Mevania*, *Fulginium*) (Feruglio & alii, 1991; Bonomi Ponzi, 1991; Baiolini, 2002; Barbieri, 2002). It is therefore realistic to suppose that the valley was unhealthy, since it was covered alternately with lakes, swamps or marshes caused by the rainy and cold climate (fig. 4). Some historians refer to two lakes – *Lacus Umber* and *Lacus Clitorius* – which occupied a large part of the valley (Pietrangeli, 1953). There is evidence of dwellings only on elevated areas. The archaeological ruins close to Collemancio are mainly Roman (*Hurvinium Hortense*), but recently foundations have been found which seem to be Etruscan. In Trevi, several remains from the Umbrian period are documented, antecedent to the Roman settlement (Zenobi, 1995), and the same is true in Spello, Assisi, elsewhere.

## ROMAN PERIOD

The Romanisation of the Valle Umbra began around the 3rd Century BC, while the climate was still cold and

humid (fig. 5). At first the Roman settlements were on the hills: as already mentioned, in a place called *Hurvinium Hortense* – close to Collemancio – at an elevation of 520 meters, the remains of a temple and of a mosaic have been discovered together with a Roman village. Here a modern elliptical olive-grove has the same geometrical proportion of a Roman amphitheatre (Camerieri, 2006) (fig. 6) and along the perimeter, remains of Roman substructures have been excavated. It is remarkable that after 2000 years the outline of a Roman structure is still evident, even if in a quite different context.

The settling on the hill supports the hypothesis that the valley floor was uninhabitable (Manconi, 1985). In the same period historians report the *Lacus Umber* and *Lacus Clitorius* were extensive and one of them as deep as 5 metres (Dragoni, personal communication).

From the 2nd Century BC onwards there is a fervent and dynamic Romanization of the valley. The outstanding cultural heritage of this period can be seen in numerous places all over the region. This period lasted right up to the 3rd Century AD.

The following list shows the evidence which exists today on the ground.

a) Centuriation: centuriation is the subdivision of the land, with exactly perpendicular boundaries. The «*centuriae*», were farms created both to reward legionaries and veterans for their military service, and also to tie the legionaries to the land in order to create a population ready to defend this land from external attacks. Some present farm boundaries still partially follow the lines of these ancient subdivisions; landmarks and towers also in many cases conform to these divisions. There are also centurial divi-



FIG. 4 - Valle Umbra swamps: hypothetical landscape interpretation of the marsh/swamp environment of the south-eastern arm of Tiberino Basin during late Pliocene (drawn by A. Speziale).

