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Changing settlement patterns in the Normandy countryside

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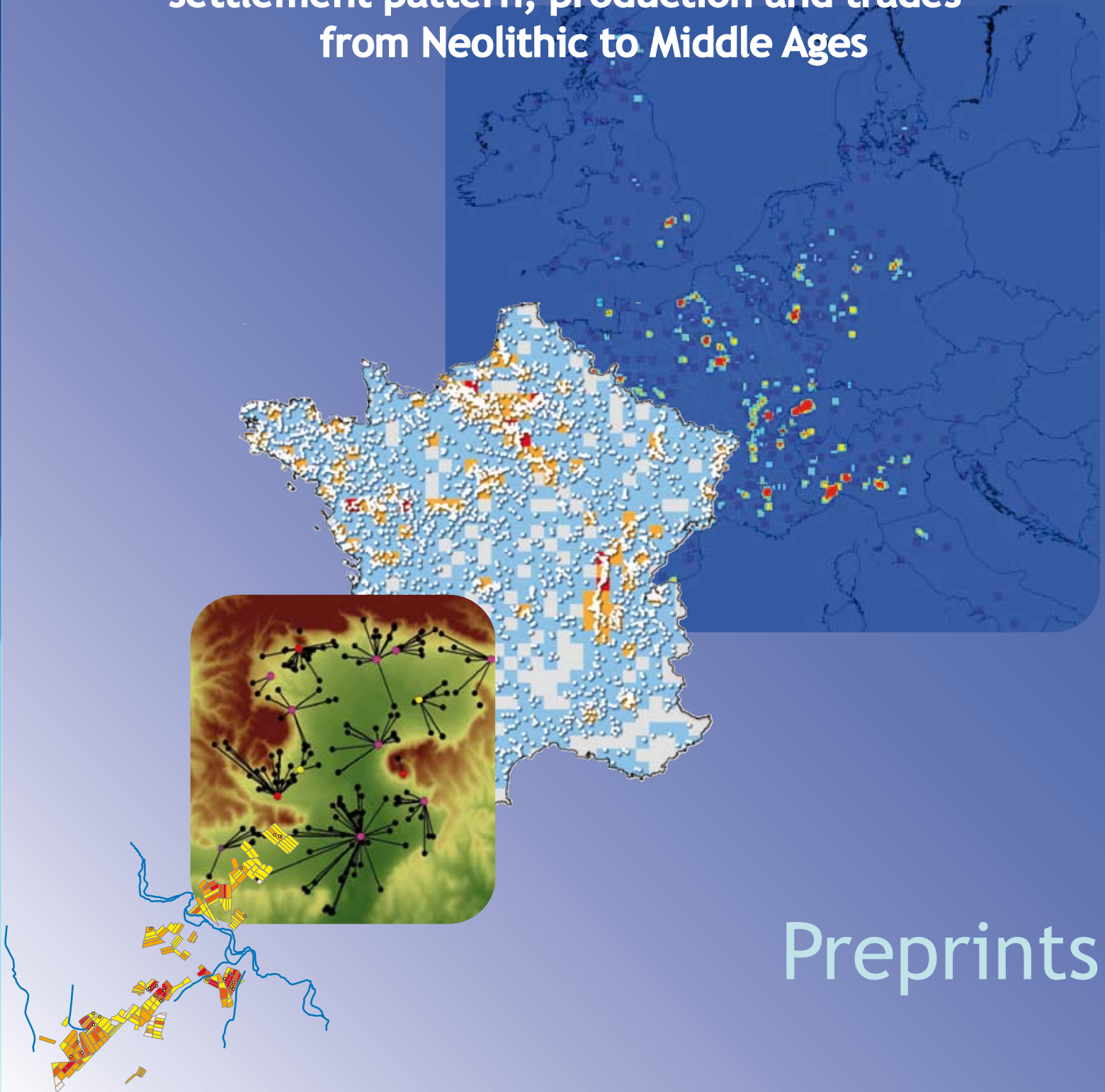
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ACI "Spaces and territories" 2005-2007
Final conference - Dijon, 23-25 june 2008

ARCHAEDYN

7 millennia of territorial dynamics

**settlement pattern, production and trades
from Neolithic to Middle Ages**



Preprints

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ACI « Spaces and territories » 2005-2007

Contract ET 28

**Spatial dynamics of settlement and natural resources :
toward an integrated analysis over the long term
from Prehistory to Middle Ages**

Final Conference – University of Burgundy, Dijon, 23-25 June 2008

ARCHÆDYN

7 millennia of territorial dynamics

*settlement pattern, production and trades
from Neolithic to Middle Ages*

Preprints

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CHANGING SETTLEMENT PATTERNS IN THE NORMANDY COUNTRYSIDE

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ABSTRACT:

The suburbs of the city of Caen (Calvados, Lower Normandy) have seen an increasing amount of development over the last fifteen years. All this construction work has been preceded by systematic archaeological investigations involving trial-trenching or excavation, the latter often covering several hectares. Out of a total of 1 400 hectares, 500 hectares have thus been investigated, providing an ideal sample zone for research into the history of settlement patterns. A G.I.S. has been used to record and map all archaeological remains dating from the Early Neolithic to the end of the Roman period.

Our main focus is on the recognition and chronological determination of phases of increase or decrease of farmsteads. The quantification of these phenomena has also been tested. While the combined data for the various periods show an overall trend towards the intensification of settlement, the progression is not linear. Two striking episodes have been identified. The first occurs during the Middle/Late Bronze Age transition (15th-12th centuries BC) and corresponds to the emergence of massive domestic enclosures. These settlements, linked to burial sites characterized by major clusters of circular ditched monuments, regularly shifted within a territory that was already cleared of forest.

