

# The Via Aurelia in the Tarquinia Area: New Results from an Aerial Photograph Study by the Matlab Image Processing Program

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## Abstract

*The object of the present study is to search, on the aerial photograph, for latent traces having archaeological meaning attributable to the context of ancient settlements and roads (Roman Via Aurelia and other roads) in the coastal plain of Tarquinia. For this purposes the techniques from the MATLAB image processing program have been used.*

*The analyzed territory, having archaeological sites previously recognized by traditional photointerpretation (ancient roads, towns, rural villas, harbors, etc.), allows calibration of the methodology of image processing. In fact, image processing ameliorates the visibility of previously recognized traces, and reveals latent traces, not observable on the un treated photo.*

*The results of the search seem to confirm the Pasqui hypothesis of a Roman Via Aurelia on the coastal plain of Tarquinia, pointing in the direction of Graviscae (Aurelia Vetus) and constructed before the upside straightaway tract (Aurelia Nova).*

## Introduction

The coastal plain of Tarquinia, bordered by the Mignone river to the south and the Marta river to the north, was only a small portion of the territory assembled by Tarquinia in the historical age. It was interest of ancient settlements from the oldest age, and during the historical age, it was under the sphere of influence (political, economical and maritime) of Etruscan Tarquinia. The maritime, political, and economical supremacy of Etruscan Tarquinia is revealed by the presence of some important harbors, that were great trading ports. The most significant was *Graviscae*, an Etruscan-Greek *emporium* active in the VII-VI sec.B.C. (600-580 B.C.), a cosmopolitan center open to external influence, mainly from the East and from Ionia.

Next to *Graviscae*, Tarquinia had other gates to the sea, through the two *maritime stations* of *Rapinium* (near the Mignone) and *Maltanum* (near the Marta), both mentioned in the *Itinerarium Maritimum*. Like *Graviscae*, all the harbors were connected to Tarquinia by three ancient, communication roads.

The coastal territory was then the object of dispute between Romans and Etruscans, starting from 273 B.C., when Rome accomplished important territorial annexations in the coastal band, that had before been part of the sphere of influence of Caere and Tarquinia. This event was the remote, historical premise for the successive Roman conquest and colonization of all of the South Etrurian littoral, initiated in the years following the first Punic war (for strategical-defensive purposes, with the aim to oppose the Cartagine power [maritime colonies of *Alsium*, *Pyrgi*, *Fregenae*, *Castrum Novum* in the southern seaboard band, founded between the 264 and the 245-241 B.C.]). The completion of a primary coastal Aurelia (probably the *Vetus*) would have been accomplished during this conflict..

The complete colonization of the coastal zones of Tarquinia took place much later, in 181 B.C., with the foundation of the

*Graviscae* colony, as demonstrated by its *castrum* structure, with its orthogonal *centuriations*.

The Tarquinia coastal plain was subjected to environmental variations and became marshy, perhaps as early as the Roman Republican Age.

In fact, materials carried back by the two main rivers, along with the existence of coastal pillows of primitive, eolian dune sand (between the coastline and the coastal plain) gave rise to lagoons and marshes. One of the main, marshy areas corresponds to Le Saline, which encompassed the ancient site before protohistoric and then etruscan-roman in the direction of south *Graviscae*. The coast line do not change very much during the Roman age and after with the greatest variations and the most considerable displacements being above all, in erosion; these variations were prevalent during the last two centuries, in particular between the Mignone and Le Saline, with erosion of the sands pillows and the consequent employment of anti-erosive barriers.

## Status of the studies

The examined territory has previously been the objectiv of study, and the analysis of aerial photos has allowed the detection of many traces of archaeological interest. Nevertheless, it remains open to other hypothesis on the pattern of the Via Aurelia, which must be clarified and could be of great historical relevance.

In fact, based on the studies and the suggestions of G.Schmiedt, which are based on the aerial photo of 1954, the site where the Roman colony *centuriations* (*Graviscae castrum*) were traced, has been identified in the up side of Porto Clementino, in a central area between the small cape, Torre degli Appestati, Le Saline and Casal La Portaccia.

Based on the photoanalysis, M.Torelli conducted excavations for many years, that have led to the identification of ancient settlements of the Roman Age and of the Etruscan-Greek

sanctuary (Fig.1 and Fig. 2-3).