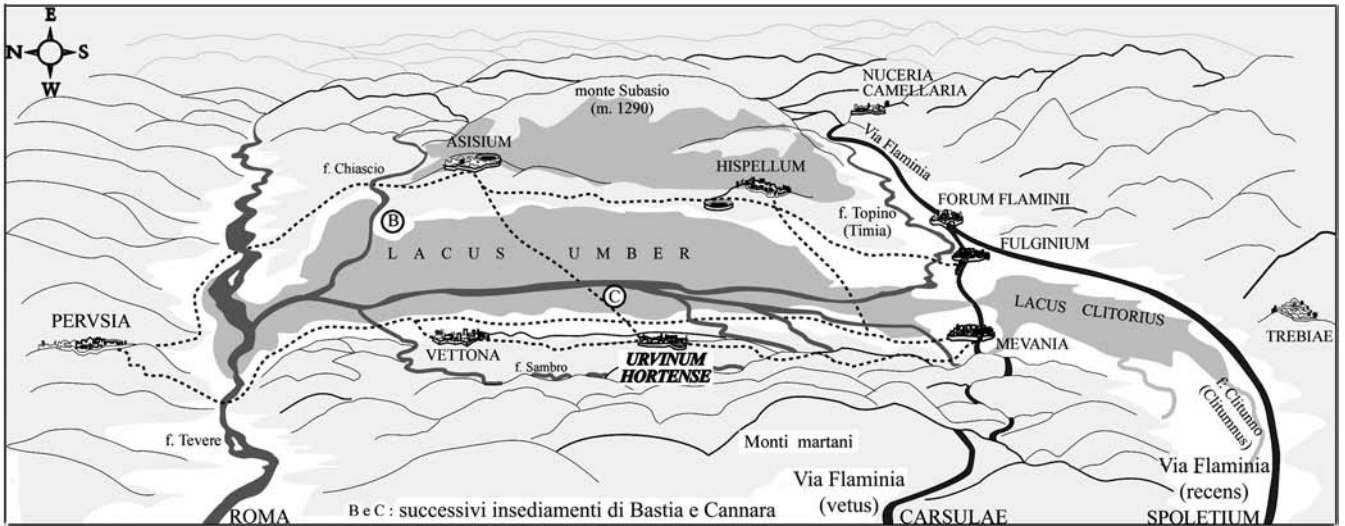


FIG. 5 - Hypothetical reconstruction of the Valle Umbra at the beginning of Roman domination. Towns and villages are on more or less elevated zones. Wide lakes prevail in the valley, and the ancient Via Flaminia (*vetus*) winds along the hills. The new Via Flaminia (*recens*) was built later, as were the towns of Bastia and Cannara on sites B and C (after Pietrangeli 1953; modified).

sions with different orientations, obviously made in later periods in the Valle Umbra (Camerieri, 2006, 2007; Feruglio & *alii*, 1991; Manconi & *alii*, 1991) (fig. 7). The reconstruction of centuriated zones, has indicated that the wide lacustrine and swampy zones, which existed in the preceding century, were greatly reduced. It is realistic to imagine that as well as the change of climate, several drainage works

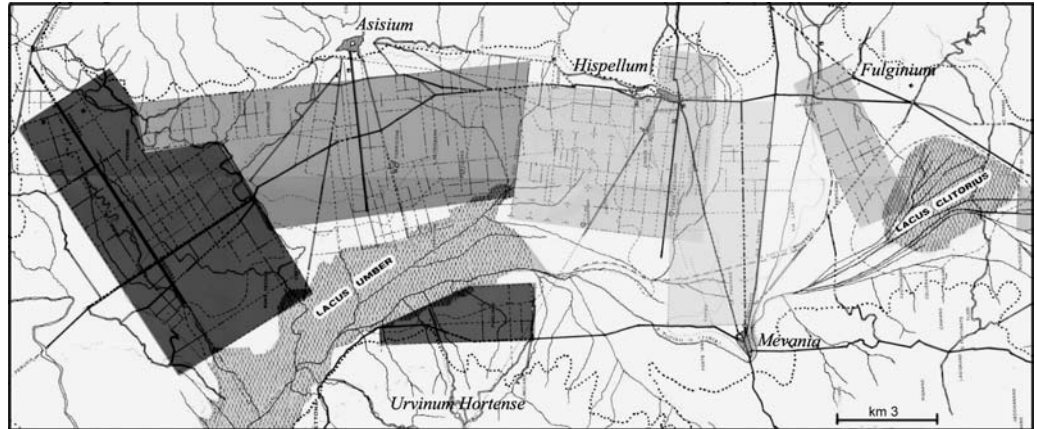
had been carried out in the valley in order to reclaim land for cultivation and stabilize its hydrography.

b) Roads: the system of road in the valley plain was increased. The old Via Flaminia, which was an essential communication route from Rome to the northern provinces, mainly followed the hills and had several side lanes, but around the 2nd Century BC the section which led straight



FIG. 6 - Evidence of the Roman settling at *Hurvinum Hortense*, around modern Collemancio: the elliptical olive grove in the centre of the photo (arrows) has the geometrical proportions of a Roman amphitheatre. Around the perimeter of the grove several Roman substructures have been revealed as well as along the white road nearby. The village on bottom left is Collemancio.