The second episode probably started during the second half of the 5th century BC, and was amplified in the 3rd century BC. It coincides with important modifications in the exploitation of the environment and in production. Farmstead expansion is associated with geometrical subdivision of space, functional differentiation of settlements and the presence of increasingly prosperous landowners.

Additional information is provided by data on the spatial organisation of the Mondeville plateau during the 1st century BC. This rural area is clearly structured and was maintained by a regular network of closely linked and interdependent agricultural settlements. The specificities of the local Gallic agrarian system, mainly based on cattle-breeding and intensive farming, influenced the size and layout of the exploited territories.

Densely occupied during the late Iron Age, the study zone was substantially transformed after the Roman conquest. In fact the archaeological data from the outer-urban districts of Caen argue for a complete reorganisation of rural settlement during the second half of the 1st century AD. This is illustrated by the founding of new farmsteads imitating contemporary Roman models. These villae are strictly organized in a hierarchical system and have left a lasting mark on the landscape, as well as contributing to the reshaping of field systems inherited from earlier periods.

As a result of this case study, we would like to underline that examination of the data in the long-term makes it possible to go beyond the narrow frame of event-based history to approach the form of history promoted by Fernand Braudel: a history highlighting the underlying dynamics and structures that form human societies.

KEY WORDS : Normandy, farmstead, agrarian system, modelling, spatial analysis

The research context

Mondeville, Grentheville, Cormelles-le-Royal, Ifs and Fleury-sur-Orne are outer-urban districts belonging to the city of Caen. They are located on a low calcareous plateau rising to a height of 80 m above sea level and dominating the right bank of the Orne Valley.

These districts are part of a fertile region which is characterized by the presence of vast open fields. It is called *la Plaine de Caen* because of its low altitude. This corridor 60 km long has a north-south aspect and relies on Secondary deposits covered in places with thick loess patches. Widely opened to the Channel to the north, its boundary is marked by the hilly landscapes of the Armorican Massif to the west and the gently undulating chalk relief of the Pays d'Auge to the east. On a broader view, the Mondeville plateau lies at the northern edge of this low-lying area and gradually rises to the scarp slope of Fleury-sur-Orne. Far from being a flat and uniform entity, this plateau is scored by numerous valleys which are now dry and filled with colluvial deposits.

The sites presented in this case study divide into five different zones corresponding to a number of small and medium sized building developments. They are located in the business parks that have been developed in the south of Caen. These zones include the industrial estate of Mondeville "Sud" (110 ha) and the four integrated development zones of Mondeville "M.I.R." (30 ha), Mondeville "L'Etoile" (60 ha), Ifs "Object'Ifs Sud" (80 ha) and Fleury-sur-Orne "Le Parc d'Activité" (50 ha). Between these zones fit numerous trial-trenches and excavations corresponding to limited development works (roads, interchanges and mainly housing estates). The sector investigated covers an area of about 1400 ha, of which 500 ha have

undergone trial-trenching and/or excavation since the nineties.

The scientific choice made by the administration to monitor every development – whatever its size – was particularly beneficial. This choice was decisive in the renewal of the available data concerning the development of local settlement patterns and of production schemes from the arrival of the first farmers at the beginning of the 5th millennium BC (CHANCEREL, MARCIGNY, GHESQUIÈRE 2006) to the stabilization of the medieval hamlets during the 13th century AD (LORREN 1983). This favourable political background paved the way to the setting up of relevant research programmes which began in 1990 and are still continuing today.

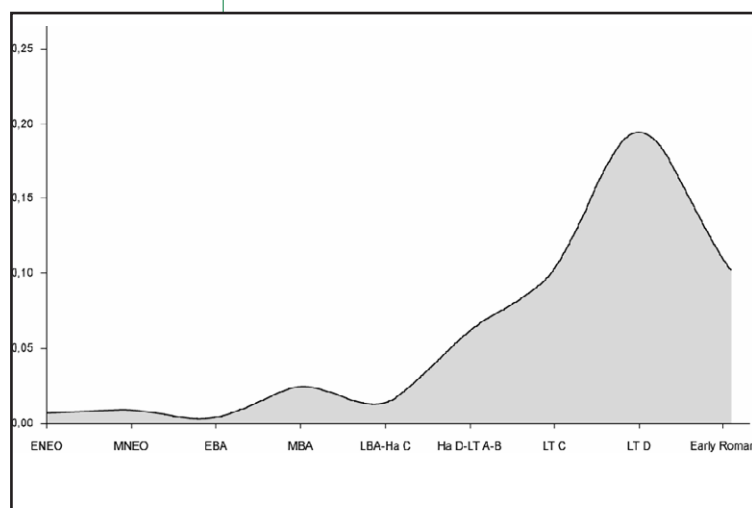
Even if they were carried out to varying levels of accuracy, the investigations have yielded a considerable quantity of archaeological remains. The study of these features and finds is well advanced nowadays thus making it possible to feed a GIS with data recorded in a consistent way and strictly organized into a hierarchy. Thanks to this appropriate protocol we aim at broadening the scope of our interpretation of settlement patterns and at obtaining long term trends that have a strong potential in the matter of human sciences. And it is only by giving priority to this type of synthetic and explicitly diachronic approach that we will be able to think from an historical angle and to design promising socio-economic models.