From the same photo, the researchers of the Istituto di Topografia dell'Italia Antica dell'Università di Roma (1968) discovered three traces of ancient, communication roads (probably of Etruscan origin), that linked Tarquinia with its *maritim stations* (Tarquinia-Rapinium, Tarquinia-Graviscae, Tarquinia-Maltanum), and also the main straightaway trace, aligned to the coast line between the Mignone and the Marta (remains of two Roman bridges on the two rivers banks), and set along the Litoranea di Bonifica.

This trace, demonstrated by field survey, have been assigned to the more straightaway and recent pattern of the *Aurelia Nova*, attributed to Lucio Aurelio Cotta, the *consul* in 125-119 B.C (fig.1). On the basis of the field survey, accomplished at the end of the XIX century for the archaeological map of southern Etruria, A.Pasqui and A.Cozza proposed that the Via Aurelia, after Poggio della Birba, diverged to left, along Le Saline, in the direction of *Graviscae* and returning to its previous direction after Casal Procoio. This hypothesis about the direction of the Via Aurelia was resumed in 1913, by D.Anziani, and again in the fifties, by M.Lopes Pegna (Fig.1).

G.M.De Rossi (Istituto di Topografia Antica di Roma, 1968), proposed a different hypothesis, based on historical maps and the *Itinerarium Maritimum*, and suggested the existence of an *Aurelia Vetus* (more ancient tracing, corresponding to the most ancient colonization on the southern Etrurian littora, and attributed to Caio Aurelio Cotta, *ensor* in 241 B.C.), aligned along the coast, between the three *stationes maritimae* of *Rapinium*, *Graviscae*, *Maltanum* (Fig.1).

#### Caracteristics of the aerial photo and its digital treatment

The examined aerial photo, from the Archivio Fotografico dell'Istituto Geografico Militare in Florence (Photo n°3828), belongs to the aerial coverage of the "volo base" (September 13<sup>th</sup>, 1954), and is the same photo used in the previous studies. In fact due to the panchromatic nature of the emulsion used for the film and the date of flight, this aerial photo is suitable for use in the search for archaeological traces of ancient roads, including any latent ones.

A scanner in A1 format, from the Florence firm "Computer Design Service" was used to digitize the photo. Finally, the interesting parts of the photo were cut out with ADOBE PHOTOSHOP, in order to make image processing by MATLAB easier. Processing by MATLAB (the release 4.2 for Win95 [1994]) was run on a PC with 133Mhz CPU PENTIUM, 96Mb RAM, with a monitor SONY TRINITRON 17 inches and a CD-ROM. The images were printed with an EPSON STYLUS PRO printer on a special glazed paper with 720 dpi. MATLAB is a type of software used in the technical and scientific environment and also, in some cases, in the analysis of artistic and archaeological artifacts.

The image processing toolbox of MATLAB is a computer program sufficiently advanced to permit the detection of existing traces of archaeological interest, on the aerial photo. The investigation aimed to enhance the contrast, without

changing the geometry or the distribution of pixels, in the regions of the photo, where existence of traces with archaeological- topographical interest were expected, and with the intention of making otherwise latent traces observable. MATLAB makes all this work possible with flexibility, by means of easy operations, procedures and elaborations, which operate on the grey levels and on contrast of the image, and by noise filtering. Good results, with this type of processing, are achieved chiefly in cases where the traces in the photo are really latent, blurred in the middle of dark areas, and therefore, not directly observable on the original photo.