FIG. 7 - Pattern of Roman centuriation boundaries: distinct grey tones point out different orientations of centuriation subdivisions made in later times. The *Lacus UMBER* and *Lacus Clitorius* appear greatly narrowed. The wide span of land subdivision points to an intense activity in the valley (courtesy of P. Camerieri).



across the plain was built (Uncini, 1995). The Via Flaminia was to survive up to the present day as a fundamental road system.

c) Temples: in many towns there are temples or ruins of religious structures built in this period. At Bevagna there is a temple dating from the 2nd Century BC. Along the *Clitumnus* river, close to the springs, there is an early Christian «*tempietto*» built on the ruins of a Roman temple. In the same period Plinius Junior mentions several small votive temples along the *Clitumnus* river. There are other temples such as the one dedicated to Minerva in Assisi (1st Century BC), and the medieval church or palace in almost every town is built above the ruins of a Roman temple.

d) Sanctuaries: close to Bevagna, next to the Aisillo resurgence a round pond with double wall has been discovered and unearthed, and remains of several structures: rooms with mosaic floors, a paved corridor in *opus spicatum* etc. (fig. 8). Archaeologists have identified this as an important sanctuary connected with the abundance of water, and, active from the 2nd Century BC to the 3rd Century AD (Albanesi & alii, 2007). Recently further studies have suggested the sanctuary could be predated to the 3rd Century BC.

e) Theatres: in Bevagna two corridors supporting the cavea of a Roman theatre of the 2nd Century BC have recently been restored (fig. 9). In Spoleto a theatre of the



FIG. 8 - Excavation at the Aisillo Sanctuary: in the foreground the Temple basement with its mosaic paved *cella* (2nd Century BC - 3rd Century AD); in the background the round pool of the resurgence with double wall. In close-up an *opus spicatum* paved corridor (photo Lopparelli).

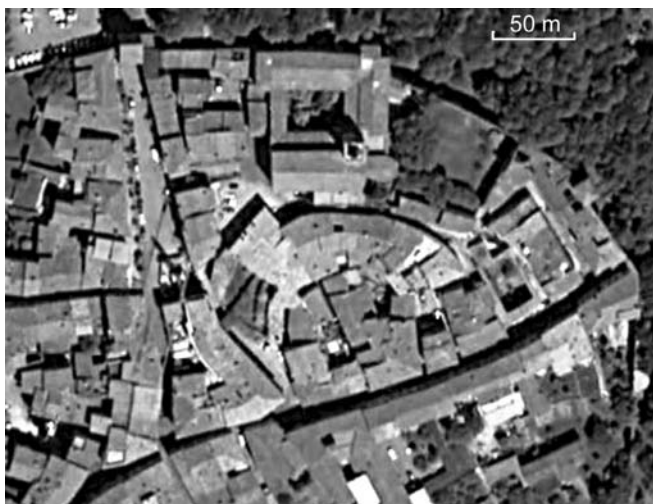


FIG. 9 - North-eastern zone of the town of Bevagna: showing the semicircular structure of the Roman theatre (2nd Century BC). The straight road (black) in the bottom right corresponds to the Via Flaminia which crossed the town (from Google-Earth, modified).

1st Century BC is still used for summer performances. In Spello there are ruins of a Roman theatre dating from the 1st Century BC. Almost all the towns in this region have Roman walls, often with monumental gates, on which the medieval walls were built.

Close to Mevania there was a harbour (fig. 10), which was the main port for shipping the products of the valley to Rome and was certainly an important economic struc-

ture (Cruciani, personal communication). In most towns there were also *aquaeductus* and *termae*, supplied by the abundant water in the Valley (Stefanucci, 2002).

The above mentioned data document an extremely developed anthropization along the Valle Umbra and in most surrounding areas. The descriptions left us by a number of Roman authors (Plinius Junior, 97-112; Propertius, 28-25 BC; Silius Italicus, 92) celebrate the pleasant amenities of the area, and the account of military manoeuvres near Bevagna (Tacitus, 104) point to a highly advanced economy and vivacious activity, even though there were battles and fights between the Romans and local populations who attempted to retain their autonomy.

