

ENVIRONMENTAL DESIGN

MULTI-CULTURAL MEDITERRANEAN LANDSCAPES



JOURNAL OF THE ISLAMIC ENVIRONMENTAL DESIGN RESEARCH CENTRE

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MULTI-CULTURAL MEDITERRANEAN LANDSCAPES

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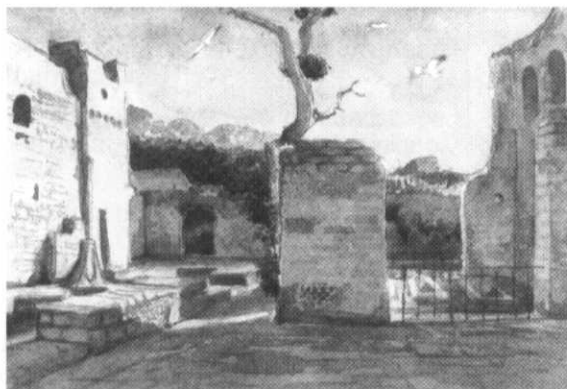
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Ruins of Chellah. Water Colour
by Enrico Genovesi



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THE GEOMETRY OF FLORENCE: THE ORIGINAL PLAN OF THE CITY AND ITS TERRITORY

"It is as though from the scraps of message that he held, he understood that the final reconstruction had to lead to the discovery of a map ..."
(from Foucault's *Pendulum*, by Umberto Eco)

Introduction: the architectural theory of the forma quadrata Italiae

What it is about. It is the conventional name given to an "architectural" theory about Roman planning procedures of Italian territory. Its check (which is still in progress), with the topographical reconstruction of the resulting ancient settings reveals new methodological prospects both in the field of historical-archaeological studies and of architecture and town planning. In fact, Roman structuring of Italian territory seems to form the indispensable substratum of any subsequent transformation, still legible and functional today, especially with regard to the orientation of land fabrics and administrative divisions. Therefore, the results of this research openly aim – in the Muratorian sense of "working history" – not so much (and not only) at identifying Roman plans as much as grasping the overall design that led from even more ancient phases to current settings. Namely, to ultimately contribute towards greater, more aware integration of new interventions in its historically established environmental context. Why "architectural". Because it is a theory that originates from architecture, whose main working tool – the plan – is used in the reconstructive reading of Roman planning. This prefigures a new survey method, which applies the peculiar forecasting method of architectural plans to the past in order to project into the future to virtually conceive – on various built scales – buildings, settlements and infrastructures that do not yet exist.

Tota Italia. The Romans' clear perception of the Italian peninsula's geographical unity is an initial consideration implying the hypothesis that they were able to dispose, as secret weapons in military campaigns, of sufficiently accurate maps representing the form of places. Apart from being a convincing "technical" reason to explain their strategic superiority over other Italian peoples (Etruscans first and foremost) as well as the rapid spreading of their conquest radius, this comment projects research (and resulting queries) into long-lasting working mechanisms which make cartography an indispensable basis of territorial planning. The Romans inherited this activity from the Etruscans but they developed it on a larger scale, triggering off this (originally esoteric) practice. On rotating ninety degrees the transversal system direction of Etruscan towns, connected via trade routes

from coast to coast to Adriatic towns, they managed in one fell swoop to find the longitudinal key to Italy, the first to conceive it geographically in its entirety.

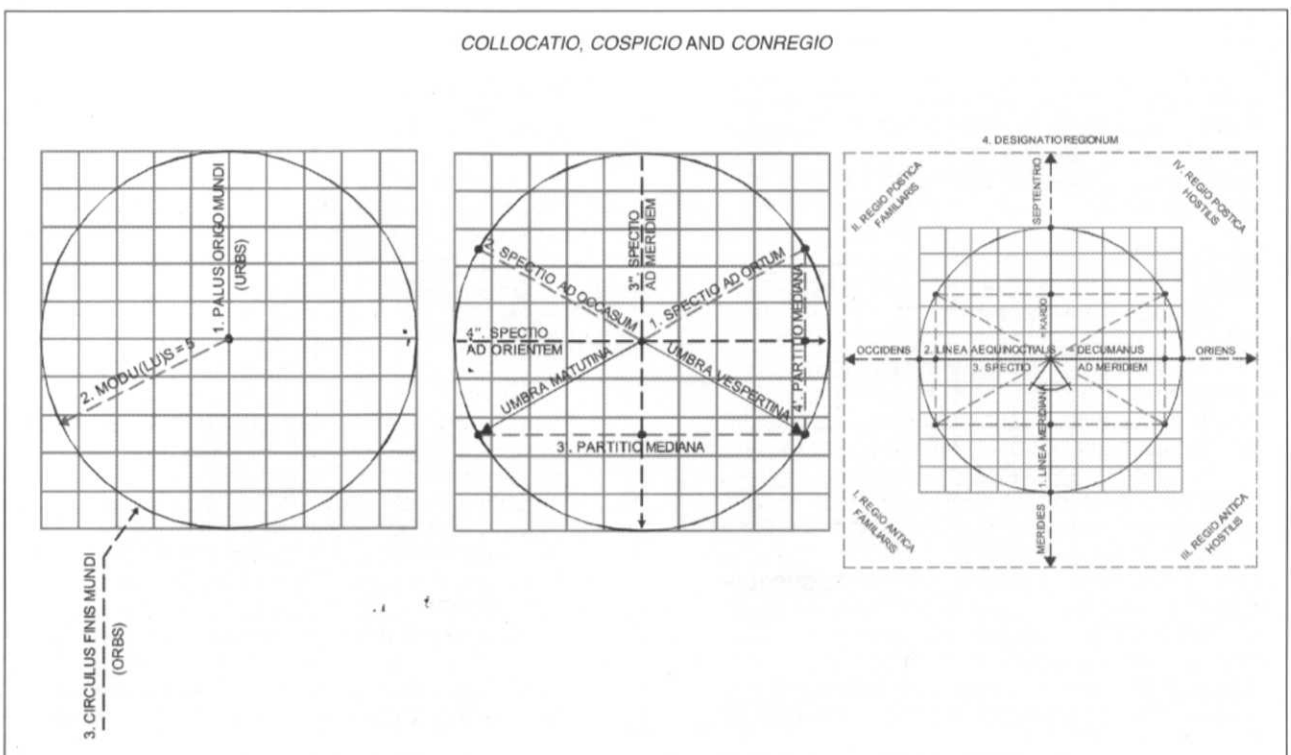
Plan: measure, represent, plan and structure the earth. The Roman peninsular strategy was enacted by means of a series of technical-planning operations tending to "geometrically" modify conquered territories for military and political control, financial gain and legal-administrative management. The last of the great "hydraulic" cultures of the ancient world, Roman civilization therefore assigns planning (the Italian word for planning literally means "laying out flat") the task of structuring new regions of the empire in one single major hegemonic design. This practically entails not only the graphical design of what we intend to build but primarily the "raised" measuring of the territorial form, including both naturalistic elements (mountains, coasts, rivers and plains) and pre-existing man-made structures (settlements, farms, streets and boundaries). We do not know how all this occurred technically: let us try to hypothesize it with planning tools according to (fragmentary) news from (late) written sources, starting from the cultural persistence of certain geometrical forms, almost identical in various cultures far from Rome, such as the Indian culture, revealing in its conception of *māṇḍala* an extraordinary (not only linguistic) assonance with that of the Latin *mundus*: both probable derivations that can originally be referred to the vague indistinct migrant of Indo-European nations.