The advantages of work have been demonstrated, above all, by the detection of the existence of a long trace from Le Saline up to *Graviscae*, in the coastal area between Poggio della Birba, Saline di Tarquinia, and Porto Clementino. Image processing has revealed this latent trace in the tract that runs along Le Saline (the tract, namely included between Poggio della Birba and Casaletto delle Lance), a tract in which the trace becomes visible thanks to contrast enhancement. In the middle path of the latent trace, along the banks of Le Saline the difference between the original photo, indiscriminately dark, and the elaborated photo with MATLAB, can be appreciated (Fig. 4). Image processing with MATLAB is useful for the parts of the photo, in which the trace doesn't result properly latent: for instance, in the initial tract between Poggio della Birba and Le Saline, where the image of the trace is already observable. Nevertheless, even here MATLAB allows enhancement of the direction of the trace (favoring the hypothesis of Pasqui), which goes to the left, and in the direction of Le Saline (Fig. 5). The final tract of the trace is not revealed by digital elaboration, and is obscured in the middle of a dark area, around the Porto Clementino. Previously recognized and identified traces from previous studies, that appear obscured in the aerial photo, are enhanced by the digital elaboration. For example, traces relative to the settlements of *Graviscae* and to the probable *centuriationes* (orthogonal lines) of the Roman colony, provide an enhanced image, which highlights well the topographical location, in the upside part of the Porto Clementino (Fig. 3). In the same way, image processing has allowed improved visibility of other traces, already studied and interpreted, like the well known rectilinear trace, attributed to the *Aurelia Nova*, observable with good clarity, in a straight line from Casal La Portaccia (Fig. 3), as well as other traces of ancient roads and installations, recognizable better thanks to image processing, like the communication roads between Tarquinia and its harbors, and rectilinear traces, that Quilici attributed to the *Graviscae horrea*, located near Torre degli Appestati and distant from the Porto Clementino zone.

The latent trace, located along Le Saline, seems to confirm the hypothesis of a deviation of the Via Aurelia (*Vetus*) between Poggio della Birba and *Graviscae*, as suggested by Pasqui. Its direction fits fully with the path indicated by Pasqui, and deviates from Poggio della Birba towards the left, running along Le Saline and finally pointing towards ancient *Graviscae* (Porto Clementino and traces of *centuriationes*). This agreement between the path, indicated by Pasqui, and the trace was observable along all the trace, from the initial tract (Poggio alla Birba) to the intermediate (along Le Saline), up to the final tract (Porto Clementino and

*Graviscæ*), where the trace disappears. Pasqui did not observe any more traces in this final tract. It can be supposed that the trace continues on to Casal Procoio. This coincidence with the Pasqui hypothesis, allows that the latent trace could be interpreted like a type of fossil remains, recognizable in the aerial photo of 1954, that was produced in a fairly intact situation of the ground, before any agrarian reform.

## Conclusions

Archaeological interest in the revealed latent trace is significant not only from the coincidence of the path with the Pasqui hypothesis, but also for the lack, in that zone of the photo crossed with the latent trace, of any modern trace visible in the modern cartography (IGM Quadrante 142 I SO "Marina di Tarquinia" and Carta Tecnica Regionale of 1992) with similar direction. The full agreement between its direction and the one proposed by Pasqui, have been strengthened by the presence, along this path, of fragmentary remains, potsherds, and scattered materials (fragments of plaster, ceramics, tiles etc.). Despite the fact that it is difficult to date these remains precisely, some could be traced to the Roman Period and to the context of the *marittimæ villæ*. The possible interpretation of this trace, as a deviation of the *Aurelia Vetus*, could be demonstrated by the meaning of fragmentary findings along the trace. Digital analysis of the aerial photo does not show any analogous, latent trace along the coast line, that confirms the hypothesis of De Rossi regarding a *Via Aurelia Vetus* running along the coast.

## Aknowledgments

The author is thankful to Prof. Giovanni Uggeri (Università di Roma) and to Dr. Maddalena Andreussi (Università di Firenze) for their help during this research. He thanks the IGM staff for their help in the initial phase of this research, and in particular, for the necessary authorization to digitize maps and photographs.

( IGM Authorization n.4332 of 18<sup>th</sup> January 1996 for the Map "Marina di Tarquinia" F°142 I SO; IGM Authorization n.4382 of May 6<sup>th</sup> 1996 for aerial photograph n.3828, flight of September 13<sup>th</sup> 1954 by the Archivio Fotografico of the Istituto Geografico Militare ).

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**List of Figures in CD-ROM.**

**Fig. 1.** IGM Map, "Marina di Tarquinia," with ancient road traces and other archaeological sites overprinted.

**Fig. 2.** Part of the original photograph, between Poggio della Birba and Saline di Tarquinia.

**Fig. 3.** The photograph in Fig.2, after digital processing by MATLAB. (light blue arrows=Aurelia Nova; yellow arrows=Graviscae centuriationes; red arrows=latent trace corresponding to Pasqui hypothesis).

**Fig. 4.** Part of the processed photograph, centered on the latent trace, clearly enhanced along its length (red arrows).

**Fig. 5.** The initial part of the latent trace (red arrows) at Poggio della Birba well visible in the photograph after image processing by MATLAB.