

2 Early Middle Ages 500–1000

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In all rural societies, peasants combined crop cultivation and stockbreeding. In this, those societies responded to two requirements and respected two constraints. Three of these parameters fall directly within the scope of this volume. First of all, there was the technical requirement of both maintaining soil fertility and renewing natural resources. Basically, peasant farming in the Early Middle Ages made cultivation and stockbreeding, plants and animals, farmland, woodland and wasteland complement each other. Secondly, peasant farming faced the constraint of technology: tillage and care for animals had to be carried out with the tools available. It also faced the constraint of nature: the natural potential of the environment in respect of soil fertility, plant cover, climatic conditions, etc. The fourth and last parameter was the social requirement, i.e. ensuring that the group had all the produce necessary for its continued existence, whether that produce was consumed directly or exchanged for other resources, or applied to meeting levies; this parameter is by and large dealt with by the three other volumes in this series (see in the other contributions in this series: Wickham, 2010; Devroey and Jaubert, 2011; Devroey, Wilkin and Gautier, 2013). The necessarily schematic analysis of a very long period – 500 years – characterized by sparse and often elliptical, written documentation and the currently large chronological margins of dating the material evidence must neither lead to compress time or neglect regional differences. By way of introduction, it is necessary to resume in the first paragraph of this chapter the most important elements of the social parameters of production that, combined with technical requirements and with technological and natural constraints, determine agricultural production within specific regional agro-systems (Mendras, 1995: 28–34; Thoen, 2004).

2.1 Social agro-systems between Antiquity and Middle Ages

Social transformations between Antiquity and the Middle Ages

The starting point of major change predates the timespan covered by this volume, and is to be found in the process of the disintegration of the Roman system in Northwest Europe from the fifth century AD onwards. Societies of barbarian peoples – some groups speaking a Germanic language, as in *Germania libera* (Germania, to the east of the Rhine and of north of the Danube, Scandinavia), and some a Celtic language, as in the north of the British Isles and Ireland – had political and trading relations with the Roman world. The nature of trade changes following the distance from the Empire. The Roman imports in the peripheral areas are centered on prestige goods and weapons, whereas ceramics and common products are extremely rare. On the contrary, the barbarian buffer zones have common Roman imports

whereas the prestige objects are less frequent than in the periphery (Hedeager, 1978). Even the remote northern elites referred to Romanness in the material expressions of power: the runes are mainly derived from Latin letters; the first Germanic animal styles reproduce zoomorphic decorations of military centurions' buckles and the oldest gold bracteates clearly imitate *solidi* with the imperial effigy. The source of wealth was mainly agricultural in both societies, which differed mainly in the nature, quantity and effects of levies on the rural economy.

Nevertheless, deep changes do affect the societies and the settlement systems in the peripheral areas – Northern Germany and Southern Scandinavia. In the late second century, rising warrior elites attempt to deepen territorial domination. The impressive sacrifices of weapons and the construction of maritime barriers speak about the violence of these conflicts affecting Southern Scandinavia and the coastal regions of the Baltic. In Jutland, the numerous regional archaeological groups are replaced by larger assemblages fewer in number (Ringtved, 1988). At the same time, settlements and farmsteads, at first in Jutland (south of the Limfjord) and in Northern Germany, adopt a regular layout, indicating some sort of planning, and settlements as well as burials reflect an increasing social hierarchy. Earlier, the late very regular Celtic field systems from the last centuries BC already suggest a high level of territorial organization, at a date before we have access to textual sources. The statement of Tacitus about the Germans giving crops and beasts to their chieftains throw an interesting light on possible taxation systems within the barbarian societies (*Germania* § 15). The changing settlement systems fall together with new social frameworks and thus suggest some link between regulation and tribute in these oral societies.