Mundus-māṇḍala: the measure of space and time in ancient foundation rites. The issue of getting one's bearings in the world is from the territorial point of view closely connected to the equally archetypal question of settling more or less stably in a certain place. It is right to believe that it must initially have been chosen after carefully considering a whole series of natural parameters (raised position, existence of sources, food resources, firewood, wind shelter, exposure to sunlight, etc.), whose importance tends to be underrated by our mechanically developed modern-day outlook, which has by now lost any reference to the natural environment. However, the remote echo of the final codification of these existential issues is still heard in sacred foundation rites. Before taking on the meaning of "major area of anthropic pertinence", the Latin word *mundus* more specifically meant "centre", pivot or polar axis connecting the sky, earth and underworld. Therefore, it co-existed with and complemented the "junction" figure of a *circulus*, traced on the ground by rotating a rope around a *palus* (materialization of a *mundus*) in order bound the settlement

space, orbs (hence the word "orbit" of the visual horizon), territorial correspondent of urbs. In other words, the destiny of a town was already virtually decided on choosing its site (hic manebimus optime), with the fixing of its original foundation pole, to which the Roma quadrata romulea place-name probably refers (Palatinus = pole in Latin?). We can try to reconstruct this operation, conventionally naming it collocatio (Latin word to be checked carefully philologically like all the others quoted), where in the palus-modulus-circulus sequence the in-between term indicates the measure of the circumference radius. Its length is related by Vitruvius – in the ninth chapter of his treatise – to the height and shade of the gnomon rod when, in introducing complex sundial construction problems, he explains how these dimensions vary according to the latitude of places, giving the example of some renowned towns, whose position on the earth can be expressed by means of a couple of whole numbers, through abscissas and ordinates (ratio). This interesting note explains how they measured angular rotations in ancient times. As we shall see this hypothesis will come into play in defining our theory, one of whose terms concerns the "geometric" measurability of the hypotenuse of rectangular triangles as an

indispensable condition for the tracing accuracy of right angles. The advantage, for instance, of taking number 5 as a modulus or circle radius can depend on the fact that the square of side 5 approximately corresponds (on the drawing) to diagonal 7, just as the Vitruvius's indication of Rome's latitude (ratio 9:8) is perhaps connected to the measure ~12 of its diagonal. Putting the so-called "Indian circle" into practice (another recurrent name of mundus-māṇḍala), astronomical axes were identified by sighting any day of the year at dawn and at dusk at the pole's long shadows: the so-called *cospicio* which, as can be deduced from the drawing, enabled the four cardinal points to be oriented according to an orthogonal foundation cross, whose degree of accuracy depended on the precision with which astronomic surveys were conducted. In Rome, this task was assigned to priests, organised in colleges culminating in Flamines (corresponding to Indian bramini), appointed by the pontifex maximus, whose religious task (as its original meaning indicates) was originally closely connected to the care and construction of bridges. Etymologically we can also assign to the rex sacrorum the subsequent *conregio* which laid down the procedures for tracing on the ground cardinal axes, according to which

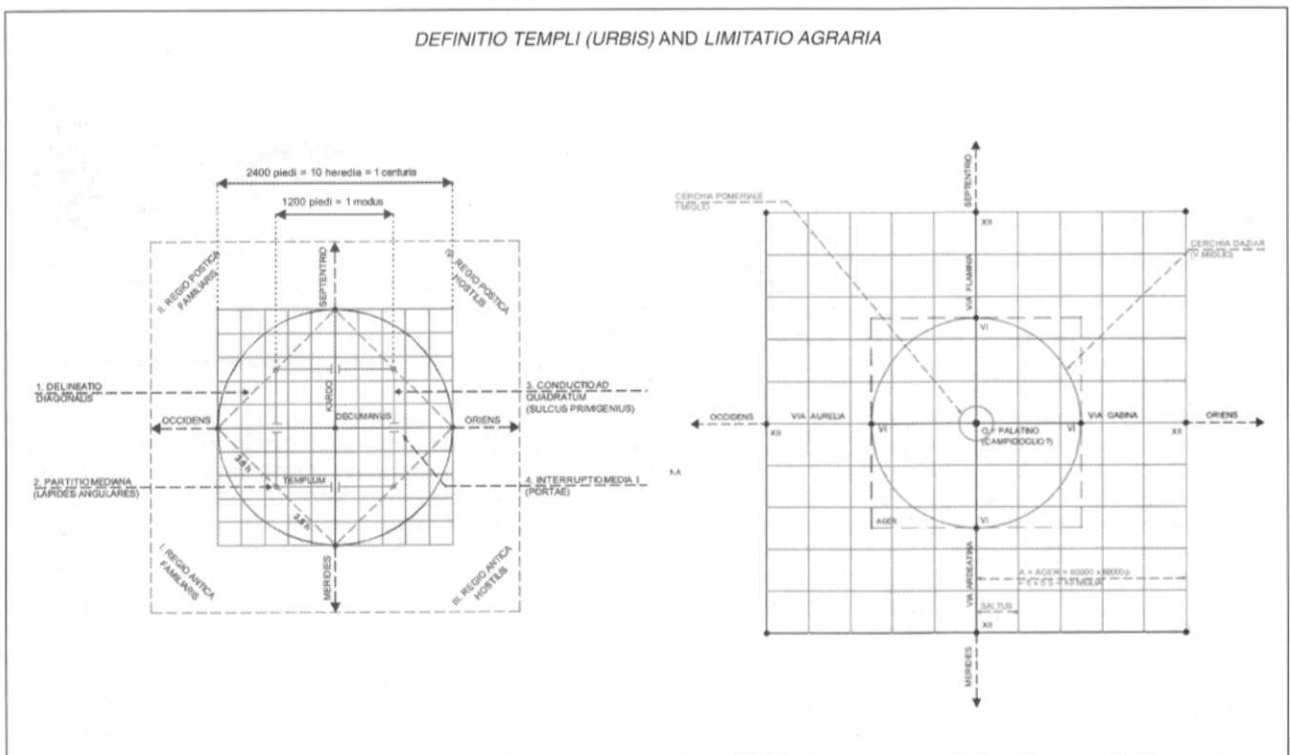
COLLOCATIO, COSPICIO AND CONREGIO



the heavenly temple was divided into four regiones named and consecrated by the rex facing east, prophesying a propitious or ill-fated day and consequently drawing the auspices (aves-spicere: observing the flight of birds). We thus come to the last and most important act in the sacred process of taking possession of a place: the foundation of the earthly temple (definitio templi: which the founder could accurately trace by joining the four cardinal points along the circumference of the circle, halving these diagonal lines (measuring 7 in a circle with a radius of 5) and fixing inscribed pillars. Whence with a plough they traced the mythical sulcus primigenius, exactly defining on the ground a templum equal to one quarter of the virtual square circumscribed to the initial circle. However, they made sure they interrupted the furrow at the height of the cardinal decuman axes for the opening of the gates, whose original (otherwise incomprehensible) meaning is significantly reminiscent of the laborious operation of raising the instrument to "carry it" across the roadway.