Changing spatial configurations

The study, which is still under way, deals with the development of rural settlements and is trying to fill in the framework of ancient sites by combining spatial and temporal data. At this prospect, our main focus is on the recognition and chronological determination of phases of increase or decrease of farmsteads. Thanks to the GIS, it is possible to quantify the intensity of these phenomena.

Obviously, to build the curve presented in figure 1 we did not simply count the sites excavated or known by survey. It was necessary to take into account the intrinsic length of every period to balance the number of observations and guarantee the consistency of the results. Comparing the data, stage by stage, we observe a broad trend in settlement intensification. The average number of sites seems to increase significantly during the last four millennia BC. However this curve only gives a basic idea of a reality that was formerly more complex.

Figure 1 - Changing settlement patterns from the Early Neolithic to the beginning of the Early Roman Empire in the south of Caen. The number of sites is stated in percentage and balanced by the intrinsic length of each period.



The observed oscillations are only indicators; but they can be considered as representative of the dynamics of the past for two reasons. Firstly, rescue excavations are dependent upon urban development thus prompting the operators to intervene without making any arbitrary selection of the sites. Secondly, erosion cannot be held responsible for the destruction of subsoil horizons in this part of Lower Normandy.

Having made these preliminary remarks, examination of the curve reveals the existence of two striking events (Fig. 1). The first one occurs between the 15th and 12th centuries BC. For example, at Mondeville “L’Etoile” and “ZI Sud” wide enclosures appear during the middle Bronze Age. Their size can reach 4000 square metres. Their exact role is not known. As a rule the internal features are almost always erased by mechanical erosion. A clue to the function of these sites is provided by the distribution of ceramic finds, grinding tools and bone materials recovered from pits and ditches (Fig. 2). The recorded spatial patterning of *artefacts* and *ecofacts* helps us to understand the nature and the intensity of the domestic activities undertaken at these sites, enhancing the *secular* interpretation. Households living here depended upon a subsistence strategy combining crop cultivation and animal husbandry (CHANCEREL, MARCIGNY, GHESQUIÈRE 2006).

As far as chronology is concerned, these enclosures are not contemporary. The detailed study of the ceramic sequence indicates the anteriority of the enclosure of “L’Etoile” in relation to the enclosure of “ZI Sud”. Given the weakness of the regional typo-chronological frameworks and the inaccuracy of the available radiocarbon dates, it is not possible to refine this scheme for the moment. However, further evidence is given by the examination of the sections of the ditches. On the one hand, they show no sign of a fine stratigraphy which is traditionally linked to the periodic cleaning out of such features. On the other hand, their filling seems to result from the rapid erosion of the inner banks made of the spoil obtained from the initial clearance of the ditches. These elements both indicate that the enclosures were abandoned soon after their construction. This hypothesis is strengthened by the vertical distribution of the finds: clusters of waste materials appear systematically in a thin intermediate layer relying on a 20-25 cm thick deposit derived from the natural deterioration of both sides of the ditches. In the upper fill of these features only sparse remains were found,

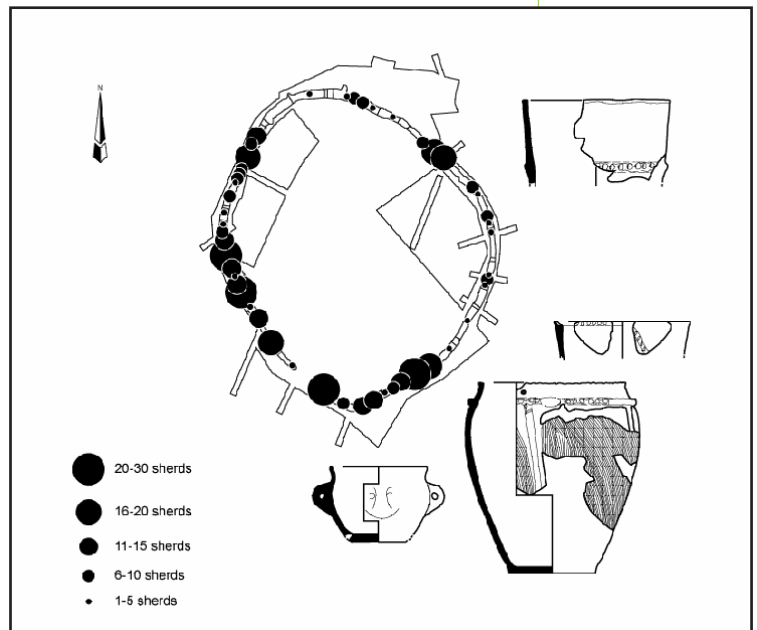


Figure 2 - Distribution map of the Middle Bronze Age ceramic finds from Mondeville “L’Etoile”.

arguing in favour of short-lived settlements which nevertheless required a great deal of expenditure of human time and effort.

At a micro-regional scale, these assumptions make it possible to sketch out a model based on previous stimulating works (SIMONS 1989, FOKKENS 1991). According to this model, replacing woodland by farmland was the only way to maintain the sustainability of an agricultural system that was rather archaic. Enclosures were consequently submitted to regular shifting within a predefined territory. The abandonment of the enclosure of Mondeville “L’Etoile” would have led to the building of another enclosure 1.5 km away from the former spot and within a relatively short span of time. In this example, the new farmyard seems to conform to the same global scheme as the preceding dwelling – meridian aspect, mean size of 4000 square metres, short-lasting houses, internal layouts that have left no trace – thus giving the impression of settlement continuity in a rather dynamic and land-hungry pattern.