Peasant societies in the 'barbarian' areas of Northwest Europe

In the 'barbarian' and in the later non-Christian areas, our knowledge of social organization and hierarchy relies on archaeological evidence. The settlement systems, burials, cult and monumental buildings are quite informative about the hierarchical framework and its ideological foundations. At first glance, the social differentiation may seem rather insignificant, and even the mightiest North European elites can hardly stand comparison with the upper levels of Roman or Frankish aristocracy. Nevertheless, the material evidence leaves no doubt that the mostly unstable and mobile barbarian societies were highly stratified. At the level of the village, the rather homogenous farmplots give the impression of an egalitarian society. The heads of the families are likely to have been free peasants. The crucial differences divided the inhabitants of the farmsteads; many may have been unfree. Tacitus emphasizes that free peasants and slaves grew up together (*Germania* § 20). It is striking that the greatest farmsteads include one or more buildings, and that the principal longhouse quite often divided into several rooms. Some, mostly large, settlements (e.g. Wijster, Bennekom, Feddersen Wierde, Flögeln or Vorbasse) have a higher status farm, where the number of buildings, the size of the byre and storage features surpass the ordinary farmsteads. In its heyday in the fourth century, the chieftain's longhouse at Vorbasse had about 30 stalls, compared to c. 15–20 in the byre of the other farms and traces of iron and charcoal production speak of specialized craftwork. It is noteworthy that this farm existed from the beginning of the occupation sequence and that it lasted for c. 300 years (or ten generations). Not far away rich graves with weapons and jewellery from the late second century probably contain the earliest inhabitants. The longhouse, where the living space and the byre shared the same roof was the principal building and nodal point of the farmsteads, even in the largest ones. The hall without livestock accommodation appears as a distinctive element of the outstanding high-status sites, notably Dankirke, Slöinge, and at the highest level, Gudme, Uppåkra, Lejre, etc.

At Feddersen Wierde, the so-called *Herrenhof* (the centre of a large estate) even had a hall, beside the traditional longhouse, workshops and other buildings (Jørgensen, 2003; Nissen Jaubert, 2007). The chieftain's farm at Feddersen Wierde, is probably one of the most northern examples of a significant presence of *terra sigillata* in a settlement context. It even surpasses Gudme, which is too exceptional to represent rural sites.

The economies of the sites of Gudme, Tissø, Uppåkra, Lejre and Uppsala must owe quite a lot to the agrarian production of the surrounding settlements and implies a system of tributes and levies. The emergence of these central places thus coincides with an increasing regulation of the rural settlements. It is particularly striking that the highly regulated settlements at Rindum, Rugmarken (Løgumkloster) and Præstestien from the fifth century, fall into a period where places of power, including the future dynastic place Lejre of the *Scylding*, are emerging. It should be noted the use of the mouldboard plough and the cultivation of rye seem to be more widespread during the same period (Agersnap, forthcoming). Again, the changing agrarian system and new planned settlements appear tightly related to the strengthening of territorial powers.

It is obviously impossible to estimate what the general level of levy was, but the degree of differentiation between peasants and elites, the size of the group of non-producers and comparisons with other societies – mediaeval societies in particular – suggest that levies were relatively small, perhaps around ten per cent of agricultural output. Peasants practised mixed farming with occasionally a significant development in respect of cattle rearing – especially in the area of the ‘long houses’ corresponding to North Germany, Friesland and Scandinavia. That type of farming was organized within a family context – not excluding free peasants living together with slaves – on the basis of common land, with rules for the use of uncultivated land determined by the local community. Communal arrangements included the sharing of arable land, livestock grazing rights, and rights to exploit woodland resources for temporary cereal crops, pasture and wood-cutting. With settlements being grouped in hamlets or villages, moreover, the morphology of land ownership is very difficult to discern from archaeological sources – written sources prior to the sixth century are non-existent for such aspects, and are very scarce for the subsequent period. However, in respect of their political, judicial and military functions, the elites exerted their domination primarily at the territorial level, with levy taking chiefly the form of tribute, justified by the obligation of hospitality and participation in judicial matters and war. The centrality of ‘royal’ power was of a personal nature.

Many elements of that model of social and political relations survived after the migrations in former ‘barbarian’ areas’, as well as in lands abandoned by, or conquered from Rome. There they combined with other social forms through acculturation or other forms of change, depending on the region. In the former Britannia, for example, abandoned by Rome after 410, the ‘Roman’ type of economy disappeared within one or two generations. Until the seventh century, the political entities that replaced it within the small Celtic or Anglo-Saxon kingdoms retained many features of the ‘barbarian’ model of domination of the countryside (Wickham, 2005). However, the impact on the farming practices of British peasants and on the countryside cannot be deduced from these political, economic and social phenomena: palynological research in Southwest Britain, indicates that cultivated plants continued to grow in the post-Roman period and that any recolonization by wild species after 400 was circumscribed. In a number of Welsh sites, wooded areas returned to their former state between AD 400 and 800 (Squatriti, 2004: 45)!