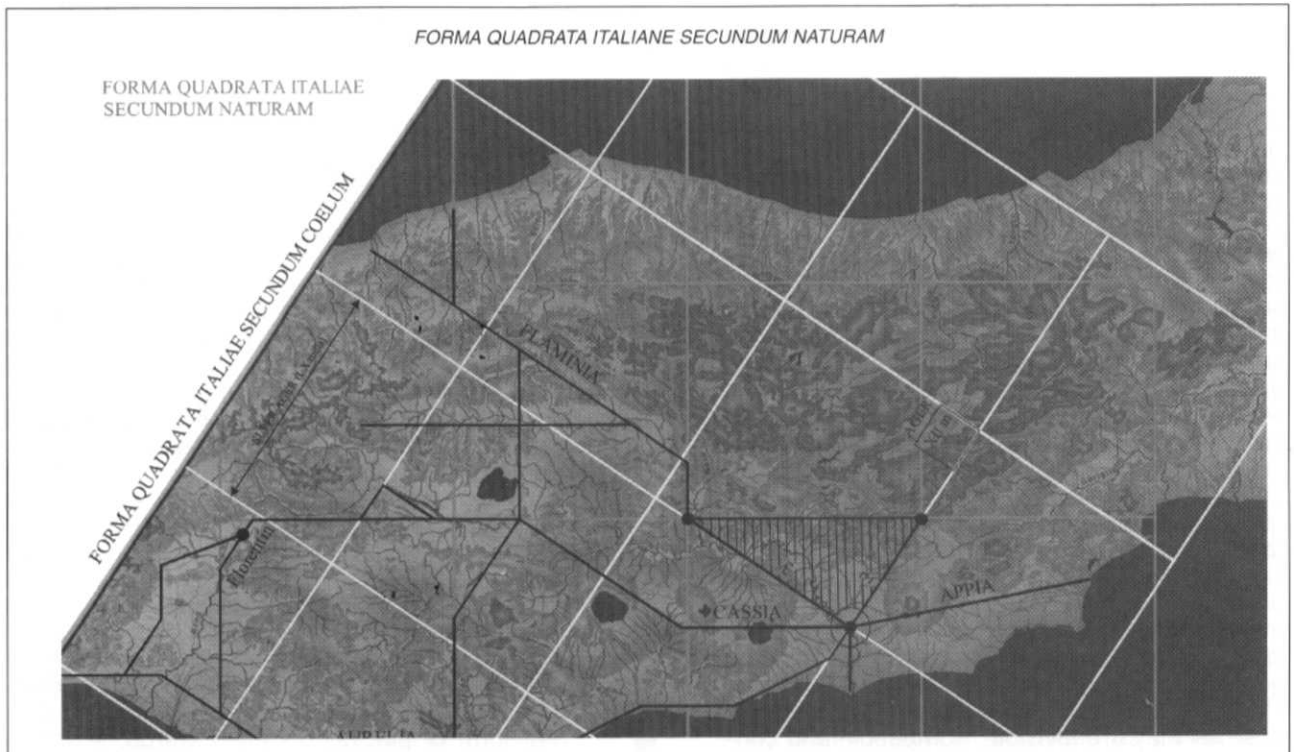
1. Measuring the ground: the relief of places. Planners know that firstly they have to refer to

the dimension of their plan, using proportionally adequate mental mechanisms according to this scalar variable. In other words, the larger the scale, the greater the need to ideally raise our selves off the ground (projecting ourselves infinitely) to take in at a glance not only the entire plan area but also (within certain limits) its surroundings. In our case, the width, diffusion and dimensional homogeneity of topographical surveys found in any area of the empire make us believe in the existence of a unitary design in Roman planning, founded as we said on a precise cartographical base, in turn implying the measured relief of the whole of Italy. In admitting the existence of these maps required for the drawing up of plans, we must, however, strive to answer the query about their technical execution. The most convincing hypothesis is that they were produced with procedures substantially similar to typically Roman procedures by means of orthogonal axes and square modules, i.e. through one of the most ancient, diffused detection methods: squaring (quadratio). This term generally indicates any reference system to square grids (as wide as you wish) which, when suitably reduced (or enlarged) enable any drawing to be accurately brought to



scale. In the case of topographical and building relief, it is assumed that this web is fixed through datum points on the ground starting from an original crossing, having previously chosen the most suitable directional system. If we make it coincide with the celestial mundus plan, the map takes on a very close configuration (apart from right angles) to that of modern maps with their grid of meridians and parallels. Each square on paper has to correspond to a proportional portion of area surveyed; consequently, it is possible to assume that through a laborious mechanism of alignments (*ad lineas*), pickets (*perticae*) and visual sights (*spectiones*), the Romans drew this modular system directly on the ground, practically producing that 1:1 map that Borges in one of his tales instead assigns to the ability of Chinese cartographers. To try to reconstruct it, we must however hypothetically fix a centre (Rome-Palatine or Rome-Campidoglio) and identify its unit of measure. What has been used up until now in traditional archaeological research – a square *centuria* measuring 710 metres per side – seems to be completely inadequate technically in relation to the width and degree of accuracy of straight Roman roads several tens of kilometres long such as the Appian and Emilian ways. It would

be paradoxical like using a ruler to measure a large building. Therefore, we maintain that land-surveyors used a large enough measure to enable the topographical survey, representation and plan of territorial portions sufficiently wide and precise to be related to the whole Italian territory. In attempting to probe the numerical mechanisms of Roman metrology – based on mixed five- and/or six-foot series of multiples and submultiples – we therefore considered the 2400 foot *centuria* the last link in a longer surveying chain. With two (perhaps three, with the 60 mile super-ager) five-digit super multiples: the 12,000 square foot *saltus* (= 5x5 *centuriae*, a module still insufficient as a large scale planning unit) and the wider *ager* (= 5x5 *saltus*), whose 60,000 foot side (= 12 *milia*) also belongs to the linear scale of distances based on the *milium* (= 1000 *passus* = 5000 feet) used in road plans. The numbers 5 and 12 distinguishing the two super multiples of the *centuria* benefit by presenting the diagonal approximately assimilable to the whole number on the basis of 7 (7.0710) and 17 (16.97) respectively, enabling, in drawing and tracing orthogonal systems, checking triangulations to obtain the maximum accuracy of cross-staffs. Inductively, we attempted to reconstruct with a series of



graphs the progressive acquisition of super multiples of the centuria through successive doubling according to territorial increases induced by the expansive Roman policy. Without going into detail in the various phases, we confine ourselves to detecting two orders of surveying problems: the former regarding passing from a so-called "organic" pattern (a 25 centuria saltus) to a "sequential" pattern (four 100 centuriae saltus), probably connected to territorial expansion's quantitative requirements, in the long term leading to a preference for a "specular" repetitive mechanism founded on the even number 4 rather than the "symmetric" one founded on the odd number 5; the latter refers to the difference between the area surface scale (centuria-saltus-ager) and the linear street scale (passus-spertica-stadium-milium), with which customs boundary distances and radii were measured. However, these scales have a measure in common: 12 miles, corresponding to the ager module, which by virtue of this consideration theoretically assumes major importance, both as an urban territorial unit (relating to a medium-sized town: basic administrative "type") and as an itinerary unit (basic military "type" relating to a legion's travelling capacity in war trim).