All this points to a very positive morphological condition, both through control by human activity, and also because of the dry and warm climate which limited swamping and flooding, and eased the work of land reclamation (Desplanques, 1969).

#### EARLY MEDIEVAL PERIOD: THE DECLINE OF ROMAN EMPIRE AND THE BARBARIAN INVASIONS

Towards the end of the 3rd Century AD, the Roman Empire slowly declined. The centre of the Byzantine Empire came into conflict with Rome; Barbarian incursions, followed by invasions, contributed to the political disintegration of central Italy. Since the Valle Umbra was an important communication route it was often traversed by armies and a theatre of battles (Albertini, 1966).

This political situation coincided with a worsening of the climate: it became cold and rainy, and, the increase of

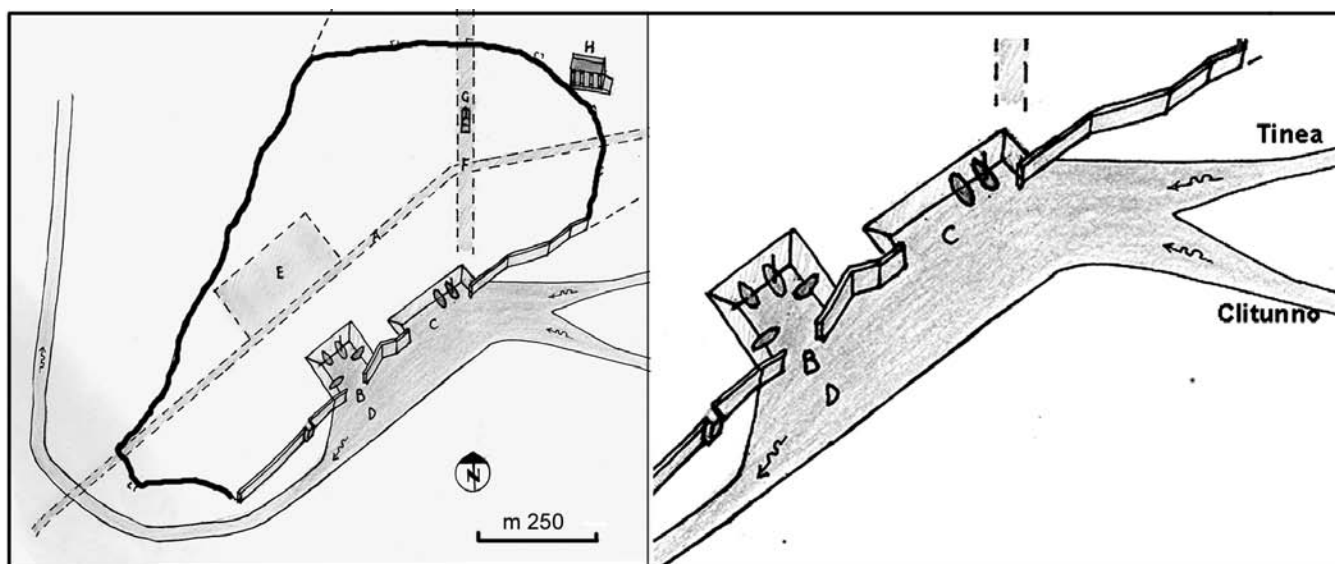


FIG. 10 - Hypothetical reconstruction of Mevania harbour at the confluence of the Clitumnus and Tinea rivers. Legend: A) Via Flaminia, B) harbour, C) dock, E) Mevania Forum, G) and H) Temples, F) the cross-roads between Decumanus and Castrum. The thick black line indicates the perimeter wall of the Roman town. To the right an enlargement of the harbour zone: the Roman wall had two discontinuities which may represent the harbour mouths (drawn by W. Cruciani).



rain and lack of maintenance of the reclamation works, as well as the destruction by armies and barbarian hordes, caused water outflow and the increase of swamps. Some Roman buildings collapsed and were covered by lacustrine or swamp sediments. In two places there are records of these phenomena: close to Bevagna, in a low lying area of the plain, the Aisillo sanctuary ruins, are covered by two meters of swampy sediments, demonstrating that a former active presence of people in the plain turned into a long lasting swamp (fig. 11).