Most of these enclosures are connected to burial sites characterized by major clusters of round barrows. A handful of these cemeteries can be used to illustrate the close relationships existing between domestic sites and burial sites. At Mondeville “M.I.R.”, eight single-ditched monuments associated with about thirty flat graves were excavated on a large scale giving a good idea of the way the cemetery was initially structured. A very similar pattern has been observed at Ifs “Le Hoguet” and Grentheville “La Sente” in spite of disturbances due to later developments. These domestic and burial sites reflect the image of a plateau already densely occupied and widely cultivated from the middle of the 2nd millennium BC. This period of expansion affected the landscape on a permanent basis

as suggested by environmental analyses. The clearances were massive and indicate the intensification of the agro-pastoral activities in *la Plaine de Caen* (LESPEZ *et al.* 2004, MARCIGNY *et al.* 2007).

The second occurrence started probably during the 6th and 5th centuries BC (that is during the transition between Ha D and early La Tène). The curve indeed shows a net increase in the number of sites. We are thus dealing with a period of definite continuous growth. This trend continues afterward and is even amplified during the 3rd century BC.

This episode matches with important modifications in production and in developments in the environment. It is in fact characterized by the establishment of a well-planned agrarian landscape. Settlements dating from this period are all made of areas that are functionally different. They consist of adjoining enclosures containing numerous features: houses, outbuildings, workshops, cellars, granaries, ovens, etc.

Within the study zone, the settlement pattern seems much denser and more uniform than in the preceding centuries. As expected, these sites were not occupied at the same time; and yet, they were occupied for much longer spans of time than ever before. The distribution maps are thus misleading. However they show a gradual tendency for farmsteads to remain on the same land. Enclosures are modified from time to time. But they are no longer part of what can be described as wandering patterns of land use. These settlements are associated with a geometrical subdivision of the landscape. The ditches bordering the plots are at right-angles to the path networks and criss-cross the countryside. We can link this phenomenon with the emergence of landowning and with the will to rationalize the agro-pastoral activities. It also supposes the adaptation of certain constituents of the Gallic agrarian system.

Modelling late Iron Age settlement patterns

Given the wealth of the existing dataset for the 2nd and 1st centuries BC, the distribution of late Iron Age farmsteads deserves a detailed analysis. Before going further, it is nonetheless necessary to focus on a few basic factors affecting the agricultural economy.

The system of production

The excavations mentioned in the first section have provided a rather small number of Gallic tools. But it is extremely likely that a large number of other iron items were used by farmers. Recycling practices and

corrosion are probably responsible for the loss of a great quantity of such objects. As a consequence, the sample presented below fails to reflect the real level of equipment of each household. However, available artefacts remain a valuable source to illustrate the range of daily activities carried out inside and outside the farmyards.

The recorded assemblage comprises thirteen farm implements including exclusively socketed ploughshares and hook-shaped cutting tools. Among the latter, the presence of three billhooks recovered from Fleury-sur-Orne “CD 120” and Mondeville “L’Etoile” proves the exploitation of woodlots in order to fodder animals during the winter months (SIGAUT 1998). Ethnographic literature gives many examples showing that twigs and leaves were harvested and stored, thus playing a modest yet not anecdotal part in improving daily food rations devoted to the livestock (RASMUSSEN 1993). In terms of farm organisation, such tools suggest that the cattle could have been kept in byres assuming that foddering took place in specific sheds. Given the high degree of alteration of archaeological layers and the dearth of unambiguous architectural remains at a local scale, little can be said about this hypothesis.

In addition, it is worth remembering that billhooks are traditionally involved in the upkeep of hedges (SIGAUT 1998). Therefore, they implicitly witness the possible existence of shrubby-made fences used to mark the boundary of the cultivated lots. The combination of vegetal and human-built physical boundaries probably made outdoor penning on fallow lands as well as on permanent pasture easier. Unfortunately, environmental data are far too limited to provide a good correlation between pollen assemblages and ancient vegetation pattern. Due to the poor condition of the pollinic materials recovered from Ifs “Object’Ifs Sud”, off-site samples are more likely to reflect the vegetational background that might be found around agricultural settlements rather than to give a precise picture of the layouts that bounded the plots (LE GOFF *et al.* 2002)

Among the metalwork finds, scythe blades coming from Ifs “Object’Ifs Sud” and Fleury-sur-Orne “Parc d’Activité” draw our attention to haymaking and to the development of hay meadows in the direct vicinity of the farmsteads. The latter point remains a tricky issue though. Available pollen profiles account for an overall decrease of ligneous species in favour of herbaceous species and cereals. Plant communities document the existence of large open arable areas devoted to crop cultivation and grazing (CLET-PELLERIN,

VERRON 2004). It should be noted that the great majority of local sedimentary pollen analyses were conducted in the Orne valley and rarely focused on the calcareous plateaus shaping *la Plaine de Caen*. As a consequence, it would be risky to extrapolate these results into convincing arguments.

In spite of these reservations, theoretical connections between the general settings of the study zone and the existence of hay meadows can be suggested. The numerous valleys draining the Mondeville plateau are characterized by heavy soils derived from colluvial deposits. These even and watered soils are thought to be best suited for the growing of hay.

Extending this questioning, it would be fruitful to take a fresh look at faunal data and to re-evaluate the exact meaning of the changing slaughter age strategies in the long run. Relying on the animal bone data set recovered from Ifs "Object'Ifs Sud", G. Auxiette showed that more young animals were slaughtered in La Tène C than in La Tène D. She argued that this trend broadly depended upon socio-economic processes, assuming that Gallic farmers would have lived through a period of relative decline during the 1st century BC. For the author, they could not afford to eat meat of the finest quality (LE GOFF *et al.* 2002). Even if they are not devoid of relevance, such statements need to be moderated as they fit poorly with other hints enhancing the wealth of the local landowners (LE GOFF *et al.* 2007).