2. Representing the earth: drawing places. Representing literally means "re-presenting" (praesens= prae-esse= standing in front), i.e. bringing back into sight (even several times) the reproduced image of any object, environment or real situation, which before being literally "copied", have to be observed and conceived (cum- caepio= I understand) by (and in) the mind. The technical problem of drawing (delineatio) arises when we start to "lay down" or put down (reproduce) the object on a two-dimensional sheet (tabula), having to decide – within the limits of the size available – which numerical reduction coefficient to choose ("scale" from scansio-scandere= ascend, raise oneself, look down) in passing from the real to the represented object. This problem has to be solved with the maximum accuracy in cartographic (and architectural) representation, in which the measurability of the drawn object is an almost indispensable prerequisite. On reading Vitruvius's treatise, we can only get an idea of Roman representation systems and techniques; what is certain – judging from fragments of the Forma Urbis, land register of Orange and Tabula Peutingeriana – is that they are capable of planimetrically representing spatial situations even with very different, expanded widths, from towns to local territory, to the entire Imperial ecumene. Using mainly two-decimal (such as 1:240 of the Forma Urbis) scales for this purpose as they are divisible, compatible and con-

sistent with the multiplying mechanisms of their metric system, whose minimal unit was the foot (pes= 29.6 cm), a dimension almost identical to that of the current standard A4 form: without a doubt a singular case, yet indicative of its efficiency (in terms of manageability and versatility) and its persistency, probably due to its degree of diffusion and duration over the centuries. Roman architects' main graphic tool was, therefore, a one-foot long ruler (ruler), divided along its edges into unciae (1/12) and digiti (1/16), through which they could initially prepare the drawing, squaring the sheet (limitatio quadri) with the cross-staff (norma), squaring it to scale (squaring: quadratio or reticulatio) and taking a close-up of the object (dispositio obiecti in tabula). The latter operation is particularly important, especially in drawing up maps and location plans, in order to use the whole surface of the sheet to its full. Italy for instance – given the particular inclination of its peninsular axis – is a serious problem cartographically: only by placing it horizontally secundum naturam (as in the Tabula Peutingeriana) can an optimal close-up of lands in relation to seas (2:3) be obtained. However, in order to do this correctly it was necessary to identify the ratio (2:3) or the most suitable angular ratio in relation to certain nodal datum points of the astronomical web secundum coelum. A geometric rotation mechanism which, when applied to planned modular systems (as we shall see in the next paragraph), is one of the most salient points in our theory: in fact, it is with these graphic-planning procedures that the Romans managed to handle the process editing of a wide, subdivided system of maps, historically drawn on the territory and continually updated. We attempted to graphically reconstruct a large-scale itinerary Forma of central Italy, tracing consular roads with a ruler and cross-staff (delineatio) as on a checked sheet in relation to the basic astronomical web, thus obtaining an easy-to-consult "tree" diagram, very similar in its approach to those used nowadays to schematically represent a subway or railway network.

3. Planning the earth: planning places. The planning process phase put into practice by the Romans is the logical technical continuation of the geographical editing of Formae, also because most probably (at least until the Republican age) geographers and planners were one and the same. Therefore, their attitude to conceiving plans (cogitatio) tended more towards perfecting maps – almost as though plans were the local specification of general map-drawing – than devising (in the modern sense) new interventions, whose plans had to fit in with the natural form of places. In other words, it was a

question of making the indifferent basic astronomical web rotate partially to adapt new orientations to all sorts of orohydrographic situations (coasts, ridges, rivers, valley-walls), technically identifying the best suited ratio for that particular angle. Experimentally we found out in this connection that any couple of catheti expressed in whole numbers and multiplied by n can approximately measure on a large scale a hypotenuse that could also be expressed in whole numbers. Such a wide range of trigonometric ratios (definable as "pseudo-Pythagoric" in this sense) always and anyway enables (in any angular situation) the surveying check of the accuracy of squares (fundamental for tracing a farm ager). The planning choice of the right rotation angle was somehow implicit in the sacred foundation moment, triggering off – with the celestial grid – the whole ambitious (and grandiose) desire to submit nature to human laws and desires. The geometric territorial survey and colonial plan project were, therefore, the result of the same mental mechanisms, which operated without fussing about conceptually distinguishing existing from new structures. In the case of streets, for instance, their survey and planning line (*delineatio viarum*) was anyway summed up in a broken line, whose segments were chosen according to their capacity to be assimilated (according to the scale, gradually increasing in detail) by the actual track or by what was considered most suitable planning wise in relation to places crossed (*segmentatio secundum naturam*), keeping as a directional average the link-up between two line ends (*coniunctio capitum*). The technical issue was practically always the same: identifying in relation to the basic astronomical grid the best suited diagonal directions (with their applicable numerical rationes) to trace street lines, whose conventional rectification made itinerary maps clear and above all easy to measure for all sorts of purposes (military, trade, administrative, etc.). With one strategic aim: to enable an overview to control conquered lands from the system centre (*Roma caput mundi*). In time, an impressive road network was created around the city's original core ("all roads lead to Rome"), initially aiming at fully covering the surrounding region (the future "Roman countryside"). With the exponential increase of the expansion radius this centripetal polar scheme gradually became less organic "with reticular beams", whose rods were the consular roads and nodes other major urban terminals of the peninsula. However, unlike what usually occurs in planning major road infrastructures, a Roman road (*strata*= paved road) arose programmatically integrated with fabrics and administrative divisions, usually forming its network axis, its *decumanus*, acting as a main street. Together