Peasant societies in the ‘Romanized’ areas of Northwest Europe

In the areas of the Western Empire delimited until AD 400 by militarized borders – the *limes* of the Rhine, the Danube, and Hadrian’s Wall, as much as in the rest of the Roman world, ownership of land was the basis of wealth, and large landholdings the basis of political power. The contribution of the countryside to the broader economy was very considerable in quantitative terms. The complexity of the Roman state and its bureaucratic machinery explain the extent of the transfers of wealth from the countryside. The weight of the elite groups as well as the densely populated and hierarchically structured urban network favoured industrial and craft production and its widespread circulation. The needs generated by the various social groups and the resources necessary for the State to function, including, for example, the pay and maintenance of the standing army (over 600,000 men), were provided for mainly from taxation (the main source being farming), thanks to the strong monetization that made it possible to assess and collect agricultural tax (Wickham, 2005 and 2010). That land taxation represented an appreciable share of agricultural income, probably in the region of 30 per cent in the fourth century AD

The Roman Empire did a great deal to shape rural areas, not only through the size of the levies, but also through the constraints exerted on population structures, through the morphology of land ownership and through the organization and the nature of agricultural production. Peasant farmers were systematically brought within a network of medium- to large-sized, directly managed agricultural centres (*villae*) (with an increasingly strong concentration of large farm holdings from the third century on), around which peasant family holdings gathered, whether isolated or grouped into villages, the *vici* (Ouzoulias, 2006). Although they are far less numerous than the future mediaeval villages, a lot of medieval boroughs or *bourgs* originate from antique *vici*. Very often burials and early Christian churches indicate that their religious functions were a decisive factor in their survival. This is confirmed by Gregory of Tours, who reserves the term *vicus* to localities with churches. Nearly all became parochial centres (Zadora-Rio, 2007).

Villae et *vici* were the nodal points in a network of scattered farmsteads. British field surveys show that, in certain regions during the fourth century, a hilltop fort or fortification could have acted as the hub of the system. Those *villae*, the largest of which also served as rural residences for the urban elites, organized transfers of wealth, in the form of cereals and animal proteins, through direct production and through land tax, and determined the places of power (marked by the monumental architecture of the *villae*) where rents and tributes were paid, labour service requisitioned and judicial matters heard.

The western provinces were characterized by extensive farming based on permanent fields and cereal crops, together with specialized produce intended for textile production, such as wool and flax, and where stockbreeding was also undertaken for meat production, for military and travel purposes (horses) and for hauling (oxen). The presence of Roman forces in the Rhine regions caused an excessive intensification of farming, even in *Germania Libera*. Extensive farming, accompanied by a significant opening up of the countryside to agriculture, in time brought about an overexploitation of soils and the formation of podzols; only the advent of mechanical tillage methods in modern times made it possible to develop those soils once again (Groenman-van-Waateringe, 1981). Many of the most well-known so-called Celtic Fields have thus been preserved in these areas. The integration of the countryside was also effected through the widespread circulation of consumer goods, mass produced and in mass circulation, such as coins, ceramics, building materials (bricks and tiles), tools, etc., so much so that one can talk in comprehensive terms of a Roman ‘economic system’. The excavation

of an ancient rural dwelling can yield thousands of fragments of broken imported ceramics and hundreds of coins, whereas that of its counterpart of the Early Middle Ages will turn up just a few bits of locally handmade crockery and a few coins (Ward-Perkins, 2005).

The collapse of the Roman economy in Northwest Europe

The chronology of the collapse of the Roman economic system varies greatly according to region. The collapse began at the end of the fourth century in Britannia (see above), in what today are the Netherlands and Northern Belgium. During the fifth century, after a gap of several generations, the effect spread in Northern Gaul. The Roman system lasted longer south of the Loire and, of course, in the Mediterranean regions, where aristocrats from old families were still enjoying the characteristic comfort of the Roman way of life in their rural residences during the sixth and even the early seventh century.

Subject to those significant differences in chronology, the evolution of the domination and transfers of wealth in the countryside at the end of that process of collapse deserves qualified analysis. Certain things disappeared completely: mass production and the extended circulation of everyday consumer goods typical of 'Romanness'; rural building techniques (with very few exceptions, i.e. all but construction with solely plant materials, wood, straw and earth); the model of the agricultural estate and supervised production represented by the large *villa rustica*. Many *villae* or secondary agglomerations lasted until at least some way into the Early Middle Ages. However, both the methods of building them and their spatial organization changed radically, bearing witness to a different social context based on small, family farming units. Moreover, these latter-day settlements were typically concentrated in the *pars rustica* of the *villae*. Tillage and stockbreeding activities were re-centred on family holdings, often located in small groups of a few dozen dwellings. Finally, land tax disappeared gradually, albeit more slowly to the south of the Loire, but in any case, not later than the beginning of the seventh century.