Bearing in mind the presence of fine bronze vessels, of gold and silver coins or imported goods in domestic contexts, it would seem more appropriate to consider this trend as the best key to understand the major shift affecting agricultural economy that locally took place around 100 BC. In a system which is unable to provide sufficient amounts of fodder during the winter months, herdsmen are actually forced to slaughter spring-born animals (that is under one year of age) in order to ensure the maintenance of the herd (MAZOYER, ROUDART 1997). Consequently, the high proportion of calves and lambs in slaughtering profiles must not only be explained in terms of social status and dietary differentiation. It may also result from the intrinsic inertia and fragility of ancient agrarian systems, heavily dependent upon low crop yields.

Thanks to the development of wide areas devoted to haymaking, this constraint becomes obsolete or at least of minor importance. Risks of fodder shortage become more remote making it possible for the number of raised animals to grow. Indeed, examination of the slaughtering profiles

shows a slight shift in cattle-breeding objectives. A significant majority of animals were bred and fattened up to the optimum age for meat yield. This obviously suggests that the rearing of cattle was essentially focused towards meat production. But farmers probably attached a growing importance to the stockpiling of large amounts of dung to support agricultural intensification. In this context, it becomes necessary to refine techniques used to increase the productivity of arable land.

The maintenance of the fertility of the soil

A broad overview of the archaeological studies devoted to the issue of the maintenance of the nutrient status of soils shows that there is slight evidence to indicate the importance of manuring in protohistoric societies (BAKELS 1997, NUNINGER 2002 : 161-163). And yet, doubtless, it played a fundamental role in the Gallic agrarian system.

Several clues support this idea such as the frequent presence, within the domestic enclosures, of large pits whose function is not obvious. Among them, some correspond to clusters of neighbouring extraction pits dug to provide building materials as demonstrated by stratigraphical sections (LE GOFF *et al.* 2002). Others, filled with hydromorphic layers, are interpreted as ponds used for water supply (VAUTERIN 1994 : 19, BESNARD-VAUTERIN 1996 : 59). A few remaining pits raise unsolved problems as far as rural archaeology is concerned. We suggest that these features might have been manure pits collecting animal dung and organic waste generated by human activities.

A handful of ethnographic records can be used to get additional hints on this matter (ZOLA 1889, HITIER 1903, SERVAIS 1925). Describing the internal layouts of a late 19th century farm from the Beauce, E. Zola underlines for instance the size and the central location of the manure pit inside the farmyard (ZOLA 1889 : 8). Considering the figures he provides and comparing them to the average area occupied by the archaeological pits, it is possible to make out recurrent ratios that give more consistency to our suggestion.

It is worth remembering that this is only an assumption relying on slight comparisons with historical sources. Large pits filled with thick organic layers containing large amounts of refuse including animal bones and pottery could match other functional hypotheses. The fact remains that the implications of such an assumption are far-reaching. Collecting animal dung in a particular feature implies the transport of adequate quantities of manure from the farm to the arable plots. It

requires an additional expenditure in energy, thus affecting the spatial organisation of the catchment areas. It also supposes the replacement of hand-carting or saddle-carting of manure by more profitable and sophisticated means of transport. It is tempting to link the laying out of the local extensive track network during the late Iron Age with the advent of four-wheeled carts. The importance of cattle-breeding is largely admitted at a regional level. As expected, animals are mainly raised for the production of meat (SAN JUAN *et al.* 1994, LE GOFF *et al.* 2002). But they can be considered as a valuable source of manure, assuming that they were not overwintered in the open. Unfortunately archaeological remains reveal nothing regarding cattle-stalling. None of the excavated buildings has architectural specificities such as plank or wattle cross-partitions bounding boxes or flagged floors that would account for its initial function. Typological and dimensional analyses are not discriminant enough to assess whether cattle were housed or not. Tested on a series of thirty-one buildings, these parameters allow a broad division of the sample into two groups: on the one hand, the vastest buildings are systematically located within the enclosures. They are interpreted as farmhouses. On the other hand, we find a heterogeneous set of buildings among which it is difficult to tell the difference between granaries, barns, haylofts, sheep barns or cowsheds given the lack of well-preserved archaeological soils. Chemical analyses of floor areas would indeed provide useful insights into the existence of cattle-related buildings. It is nevertheless clear that some rural settlements were specialized in the breeding and the slaughtering of animals. This is the case with Mondeville “L’Etoile I, site 1” where the main enclosure is preceded by a ditched corridor which could have been used to drive the cattle through and to make certain tasks easier: branding, castration, isolation of gravid females, etc. This corridor is linked to a small secondary enclosure possibly used to pen the cattle (VAUTERIN 1994).

Finally, indirect information on grazing is provided by recent phytosociological evidences. Archaeobotanical data on the weed floras harvested with crops suggest that the level of the reaping cut of oats (*Avena sativa*) was exclusively high during the late Iron Age in Normandy. In other words, stems were not uprooted during the first stages of crop processing. Assuming that adequate fences were in use, stubble was easily accessible to the livestock for a limited period (MALRAIN, MATTERNE, MÉNIEL 2002). When fields

under cultivation were harvested, animals could be grazed on them with benefit to subsequent crops as illustrated by historical records. Varro highlights for example that “it is profitable to drive [the cattle] into stubble fields for two reasons: they get their fill of the ears that have fallen, and make the crop better the next year by trampling the straw and by their dung” (VARRO, *Res Rusticae*, II, 2, 12). This practice, promoted by Latin agronomists was undoubtedly efficient, and met with relative success until chemical inputs began to spread.