A similar situation occurs close to Trevi at Pietrarossa. A portion of a road, paved with Roman flagstones, has been discovered together with some remains of walls, pottery and mosaic fragments attributed to a late Roman settlement – 1st Century AD – (Manconi, 1990). The road, which may be related to the Flaminia, was restored three times after flooding, and today it is totally covered by two meters of swampy sediments (Ravagli & Mattioli, 1990). A situation very similar to what happened at Aisillo. Around the 12th/13th Century AD the Christian basilica of S. Maria di Pietrarossa was built with some stones which came from Roman structures.

#### GOTHIC AND LONGOBARD DOMINATION

In 446 AD, during the acme of the cold medieval phase, a sequence of very strong earthquakes lowered drastically the discharge of the *Clitumnus* river causing the decline of Mevania harbour, which may even have ceased to operate altogether at this time. Buildings all along the valley collapsed (Venuti, 1753). These facts, together with

the devastations caused by barbarian hordes, led people to desert the valley, and a general economic and moral decline in the countryside set in: it rapidly became impoverished, so that reclamation works were no longer maintained and no new land reclamation took place. Thus the swamps and marshes reconquered much of the plain.

During the Gothic domination, from 507 to 511, in a limited zone north of Spoleto reclamation was attempted by Theodoricus: it is uncertain if he accomplished this, and in any case it was rapidly abandoned. The Longobard invasion at first caused the destruction of several towns and further depopulations. After the constitution of the Longobard Duchy of Spoleto (570), the situation improved but no reclamation is recorded in the Valle Umbra, and the surface of the *Lacus Clitorius* expanded (Vetturini, 1995). The same situation occurred when the Franks replaced the Longobards in Spoleto, even if the Franks fought and defeated the last Saracen and Hungarian raids (9th and 10th Century) in defence of the local populations.

Between 700 and 800 AD and the 13th Century a positive climate oscillation, towards warm and dry, could have stimulated new reclamation and swamp drainage of the plain, but lack of a central organization and depopulation hampered an organized and effective activity in the valley. Only the Benedictines who owned land, forestry, and mills, and had noteworthy economic and managerial talents, counteracted the hydrogeological degradation. They tried to drain swamps around their abbeys and create embankments along the rivers, and regularize the waterways, in order to have cultivable land and a regular waterflow for their mills.



FIG. 11 - Aisillo Sanctuary: the Temple structures are covered by two metres of swamp and marsh deposits representing 1700 years of sedimentation (photo Lopparelli).

## LOW MIDDLE AGE TO PRESENT DAY

Around 1200-1250 the climate had a negative variation towards a cold and rainy period which was to have its *climax* in 1700 (LIA). Rainfall increased, swamps, marshes and lake surfaces were enlarged, overflow and floods made the exploitation of the valley plain more and more difficult.

From a political point of view, the development of «Communes» began in around 1200: cities and towns set up as free municipalities with their own statute and laws claiming their autonomy. These were loosely controlled from Rome by the Curia Romana. Following the constitution of Free Communes, the period of stagnation and depression began to wane, and activities were resumed to improve the valley's economy. Most medieval Umbrian churches and palaces were built during 11th and 12th Century: the Cathedral and San Pietro in Spoleto, San Silvestro and San Michele in Bevagna, Santa Maria Infraportas in Foligno and many others.