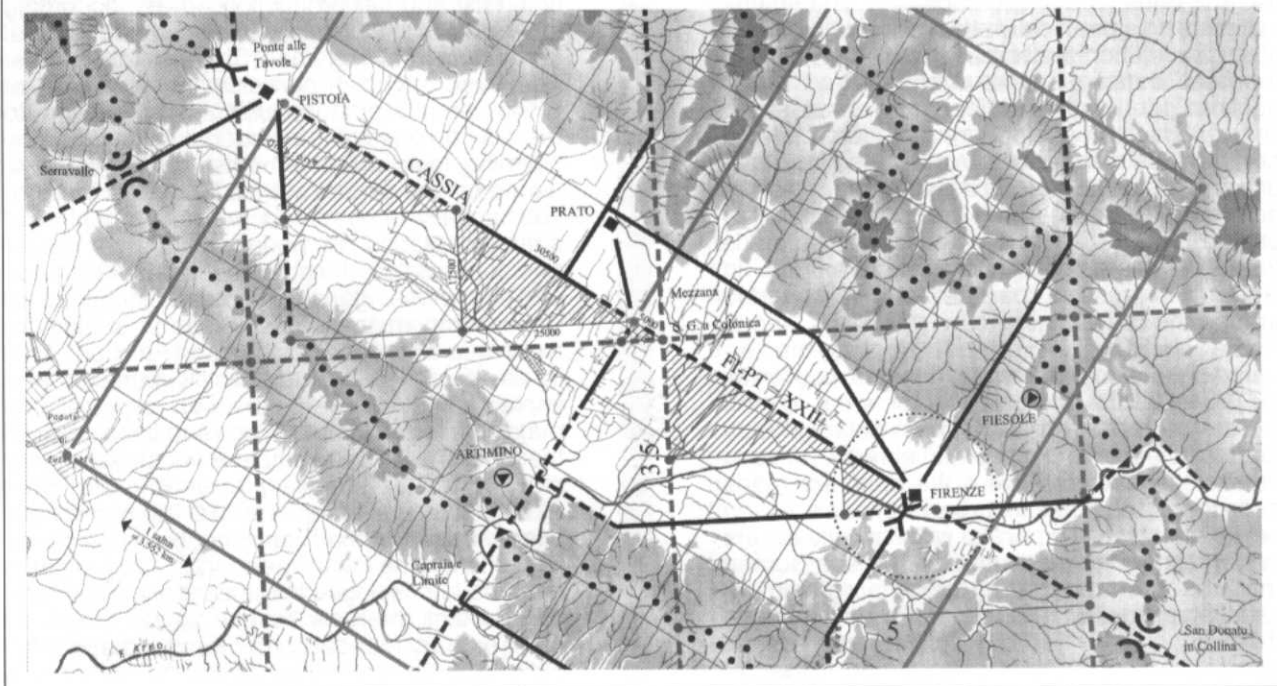
with its orthogonal counter-axis (*kardo*) it formed the so-called territorial foundation cross (*tetrans* or *decussis: institutio cruci secundum naturam*), in turn giving rise in the four spatial regions to a certain number of large typical territorial squares (*limitatio per agros*), subdivided into submultiples (*adsignatio publica per saltus*). In this way a hierarchized modular grid appeared, facilitating quantification in whole numbers of administrative pertinences of both towns (*municipia* and *coloniae*) and minor settlements (*vici* and *pagi*). We are therefore led to believe from the numerous territorial specimens compared to date that with these procedures the Italian peninsula was progressively submitted to what can be defined as a real "domino strategy", implemented through the typical and continuative replication of the square farm ager placed *secundum naturam* along major highway axes and intended to cover the entire peninsula. Significant exceptions were provided by marginal outlying areas, not so much programmed areas originating from the rotation of two adjoining systems hinging on the same main street and therefore geometrically turning around the same bisector (*rotatio agrorum*) as the remaining "irregular" interstitial areas between two systems on different, opposite plan axes, cut out through a lack of modular overlapping (*agri publici excepti* or *subseciva*). On completion of this planning phase concerning the area of public interest (including public mountain *salti* for collective use, common grazing land and the right to gather firewood), the local subdivision of *centuriae* started up (usually in hilly and flat production areas), according to which private lots were assigned to individual farmers by drawing lots. Sizes varied in time: from the mythical *heredium* (inheritable) of 1/100 *centuria* of Romulus's checked Rome to the 4-5 centuries of late Imperial *latifundia*. The planning logic of settlements (choice of sites, hierarchy and degree of their territorial diffusion) substantially obeyed two principles: control of strategic places of nodal importance (crossroads, saddles, heights, but above all fords and river crossings) and modular distribution (at a constant rhythmic distance) of settlement types that differed in position and function. This in particular was systematically pursued and implemented (at least in Italy), especially in major reclaimed plains. The renowned case of the Emilian way is exemplary: its straight piedmont stretches (totalling three or four from Piacenza to Rimini for over 260 kilometres) are characterized at their junctions by major terminal cities (the two mentioned above plus Modena and Bologna in the central bends), and at constant intervals (every 10-12 miles) by other primary foundation centres (perhaps originally built for special purposes as *castra* and

fora), each strategically placed to control a bridge along the consular road, at a crossing with the transversal valley floors of the Apennine slope. Subordinately – midway between each previous couple of centres – a typical series of minor centres were founded with a regular chessboard plan, similar in shape and size to numerous others homogenously distributed within the two hundred-juger web. Its internal weft of farm tissues is in turn typified by the building type with a large farmyard, widely diffused throughout the Po Valley (in a wide range of local variants) to such an extent that it is believed to have originated from a country-house and a Roman domus.

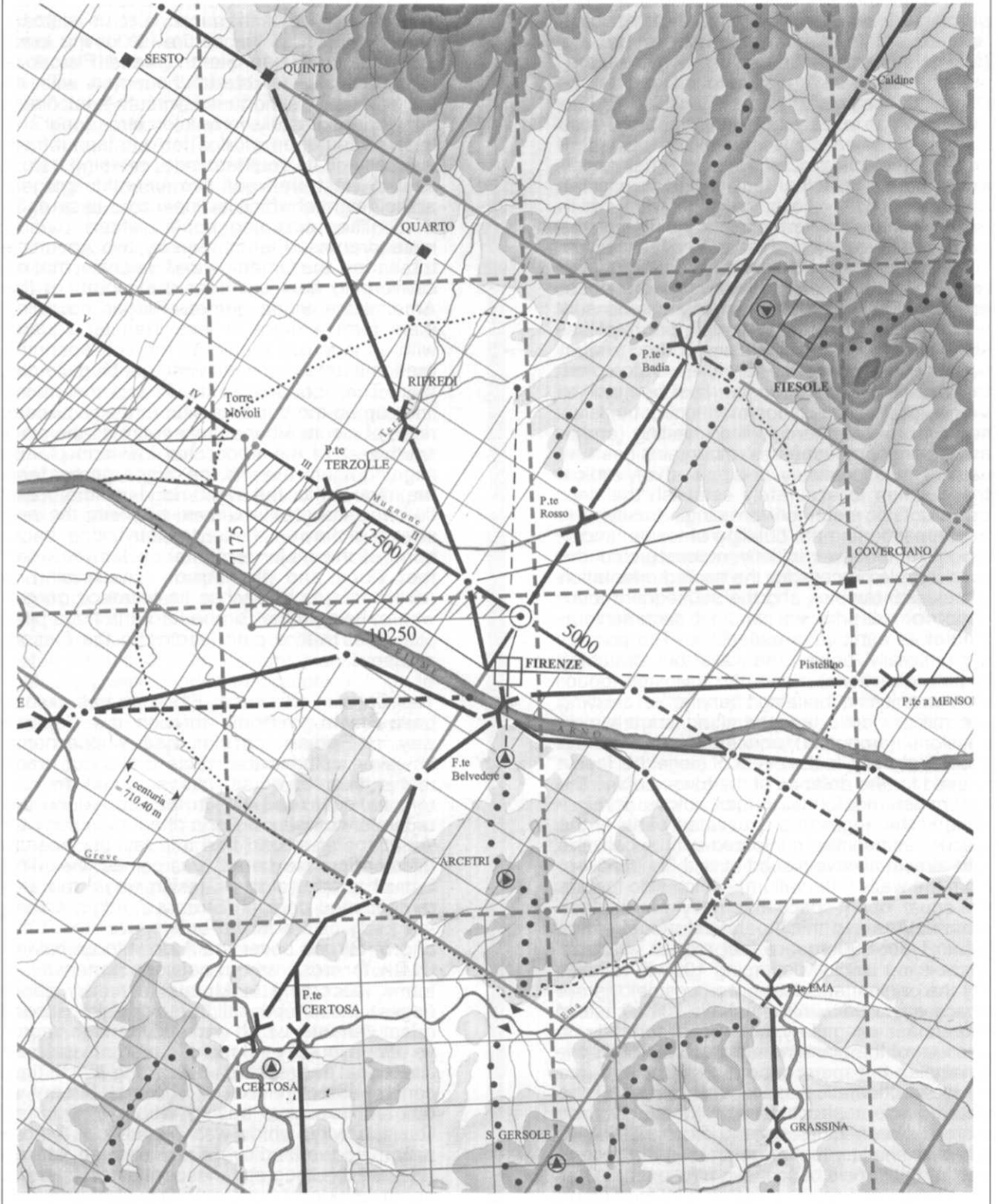
4. Structuring the earth: the construction of places. “Architectura nascitur ex fabrica et ratiocinatione”: perhaps not by chance Vitruvius in this famous definition that serves as a preamble to his book places architectural practice before reasoning, thus fostering common belief that Romans were more familiar with the actual building practice than with its theoretical conception. Without discussing the merits of the question, which would make us stray from the subject, in introducing the last enactive phase in the course of territorial