The excavations carried out in the outer-urban districts of the city of Caen have yielded many clues enhancing the significance of cattle-rearing in the local Gallic economy. The end of the 2nd century BC sees the unprecedented reinforcement of the interactions between crop cultivation and animal husbandry. These two fields no more correspond to competing sub-systems reaching the limits of their own growth. In terms of quality, a step is crossed during La Tène D witnessing increasing farming efficiency. As a result, the agricultural system becomes a more integrated one provoking better yields. Of course, this major shift affects settlement patterns as well as land use strategies.

Modelling land use: methodology and analysis

The land use model we elaborated appeals to several sources encompassing environmental and archaeological data. Ecological information was collected to form a basic framework focusing on soil characterisation and water availability since topographic constraints are slight in the region under investigation. Thanks to the GIS we made use of a range of standard data manipulation techniques that allow the linkage of various parameters coming from different layers of information. Following this procedure, we produced a reclassified topographic and geological map of the study zone. By paying close attention to this map, three soil types were identified. Limestone is the geological dominant feature. It corresponds to silty-loamy and water-permeable soils characterized by a remarkable agricultural potential (AMIET *et al.* 1996). Aeolian loess patches are also well represented. These well-drained and stone-free silty soils are thought to have the greatest inherent value for agriculture as they currently show high availabilities of nutrients. As for colluvial-related soils, they are not devoid of interest. But it was probably difficult to till them by means of simple ards since the seasonal excess of water remains a strong limiting factor.

At this stage of the simulation, we tried to evaluate the potential of the local environment. For each recognized soil type we calculated a yield value by confronting each land use strategy requirements to the estimated potential of the different environmental units. We also took into account the intrinsic nature of the main tools involved in tillage. For instance, heavy and water-saturated soils were considered as unsuitable for crop cultivation given the fragility of the Gallic ploughing implements (MALRAIN, MATTERNE, MÉNIEL 2002). Conversely, they provide optimal conditions for animal grazing. As for loessic loams, they were considered as unsuitable for permanent pasture as excessive animal trampling provokes the formation of surface crusts impairing their subsequent productivity (AMIET *et al.* 1996).

Examination of the available distribution maps highlights the exceptional density of sites between Fleury-sur-Orne and Mondeville from the 3rd century BC (Fig. 3). This density is all the more striking as there are virtually no differences in status between the contemporary sites. Metal artefacts (vessels, weapons and tools), a few amphorae and imported goods (fine wares) were recovered from every studied site. The regular practice of votive deposition including metal items and faunal remains is demonstrated at Fleury-sur-Orne (SAN JUAN *et al.* 1994), Ifs (LE GOFF *et al.* 2007) and Mondeville (NILLESSE 2006). At a local scale, it seems possible to question the existence of a pronounced hierarchy.

The farmsteads under consideration are regularly spaced out, as if a standard module was repeated from east to west. This pattern suggests the existence of a well-planned organization of the countryside. In the three sectors of Fleury-sur-Orne, Ifs and Mondeville, the theoretical distances given by Thiessen polygons are indeed all less than one kilometre: sites are distributed approximately every 600 meters. This suggests that the exploited territories were smaller than those described by geographers (DUNN 1954, CHISHOLM 1962). Thus, the agricultural works took place in a maximum range that does not exactly correspond to the models traditionally admitted. Assuming that distance affects the type of land use, the small size of these territories has to be explained.

Animal farming is an important component of the local economy. There are several strands that lead to this conclusion (cf. *supra*). This activity requires vast areas to feed large numbers of and yet mobile herds. Consequently, it is extremely likely that zones

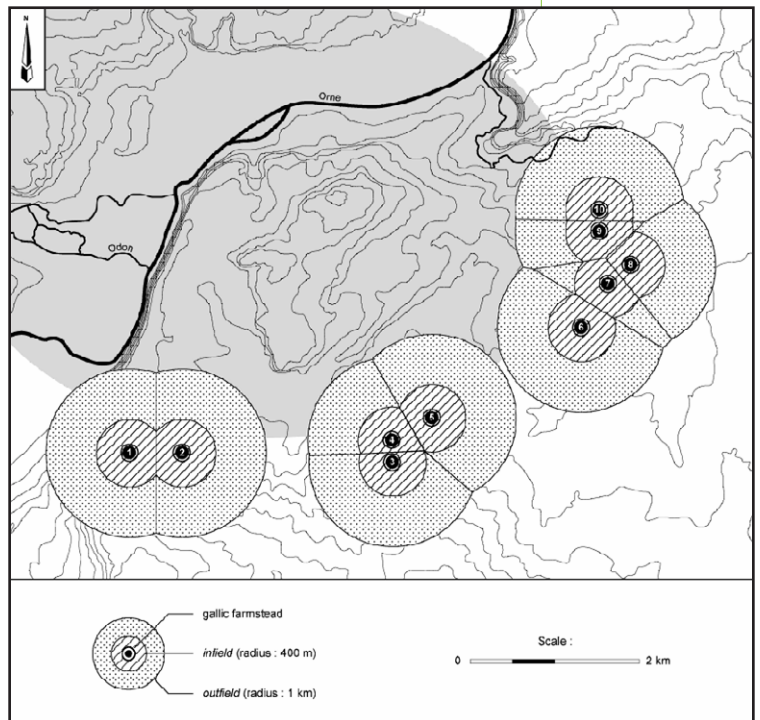


Figure 3 - Distribution map of the Gallic farmsteads located on the Mondeville plateau and demarcation of infield and outfield areas surrounding the studied Gallic farmsteads. The extension of the actual city of Caen is shaded grey.