The population increased, and some reclamation which aimed at recovering land for agriculture was attempted. But further problems arose due to lack of coordination from a central organization. In fact, reclamation and water regulation in some zones caused problems amongst neighbouring towns, because speeded water flooded the land of the villages further downhill, or water itself, canalized away from a zone, caused a lack of water for the mills of neighbouring Communes. Hence debates, disputes and sometime even fights took place, and punitive raids to cut embankments, or to destroy barrages etc. (Vetturini, 1995).

Around the end of the 14th and during 15th and 16th Centuries the climate worsened reaching the *climax* of the LIA. Continuous heavy rains caused flooding and bank collapse; each Commune tried to counteract this with episodic and localized actions but these failed to solve the problem completely. In 1456 there were major quarrels between Spello, Cannara, Bevagna and Foligno, about an overflow channel, which lasted up to 1473: this conflict was only solved through the intervention of Perugia and the Curia Romana.

At the same time, due to heavy rains, the turbid load of the torrents flowing down from the mountains to the plain, increased the obstruction of channels. Overflows caused sandy fans and ridges to divide the plain in swells and basins, which were flooded and stayed swampy for a long time. Three main areas subject to flooding may be indicated: one north of Spoleto, a second between Bevagna and Trevi and a third from Cannara to the Chiascio confluence (Vetturini, 1995). Meanwhile following the population growth, cultivable land reclaim increased, so, flood carried debris and materials dug from overflow channels, were used to reclaim and to fill low-lying basins.

At the end of the 16th Century, with the help of the Curia Romana, an important operation of regulation was carried out: the bed of the Topino river was deviated, straightened, and shortened, moving the confluence with

the Timia 7 km downstream, increasing inclination and tilt regularity, and embankments were built. This was a well coordinated action which was the first well-planned intervention on the major drainer of the middle Valle Umbra. Very famous architects (Sangallo Junior, Maderno, Fontana) were called in to regularise the hydrology of the valley (Messini, 1942).

The first serious attempt to regulate the river was followed by an exceptional increase in rainfall and rain intensity, introducing to the *climax* of LIA (Guarino, 1985; Pinna, 1996; Vetturini, 1995). But discharge growth and water violence caused a further increase of erosion and transport capacity, followed by debris deposition in the plain, overflows and strong streams which wrecked the recent reclamation works. Many problems which had been solved between the end of the 16th and the beginning of the 18th centuries had to be faced once again (Rutili Gentili, 1837). It was as if the intensity of meteorological phenomena increased as soon as the reclamation works were completed. This frequently caused damage and even serious disasters.

After a devastating flood happened in 1836 (Messini, 1942), a general study with a complete analysis of the hydrological situation was proposed by the managers, hoping to find a lasting solution to the problem. A group of hydraulic engineers, which including Rutili Gentili and Goretti, made a detailed study of the morphoclimatic situation of the whole valley and the predictable discharge as far as the confluence with the Chiascio and the *Tiber*. The result was a project which took into consideration not only the major drainers but all the channels of the plain. The channels' cross sections were recalculated, meandering streams were straightened, embankments able to retain flash floods were built, confluences were rearranged so that debris deposits did not obstruct water flow, bridge lights were enlarged. All the works carried out in the second half of the 19th Century, achieved the hydraulic stabilization of the valley as it has remained to this day (Guarino, 1985).

## DISCUSSION

Comparative examination of climate oscillations and human activities in Valle Umbra underlines relationships which in some cases are evident, with a linkage between cause and effect, but in other cases are more vague, and sometimes difficult to identify. In general in the earliest period, Umbro-Etruscan, Roman, and early medieval, influence and control by climate variations are evident. During the first cold and humid event of the Subatlantic period, there is no evidence of stable human settlements in the valley plain. Wide lacustrine zones which persist up to the 2nd-3rd Century are reported.

In the following warm and dry period, during the Roman domination, there is increased activity of anthropization and land use of the valley plain, with centuriation,

agricultural exploitation and a widespread urbanization including roads, temples, villas, and sanctuaries.