planning, it would be best to dwell on the primary meaning of the Latin term *fabrica*. Etymologically, it indicates a place in which “one produces” a certain object or building, thus corresponding in building practice to the modern-day “yard”. On Italian Military Geographic Institute maps, there are numerous place-names of the kind (“*fabrica*”, “*fabbrica*”, “*fabbro*”), some of which still today denote a medium-sized municipality, such as *Fabrica di Roma* in the province of Viterbo. What immediately springs to mind – according to our theoretical hypothesis – is that the major *Forma quadrata Italiae* territorial plan was implemented down the centuries through the coordinated labour of a large number of servants and slaves, scattered here and there on numerous building sites, in time becoming stable settlements. In this sense, the study of place-names should widen its horizons, introducing new categories (dropping more obvious plant- and animal-names) such as technical names that are almost certainly reminiscent of yard tools and their visual identification at a distance (“goats” to lift weights, “deer” for sight operations, “landsurveyors’ instruments”, “tripod”, “pole”, “shovel”, “spade”, “vertical waler”, etc.) and numerals, not to mention surveyors’

ROMAN PLANNING OF THE ARNO PLAIN BETWEEN FLORENCE AND PISTOIA



ROMAN PLANNING OF THE FLORENTIA PLAIN



terms symptomatic of the actual tracing of planned structures ("axis", "line", "edge", "corner", "tip", "flat", "wheel", etc.), jurisdictional place-names ("limit", "end", "threshold", "ianua", "calenda", etc.), street names ("street", "cart-road", "paving", "triple crossroad", "Y-junction", etc.) and histone-names ("saltara", "centoia", "quarrata", cell", etc.). In other words, in Italy not only signs but also Roman planning names have left their mark more than official place-name study has revealed to date. In actual fact, it had to use the same mental and technical tools with which map-drawing and territorial planning phases prior to surveying had been processed, i.e. visual alignments with sight shovels (*spectiones et metationes*), squares (*quadrationses*) and checking triangulations (*triangulations in whole numbers*), in keeping with our hypothesis. There is nothing new as compared to what has been assumed. Therefore, to complete the technical side, reference must be made to the so-called *cultellatio*, mentioned by land-surveyors with regard to the levelling (and/or measuring) procedures of mountainsides and slopes. Conceptually it is a sort of vertical triangulation to accurately establish the "top" and "foot" of mountain terracing. Lastly, it is worth mentioning the building of towns, according to which we initially reconstructed the magic circle process for the sacred orientation of celestial temples and the subsequent foundation process for the cardinal decuman tracing of its earthly correlative. The *pomœrium* (literally "behind the walls" but stretching in both directions) marks the inviolable boundary prohibiting building, burying or carrying out military drills but permitting augural processions (*amburbia*) on certain days of the year. Naturally, in the event of siege this *fascia* is used for the defence of the town: behind the outermost moat (the former *sulcus primigenius*) is the *agger* (the excavated earth of the *sulcus*) sometimes reinforced with a palisade and almost always placed at one hundred feet from the walls (*intervallum*), which also feature an equal open space internally for defence manoeuvres. In the theoretical model of the urban type, 800 square feet remain available for building blocks, becoming 1000 if, to identify the original enclosure, we consider the net space enclosed within the walls. The case of *Florentia* is exemplary, not only specifically on account of the planning mechanisms of its original plan but more generally due to the geometric-mathematical ratios at the base of the entire ancient structuring of the large Arno plain between Florence and Pistoia. This is what we shall try to demonstrate in the second part of this article.

Planning of the Arno plain between Florence and Pistoia

The natural lie of the land. Let us start by briefly describing the natural lie of the land. The plain between Florence and Pistoia is nowadays a vast stretch, oriented with its major axis in a north-west south-east direction, approximately forty kilometres long and twelve kilometres wide. The Arno laps it transversally on its southern side, crossing it from east to west, between two mountain gorges, at the height of which its linear course starts to wind. The remaining upper (wider) part is instead crossed lengthwise by two Apennine tributaries, the Ombrone and Bisenzio, that on converging flow out near the mouth of the Arno at the Signa gorges. Ridges bounding them form a more or less irregular square, with an indented profile on the sub-Apennine predominant side overlooking the Mugello plateau. The brief arch of the Pistoia mountains links up on the opposite side to the rectilinear ridge of mount Albano that separates the plain southwest of the Fucecchio low-land plains, aligning itself, beyond the Signa gorges and the river, with the right ridge of the Pesa flowing through the Chianti hills into the end stretch of the so-called "Etruscan" ridge, backbone of the major territorial system between the Tiber and the Arno. Ascending it northwards, one reaches its entrance gorges where, beyond the Girone ford, the ridge *periplus* ends with a path leading to the Fiesole acropolis.

The Cassian way area. Florence has always been linked to Rome through the Cassian way. A Roman consular road, whose name however includes the whole groups of roads that in time served as links (as far as the current national road 2). In fact, to extend the radius of complex historic phenomenology on variations of a road bed and layout, recently the wording "road area" was coined, including in such grade (of the Cassian ways) the aforementioned original "Etruscan" ridge, uniting the fords of the Milvio bridge over the Tiber and of Girone cover the Arno without having (N.B.) to cross any in-between waterway. It forms (according to Muratori's theory about ridges) the directional "matrix" of all subsequent variants, which generally tend to improve its layout in relation to various historic situations and events, privileging each time certain attractive routes to the detriment of others. However, tracing it back, the first Cassian way, which was Republican before becoming the Medieval Frankish road, strives to avoid the orographic asperities and hairpin bends of ridge roads, reaching the Florentine

"Ponte Vecchio" crossing from south-west, more or less following the same route as the current national road from Siena (the old Frankish road continues instead from Poggibonsi to Val D'Elsa, heading for Lucca). As far back as the early Imperial Age, the "inner" Cassian way was flanked by a quicker, rectilinear "outer" variant, forming the axis of the Val di Chiana and the mid-Valdarno (nowadays the "autostrada del sole" partially follows its route). In order to reach Florence, near Incisa the straight Valdarno line forks: the briefer ridge road crosses the S. Donato in Collina valley, dropping through Bagno a Ripoli to Ponte Vecchio; the other longer, yet evidently smoother, valley floor road, follows the river's sharp turn, reaching through the so-called "Aretine" Cassian way the eastern gate to the town.