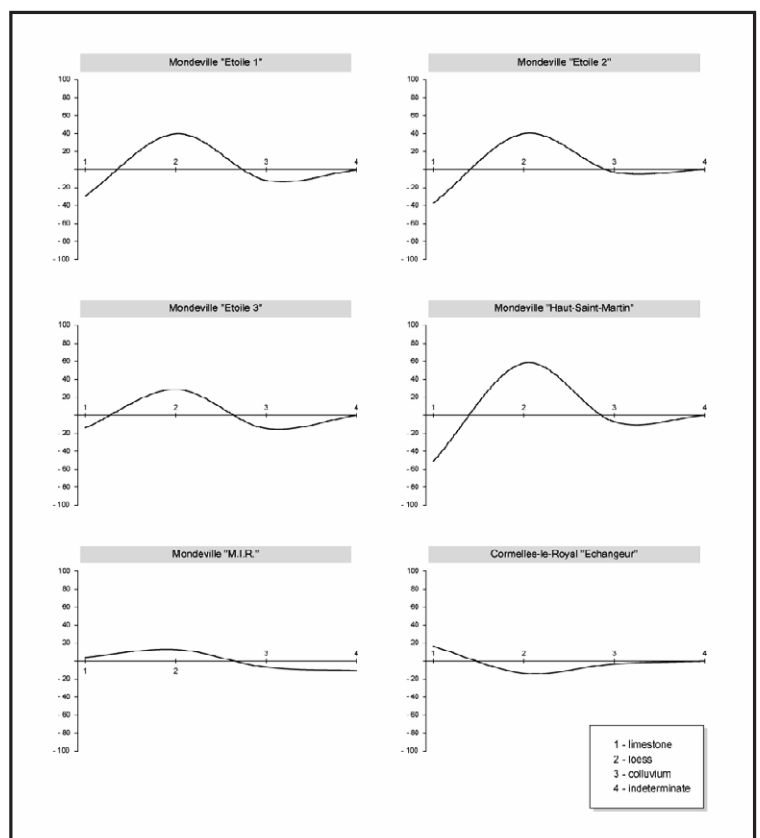


Figure 4 - Difference between the ratio of pedological units comprised within the infield and the ratio of the same units comprised within a circular territory of 1 km radius (stated in percentage).



Figure 5 - The villa of Fleury-sur-Orne "Parc d'Activité" and a detailed plan of the stone-walled building.

of relatively stable grassland were located in marginal areas and/or on soils unsuitable for tillage. It is also worth remembering that waste lands and woodlots could provide highly nutritive fodder during spring time. Resorting to hay foddering affects the spatial organization of the catchment areas in another way. The upkeep of hay meadows requires a great expenditure of energy to prevent animal straying or to reap the grass that needs to be piled into haystacks. Another constraint is related to the transport of hay by means of carts. Such clues suggest that hay meadows were in the immediate vicinity of the farmsteads – that is in well-served areas.

In spite of their small size, the agricultural territories were not submitted to an even anthropo-zoological impact. This might have led to the division of the catchment areas into two concentric rings: an outer zone of forest and grassland which was slightly exploited and a core area of about 35 ha for which more subtle farming techniques such as ploughing and manuring were developed (Fig. 3). Furthermore, in a system where soils needed extended periods of fallow if they were to remain at a sufficient level of fertility, it is assumed that the infield was only partly cultivated (MAZOYER, ROUDART 1997). According to the principles of a cropping system with

a two-course rotation of alternate crops and fallow, only 15 to 20 ha were actually sown with cereals, leguminous plants or hay. Even if the outfield could be used for occasional and less demanding crops, the problem of the viability of the Gallic farmsteads is raised.

Before going further, it is necessary to put this issue into perspective. The figures mentioned above are approximately similar to those obtained by other simulations concerning the late Iron Age (MALRAIN, MATTERNE, MÉNIEL 2002 : 150) and the Roman period (OUZOULIAS 2006). According to the data recorded by the Roman administration, the area which can be ploughed in one year by a single yoke was about 15 ha (FERDIÈRE 1988). These clues suggest that the bases of our model are satisfactory and reliable.

Having made these preliminary remarks, it is possible to pursue the line of reasoning further by examining the distribution of each land class within the two concentric rings defined above. At this prospect, we first calculated the proportion of each pedological unit belonging to the infield. The results were then compared to the relative proportion of the same units comprised within a theoretical territory of 1 km radius. In the sectors of Mondeville and Fleury-sur-Orne, it is clear that the presence of thick loess patches played a significant role in the laying out of the Gallic farmsteads and in the location of the related fields. These soils were obviously attractive ones due to their remarkable fertility (Fig. 4). The deficit of water-saturated soils in the inner ring is also noteworthy. These facts, notably the high agricultural potential of loess-covered soils and the density of the Gallic farmsteads, argue in favour of a possible specialization of the core area in the farming of cereals and leguminous plants. Animals might have been grazed on lands of poorer quality or on fallows. As expected, the quality of the land was an important factor influencing the distribution of the farmsteads. Agricultural settlements concentrated first on more fertile soils making it easier to develop a strategy based on agricultural intensification. This strategy did not match with the spatial expansion of the areas under cultivation but resulted in major shifts affecting agricultural practices including crop husbandry and cattle-breeding.