Temperature decrease and rain rise during the climate worsening from the 3rd to the 7th Century AD produced critical situations in the valley plain; these were aggravated by the lack of a strong central power which could plan intervention, and by the depredations of barbarian hordes, both causing population escape. The growth and widening of swamps and flooding were the result of a number of different causes.

In these three periods the climate control on anthropization is clearly evident.

During the following warm period, only the Benedictine monks, who were the only organized economic force remaining in the valley, tried to dry some zones and to embank rivers. The positive climate influence could not therefore be exploited to the full because of the political and economical situation existing in the valley.

From 1250 up to 1800, during the LIA the influence of the worsening climate is evident: numerous efforts to reclaim low lying areas, to embank and canalize rivers attempted to contrast the waste due to flash floods. Meanwhile as dangerous and destructive phenomena grew, the work to counteract these through the development of effective technologies increased as well. The high point was reached in 1800 when operations were planned for the whole valley, the strength of the stream flows were calculated, and the scale of the works was increased so that they could also resist paroxysmic events. Reclamation and other work carried out in the nineteenth century led to the present situation.

At a general glance a progressive population increase is evident, with oscillations induced by human as well as climatic phenomena. Population increase caused a rising demand for usable land, and therefore stimulated reclamations and hydraulic control, together with a progressive development of knowledge and technologies as well as the conviction that study and general organization were necessary to achieve a final solution to the problems. In fact after a certain period the Communes of the area constituted consortia to join and coordinate their efforts. It is evident that human action grows more incisive as population increases, and knowledge develops, while natural forces prevail when population rarefies and when politics producing internal contrasts hamper a coordinated action.

## RELATIONSHIPS WITH THE CULTURAL HERITAGE OF THE AREA

The Valle Umbra is very rich in cultural heritage from the Umbrian, Etruscan, Roman, Medieval and Renaissance periods. It is therefore an ideal destination for a cultural-religious tourism. Apart from the obvious and immense interest of Perugino and San Francesco, the historical events regarding the anthropization and the subsequent socio-economic development of this area, documented with progressive intervention, give the idea that geology, geomorphology and climate oscillations affect the life and the de-

velopment of a region. Periods of thriving economy may be followed by depression when earthquakes occur or changes in the hydraulic regimen; but the necessity to defend the population from natural disasters acts as a stimulation for the development of studies and new methodologies. At the same time it is evident that lack of organization and of over-all planning, frustrate efforts and result in a waste of energies.

Taking into account archaeological, artistic and religious heritages, a historical reconstruction from naturalistic as well as an evolutionary point of view, should stimulate interest in knowledge of the wider cultural overview of the country. Even the study of important hydraulic works carried out with little technological resources, may stimulate our knowledge of exceptional civilizations, and may be considered a cultural heritage in itself.

Unfortunately, at present a large part of the archaeological cultural heritage of the Valle Umbra, mainly Umbrian, Etruscan and Roman, are lying under swampy and alluvial deposits. Many places where the presence of Umbrian, Etruscan and Roman remains beneath the soil are known, these remain unexplored because of lack of funds as well as lack of initiative. This severely damages the development of the region which could receive economic benefits and an increase in cultural tourism if these were to be exposed.

An important project entitled «*Invito al Parco*» (Invitation to the Park) which proposed the realisation of a multidisciplinary Park (scientific, archaeological, naturalistic), extending throughout the entire valley, has been drawn up by a group of scientists, including geologists, archaeologists, architects and biologists. This planned to recover all the archaeological material existing in the valley, and to show the connections between natural phenomena and cultural and socio-economic development, in an integrated framework which would enhance the region's cultural heritage (Trabalza & Colacicchi 2007). The project was submitted in 2004 to the local authorities, but despite interest from a number of organisations no action has yet been taken to develop this project, and no funds have been forthcoming to support it.

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(Ms. presented 30 April 2007; accepted 30 August 2008)