Forma quadrata secundum coelum. Cardinal decuman signs oriented secundum coelum abound right throughout Italy. According to our theory, as a rule they can form an equal number of potential traces of the territory's ancient relief modular grid, on whose cartography the various colonial plans were based (according to precise geometric-mathematical dictates). In order to transform them into probative elements, we have to demonstrate their congruity and dimensional compatibility with the Roman metrological system; surveyors' checks (generally enacted by placing a transparent square on an adequate scale, the so-called "centuriometer" on top of 19th century maps) require sufficiently well-founded topographical finds to put together the first pieces of the puzzle in targeting research on the Roman geodetic web. Due to its extension, map reading creates numerous problems to be solved both due to the inevitable errors that inevitably arise, essentially based on the degree of accuracy of the technique used by ancient agrimensores in reproducing in any area of the peninsula (also in impervious territory) the same astronomical direction starting from a single original central point and due to technical difficulties that occur in following alignments between the various traces facing in the same direction and existing in the numerous sheets comprising, from Rome to the Po Valley (in whose direction the survey has been conducted up until now), the mosaic of Italy's administrative map on a 1:100.000 scale. To which the (archeo-astronomic) incognita of the ancient northern direction must be added. Even one of these problems, individually or combined with the others, can invalidate our survey, above all in view of the fact that minor angular deviations lead to macroscopic errors at a distance. At present, after initially checking the hypothesis of the territorial foundation cross

hinging on Palatine Rome and on the four cardinal decuman axes oriented secundum coelum (Aurelia-Gabina, Flaminia-Ardeatina), we realised the need for more precise, technically founded measurements, based on the automatic scanning of maps and their georeferential connection, then passing on to a second phase, working backwards starting from reading the Po Valley. And in actual fact, as to be expected, the Po Valley proved to be a decisive test bench: in it secundum coelum signs clearly abound, coinciding exactly with the webs of a virtual grid whose generating support axis is the straight long line linking Cesena to Ravenna, still called "dismano". The Emilian way seems to be traced in relation to certain intersections of this grid, according to a precise numerical ratio (3:5), theoretically chosen on the hypothetical checked geographical map, as the most convenient in sticking at a certain angle to the piedmont profile of hills yet remaining at right angles (as the matrix of two hundred-juger fabrics) to the predominant flow direction of Apennine waters. Based on these elements, the alignments of the main axes from map to map (continuously checking the persistence of traces) have been

extended as far as the Florentine plain with the secundum coelum grid. Where our hypotheses seem to be confirmed by numerous signs facing in the same direction and by other geometric circumstances, including in particular that of the main cardinal decuman crossing the centre of the plain (near S. Maria and S. Giorgio a Colonica) close to Bisenzio, whose natural course runs parallel to its northern foundation, similarly to the stretch of the Ombrone west of Pistoia, that more or less coincides with its contiguous axis to an exact distance module (1 ager = 12 miles). Other indications converging in this direction give us its place-names, featuring in the immediate vicinity of the web's main points (as in the case of the two previous "farm" suffixes and of two others mentioned in the next paragraph) significant technical-planning confirmation.

Forma quadrata secundum naturam. Therefore let us try to imagine our anonymous Roman planner coming to grips with the large-scale plan problem. On the table, in front of him, he has a Forma, a map of the territory perhaps drawn by himself after having measured the ground. We do not know the graphics but we know exactly what was represented: among natural elements most likely rivers, ridges and piedmont edges; strategic places and primary built-up areas among signs of man including the sites of the two major Etruscan towns, Fiesole and Artimino, that overlooked the plain (on both sides) from their defensive ridge head positions.

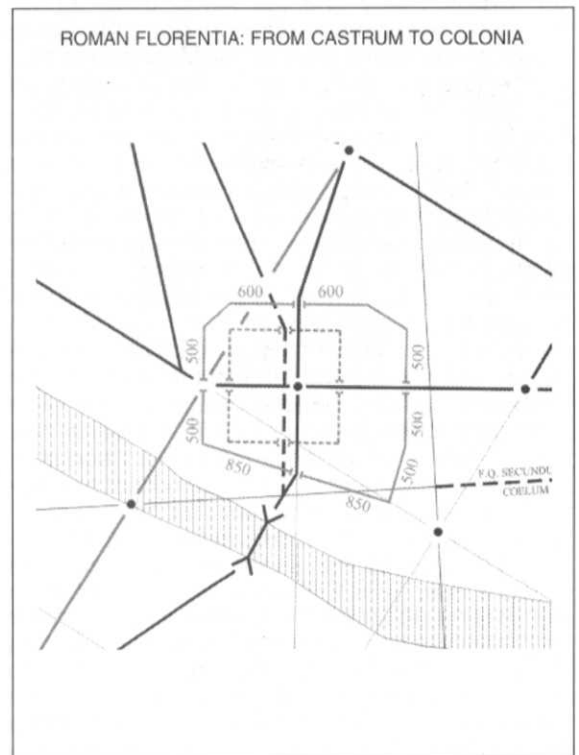
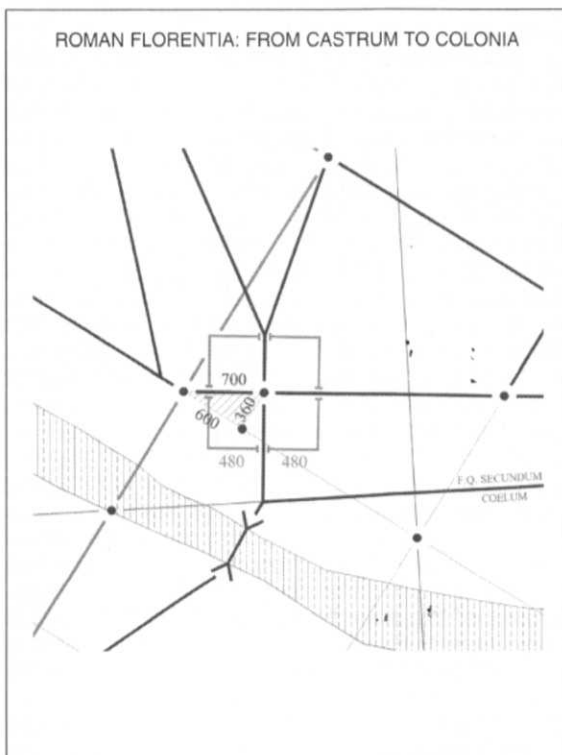
ROMAN FLORENTIA: FROM CASTRUM TO COLONIA
(REPROCESSING OF THE LEOPOLD'S CADASTRE BY A. SIGNA)



submultiples), like a virtual network of parallels and meridians. The plan was intended to search for a new farm ager the directional system that stuck closest to the lie of the land: in other words, it was a question of identifying the most suitable angular gradient to assign to the decumanus maximus – in our case the straight stretch of the Cassia – that as a “matrix” road was to form the geometric plan axis of (administrative and two hundred-juger) fabrics and of roads at right angles to it. In crossing lengthwise the plain (that goes from the valley of S. Donato in Collina to Ponte alle Tavole on the Ombrone to the north-west of Pistoia), the decumanus ended up in the same direction as prevalent stream discharge and with a strategic need for a median counter-axis (cardo maximus), which was to cut across the Arno gorges beyond Signa, at the height of the Comeana-Capraia and Limite route. A simple way to tackle the problem could have been to ideally rotate the cross of celestial coordinates in the centre of the plain until the required angle was found. In terms of numbers, here it appears to be slightly less inclined than that of major Emilian planning: assuming in this case values of 3.5:5 (7:10), which on a large scale entail (to measure the hypotenuse) the pseudo-

Pythagoric tern 35:50:~61. In fact, from the choice of the rotation angle carried out geometrically on the Forma grid, one can mathematically arrive at the corresponding ratio in whole numbers, and from it (possibly through tabulation) to the (approximate) value of the hypotenuse required for the precise tracing of squares. The axis of the Cassian way (of which various interaligned stretches have been found on maps) joins Florence in a straight line (from the outer S. Ambrogio turnoff) to Pistoia, the two towns that were to programmatically control the plain at both ends with their respective bridges over the Arno and Ombrone.