It is possible to link these observations to the results obtained by V. Matterné. Her archaeobotanical analyses highlight a specialization of the Gallic establishments of *la Plaine de Caen* in the farming of peas and broad beans (MATTERNE 2001:105). These plants are notorious for the careful handling they

require during their growth. In other words, we are perhaps dealing with a system giving priority to intensive farming; a system whose sustainability relies on heavy investment in agricultural work and in farm-hands. In this context, farmers logically reduced the size of the cultivated territories, thus adapting the landscape to their specific agrarian system. The resulting pattern contrasts with the extensive systems of northern France. In fact, the spatial organization set up south of Caen made it possible to gain time by minimizing the constraints of movement and to lower additional costs of production without necessarily impairing cereal outputs thanks to an efficient manure policy and to the high fertility of the local soils.

The will to maximize returns for least effort helped shape the countryside in a particular way. Subsistence economy began to turn towards becoming a *maximizer economy* locally based on cattle-breeding and intensive farming. And the system apparently remained unquestioned until the Roman conquest provoked its collapse

Change and continuity during the Roman period

Densely occupied during the late Iron Age, the study zone was indeed substantially transformed after the Roman conquest. In fact the archaeological data from the outer-urban districts of Caen argue for a reorganisation of rural settlements during the 1st century AD. This is illustrated by the founding of new farmsteads gradually imitating contemporary Roman models. This is the case at Fleury-sur-Orne “Parc d’Activité” where a large agricultural settlement is laid out on the ruins of an earlier Gallic farm, soon after the Roman conquest (Fig. 5) (CHANSON-BERTOLIO, LE GAILLARD, PAEZ-REZENDE 2001). Made up of two courtyards and bounded by a series of ditches, this dwelling-site witnesses the rapid abandonment of former *native* models in favour of Mediterranean standards.

The Romanisation of the area under consideration is above all illustrated by the erection of a stone-walled building around 20-30 AD (Fig. 5). Designed as a well-appointed set of rooms, this building undoubtedly displays Roman features including baths as suggested by the tile *piliae* recovered during the excavations. Other clues corroborate this opinion: carved stone blocks, limestone capitals as well as fragments of painted wall plaster reveal that the Roman building style was deliberately adopted by a few landowners at an early stage. This provides useful insights into the existence of high standards of comfort and

sophistication which can be used as status indicators.

On a local scale, it is necessary to moderate these assumptions as other contemporary settlements seem to be less concerned with the introduction of a new *way of life*. At Ifs “Object’Ifs Sud”, the farm n° 7 perpetuates the traditions that characterized protohistoric settlements: timber-framed buildings, extraction pits or wells are distributed within a large rectangular ditched enclosure connected to the path network and to the cultivated lots (LE GOFF *et al.* 2002). As in Fleury-sur-Orne “Parc d’Activité”, the general aspect of these features is slightly modified, enhancing the significant reshaping of field systems inherited from earlier periods.

According to these two examples, it is possible to support the idea of a progressive and heterogeneous Romanisation of the Normandy countryside. Other regional studies relying on surveys and on systematic inventories agree with this impression (GANDINI 2006 : 470). Even more interesting, the advent of humble *villae* may be linked to increasing social distinctions among the local peasantry. This process probably matched major transformations affecting both the rural economy and the spatial organisation of the Mondeville plateau.

From nucleated farmsteads to great estates Despite the well-attested continuity of a few farmsteads, there are signs showing a trend towards the contraction of the local settlement pattern. From the beginnings of the 1st century AD, the number of rural establishments decreased somewhat. Gallic farmsteads were definitely abandoned in favour of a few larger settlements whose sizes range from 1.3 ha to approximately 2.5 ha. Involved in farming activities, these settlements seemed to control wider territories than ever before.

Given the available data, it is still difficult to evaluate the exact nature of the *stimuli* that may have affected the size of land-holdings. The prosperity of the estates mainly rested upon the same agricultural products as in the preceding century. Regarding crop cultivation, shifts are of minor importance. On the basis of tools and archaeobotanical remains that were recovered during the excavations we are more likely to assess a relative continuity of the technical system. However, the introduction of arboriculture should be considered as a real innovation as it requires the acquisition of specific skills and the development of orchards as illustrated at Giberville “Rue du Marais”. It also implies the integration of the farmsteads into a wider economic system that made it possible to supply emerging urban markets.

The rise of cities and secondary towns such as Araeague and Caen may be the key to understanding why the local countryside underwent major restructuring during the early Roman Empire. Landowners and farmers began to play a significant role in the market economy and contributed to the reinforcement of trade contacts between these cities and their hinterland.

Conclusive remarks

The first models suggested here result from coherent archaeological decisions that have been taken by the administration since the eighties and carried out by a single operator: INRAP. Thanks to the mechanical stripping of large areas and to the prescription of systematic evaluations, the growing number of outer-urban building developments has allowed us to observe not only archaeological sites and their immediate environment, but also areas considered as "off-site". The latter

consists of ancient fields, path networks and zones without archaeological remains. Each site can thus be linked to a wider network whose social function is obvious.

Even more promising, the examination of the data in the long term makes it possible to go beyond the narrow frame of event-based history and to tackle another form of history promoted by Fernand Braudel: a history highlighting the underlying dynamics and structures that form human societies.

This multiscale approach to the archaeological data, within a broad space-time framework, forces us to take a fresh look at our methodological tools and to develop new research projects. The use of GIS helps us in handling huge quantities of data and in interpreting the organization of past human societies. Other zones which can be considered as coherent samples should now be investigated in detail.

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