Other things evolved. The average size of livestock decreased substantially in the main species (cattle, sheep, pigs and poultry), with the exception of horses. Initially, that development was interpreted in catastrophist terms (loss of Roman technical expertise, livestock undernourishment). Today, it is rightly understood as being the result of not only the very strong decline in stockbreeding for slaughter (although there are examples of greater size in the early eighth century at the aristocratic site of Flixborough and at commercial sites in Great Britain and on the Continent: Loveluck, 2007: 122), but also the import of 'barbarian' models of cultural behaviour, and the search, within the context of family farming, for types of animal of a more robust stamp and better suited to hauling and to a feeding pattern based on *saltus* pasture and woodland pasture. Roman farming equipment and tools remained generally in use (with the exception of machines such as the *vallus* (a harvesting implement – probably for spelts – pushed by mules or donkeys), suited to extensive farming unconcerned about the extent of material losses during harvesting). The use of some equipment, such as the mill, even underwent widespread expansion from the Early Middle Ages on (see Devroey et al., 2013 and below). In the organization of road networks and the structure of rural landscapes, the Roman heritage seems to have persisted very strongly, the break from it occurring in Gaul in the seventh and eighth centuries (see below). Landscape archaeology has done a lot of work on Roman field systems (*centuriations*) and on systems of parcelling land by postulating the idea that the successive use of the same land division lines and of ancient or protohistoric roads indicates strong territorial continuity. Regional studies and the very many excavations of ditch-marked land divisions have revealed a much more complex picture. In

several cases, those boundaries were marked out before the Roman conquest, whereas others were laid out during the Early Middle Ages. (Chouquer andWatteaux, 2013).

Outside the Romanized world, the so-called ‘Celtic fields’ also provide evidence of a meshwork of cultivated lands several centuries before our era. Fossil fields, in particular those created by the podzolization of sandy tracts of land along the North Sea coast, concealed the late use of those systems in several places (Nissen Jaubert, 1995). A metrological study of fossil fields in Jutland revealed that they adhered to a standard unit corresponding to the Danish are (Eir). More recently, Mads Holst has convincingly drawn attention to the almost identical dimensions of Celtic fields and of the enclosures of the farms of Nørre Snede and Vorbasse of the third to the seventh century. Above all, it showed how the lines of seventh-century enclosures extended into settlement perimeters of the eighth to the tenth century (Holst, 2010). That observation makes it possible to understand how standard units could be preserved during settlement displacement. The importance of the farmsplot’s modules has also been previously noticed by E. Porsmose and B. Rømer who had compared the layout of occupations from the eleventh and twelfth centuries of Vorbasse and Trabjerg with the cadastral map of the late eighteenth century (Rømer, 1996).

Migrations (and not only those since AD 400!) and the intensity of all kinds of exchanges in border regions undoubtedly brought with them social and cultural influences, not to mention mutual innovation – factors that are often underestimated on account of the ideological implications of the confrontation between ‘civilized’ and ‘barbarian’ peoples. Here, brief reference can be made to the diffusion of crops (rye and oats), and of the tools and practices of tillage and stockbreeding (the mouldboard plough, the long scythe, ridge-and-furrow ploughing, crop rotation, forest customs, etc.) between ‘barbarian’ and ‘Roman’ areas (Hägermann, 1997; *contra* Henning, 2009 and see below)

The evolution of other elements of the Roman system of countryside domination is more ambiguous. That is the case, in particular for the importance and status of the large property, and the wealth and size of the group of elites. The comparison of funerary and settlement sites underlines the difficulty of gaining a full grasp of social categories and ways of life. Emphasis should be laid on the differentiation to be made between a) the existence of ‘large farm holdings’; b) the importance of a large and rich group of big landowners within the social landscape of the countryside; and c) the distribution by the king to nobles and ecclesiastical institutions of privileges to enjoy dues within a local or broader territory (on the model of tributes of hospitality and war). Like the *villa rustica*, the large farm holding under direct management had probably disappeared in Northwest Europe. The ‘landed’ patrimony of a Gallo-Frankish or Anglo-Saxon aristocrat of the sixth or seventh century formed a network of scattered properties and rights, centred around a few *villae* under direct management (albeit that their *inland* had greatly shrunk in area), and worked with the help of landless peasants, besides also serving (like the former *villae rusticae*) as places of power for collecting rents and dues, ‘demanding’ labour service and hearing judicial matters. The other part of that patrimony in fact derived from domination over peasants (and not directly over land): that could be ‘private’ domination based on personal relationships, on families of smallholders, ‘freemen’ or hutted slaves, settled in territories where their master did not own any *inland*; or ‘political’ domination within the limits of a territory, obtained as part of gifts for services or as a result of royal favour, which gave their beneficiaries a local position of power over the inhabitants and the enjoyment of dues and gifts of honour. The Church, even if its patrimony was not in essence organized differently, must be considered separately: in the first place, because the ideological, political and cultural continuity with Christian Rome was obviously much stronger; secondly, because, in theory, that patrimony escaped division by inheritance or alienation (but not always plunder), which put the interaction of landowners with the landscape and peasants into a different timescale; and thirdly, because of the