About halfway (cf. the place-name “Mezzana”) the transversal main road in order to cross the outgoing axis of the Arno at Comeana had to veer considerably north west as compared to the centre of the astronomic system (thus linking two cross points of the celestial web) by exactly one mile, a measure that expressed in Roman feet (1 mile = 5000 feet) can form (according to the final tracing of the main counter axis) a cathetus of the project tern (5000:3500:6100 feet). With the same ratio between similar triangles whose size depended on the various topographical situations, one could accurately trace on the ground under con-



However, we assume the reference coordinates (reconstructed through topographical research on cardinal decuman alignments *secundum coelum*), dividing it – together with the territory – into twelve mile squares (and relative five-digit structure the remaining axes of the web, whose dimensional values (distances and surfaces) could geometrically be determined in theory on the Forma. In this connection, we calculated (by summing up the hypotenuses of similar triangles) the overall distance of the straight stretch of the Cassian way from the turnoff before Florence to the vertex of the last triangle before Pistoia: 22.8 miles, which by adding 1000 feet (1/5 of a mile) measure 23 miles at the height of this city's entrance gates (still to be checked in detail).

Ager florentinus antiquus. Let us now verify the hypothetical geometric-proportional mechanisms of original Roman planning in the Florentine area (Italian Military Geographic Institute's late 19th century table to 25,000), of which there are still (topographically ascertained) two hundred-juger traces which have naturally been assumed as the documentary base of reconstructive reading. Integrating them planning wise to provide a sense of completion gives a clear convincing picture, which is still (two thousand years later) legible and (partially) operative in that it adheres perfectly to the nature of places. We took *mundus locale* to be the crossing between the *decumanus maximus* of the Cassian way and the *kardo minor* of via Faentina, transversally linking (through Ponte Vecchio) the valley floor of the Mugnone to that of the Greve. Both beds of these (opposite) tributaries of the Arno seem to have been (artificially) deviated over the centuries far west of the town, probably to alleviate it from the risk of floods. The hydrographic correction is eye-catching (and "unnatural" as it is almost at right angles) due to another former left-hand tributary of the Arno, the Ema, which instead of spilling over (as would appear to be logical) into the Chianti and Arcetri hills (to then join the Arno more or less at Badia di Ripoli east of Florence) bends sharply at Ponte ad Ema to pour into the Greve at Galluzzo, whose bridge system (with reference to the Siena and Volterra roads) has always been one of the (problematic) nodes of the Florentine territory, not by chance overlooked by the Carthusian "abbey castle". Symmetrically to Florence, we find on the opposite side (along the same counter axis) the Fiesole rise, which likewise controls (from a dominating position) the underlying valley floor that continues in a straight stretch as far as Croci, beyond Caldine (Cardine?), parallel to the road linking Fiesole to Florence to the south-east at a distance of one centuria or two hundred jugers. As for the Cassian's main decu-

man, topographical queries mainly concern the two branches preceding (before forming a straight line in the direction of Pistoia) its aforementioned inlet to the plain. The problem of geometrically fitting them geometrically into the centuria web remains unsolved. The shortest pass branch reaches Bagno a Ripoli through a descent ridge that does not coincide with the decuman route but remains more or less parallel to it (at a distance of two hundred jugers). Having reached the plain, this axis seems to continue in a straight line as far as the crossing preceding the river where it bends to assume a diagonal direction versus the web 1:2, heading directly for the Ponte Vecchio. The longer, flatter valley floor branch has the benefit of sticking to the opposite bank, thus being able to link up *secundum coelum* to the decuman axis for Pistoia, without necessarily having to pass through the Ponte Vecchio, which is likewise reached continuing along the same east-west route joining the centuria vertex at the town of Pistellino area with its Ponte a Greve equivalent (ratio 7:10). The accessibility of this axis, linked through its eastern gate, shaped the urban history of Florence.

The original plan of Florence. Let us take as a point of reference for our reconstruction of Florence's initial urban phases Gianfranco Caniggia's excellent reading (that is still perfectly viable), which we shall amend territory wise, supplementing it with our hypotheses, whose salient points in this connection can basically be summed up as follows: - 1. The town's first developments do not precede its territorial plan but are planned on it; in fact, the direction of Florentia's cardinal decuman plan does not coincide (by a few degrees) with the *secundum coelum* of the original axis of the Aretine road ("heading" for Ponte Vecchio, dodging its original centre, but (geometrically) connected to two centuria crossings (the junction of via della Vigna Nuova and via della Spada with via Tornabuoni and Fort Belvedere), in relation to which we maintain the *castrum decumanus* (the current insertion into Corso-Borgo Albizi-via Pietrapiana) and the *colonia cardo* (the axis of via di Calimala=*callis maior*). The numeric ratio as compared to the centuria web is 3:5, therefore (slightly) different from the 7:10 that the territorial warp presents versus the astronomic web. We note (incidentally) that the town decuman is aligned eastwards with the same centuria crossing (Pistellino) used for the astronomic tracing of the Aretine road. - 2. The main counter axis of the *ager florentinus* is not the Fiesole ridge road but the Faentina valley floor, which is linked through the town and the bridge over the Arno to its Greve equivalent for Siena. Consequently, the territorial cardinal decuman cross (*mundus*) coincides with the via

Guelfa/via San Gallo crossing (and not canto a Candeli between via degli Alfani and Borgo Pinti), on which the homonymous 14th century wall gate was then opened. – 3. The square camp plan (1000 x 1000 feet) identified by Caniggia fits in perfectly with the design of the centuria web and with the applicable road network, barycentrically positioned to control the nodal intersections between the territorial roads converging on the Ponte Vecchio: the three vertices of the centuria that transversally frames the town, plus the turnoff of the Aretine road with the Cassian way for Pistoia (nodalities which then played a fundamental role in Florence's history). A last note to confirm our hypotheses: Florence's late 19th century municipal borders (1874, year in which the Italian Military Geographic Institute's map was drawn up) are still exactly tangential to the innermost of the four major square sectors (4 saltus totaling 100 centuriae) hinging on the territorial mundus testifying to the extraordinary structural continuity of the Roman plan. What is surprising (given its dimension) is the circular course of the northern limitatio (the so-called customs boundaries?), which makes us think (as the only plausible hypothesis) of a large-scale application of the sacred technique mentioned at the beginning of the article.

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