widespread diffusion of the collective way of life and farm production imposed by Benedictine monasticism (especially from the seventh century on), which encouraged the meeting of monks' needs through the management and the direct production of agricultural and craft resources (or through exchange) (Devroey et al., 2013), and organized production according to those needs (cereals, wine, etc.). As far as the size and the prosperity of the elites are concerned, which had a direct impact on agricultural transfers, Wickham rightly emphasized that Gallo-Frankish aristocracy enjoyed greater wealth (a fact stemming from the arrangements of the former local elites with the conquerors) than other regional aristocratic groups (Lombards, Anglo-Saxons, Danes, Saxons, etc.), which was precisely reflected in a greater domination of the countryside by the royal house, the Church and the secular aristocracy in the heart of Francia, unlike the situation in other regions, where free peasants had a much greater hold on land and much greater autonomy.

Economic trends and social agro-systems during the Early Middle Ages: abatement and intensification

The end of the 'Roman system' is characterized today in terms of 'involution of the productive complexity' and 'abatement' (fifth to the seventh century), within an overall context of profound demographic decline (Devroey and Nissen, 2011), whereas the subsequent period is generally seen as a time of growth. The decline of the levy and the involution of State and aristocratic networks resulted in peasants enjoying greater autonomy in the organization of their activity and the orientation of their production. The factors of that equation for peasant farmers had to be expressed in the increase in consumption and in family investment in land, livestock and tools or in a decrease in the amount of work, or in both: for example, by giving priority to breeding activities, which are less labour-intensive, to the detriment of cereal growing (Horden and Purcell, 2000: 153–172; Ward-Perkins, 2005: *passim*; Wickham, 2005: *passim*).

The signs of a phase change, with the progressive reversal of that trend of abatement, increased in Northwest Europe from the seventh century on, such signs being the demographic revival (Devroey and Nissen, 2011), and the complexification of exchanges (see Devroey et al., 2013) and political structures (Wickham, 2010). From the late eighth century, these were dominated by the military expansion of Frankish power northward as far as the *Dannevirke*, and eastward as far as the Elbe and the Danube, with that hegemony culminating around 800 in Charlemagne's empire. During the same period, the Anglo-Saxon kingdoms became progressively unified under the hegemony of Mercia and subsequently, at the end of the ninth century, Wessex. In the same way as the Austrasian supremacy on the Continent, the Mercian supremacy had firmly developed the structures of royal power, and linked the episcopal network more closely to government (Wickham, 2009: 455). Two different illustrations of that concentration of wealth and power – modifying 'the social imperative' – may be mentioned, relating to several areas of the great North European plain. In Denmark, we also see signs around 700 of a broader political system, creating the trading centre of Ribe (705–710), in parallel with the English, king-centred emporia of the eighth century. For a long time, Danish archaeology explained the emergence of the emporia, first of all at Ribe, then Hattabu, Kaupang and Birka, by the strengthening of a royal power. These theories are the subject of current debate (Nissen 2012). However, even if the earliest trading place of Ribe may derive from a local initiative (Feveile 2006), chronological coincidences with great, monumental building sites plead in favour of new social frameworks accompanied by new economic infrastructures and military works to ensure territorial defence.

Dendrochronological dating (737) and stratigraphical observations show that the eastern rampart and the stone wall of the *Dannevirke* were added in the early eight century (the oldest wall goes at least back to *c.* 500). Their construction is contemporary with the digging of the channel at Kanhave *c.* 726. A similar demonstration of the strength of royal power was Offa's Dyke, an earthwork more than 100 km long dug between the Severn estuary and the Irish Sea by the king of Mercia to delimit the border with Welsh territories. The purpose of both those earthworks was not solely military; they also represented demonstrations of the sovereign's power in disputed regions and a means of placing trade with the outside world under royal control.

The return that began in the 'long eighth century' to stricter forms of countryside management was also manifest in the desire of royal rulers to set the taxes and duties levied on peasants within a legal framework and thereby standardize them. The famous passages of the laws of the Alemanni (beginning of the eighth century) and of the Bavarians (740–748) fixing customary practice in respect of smallholders and *servi* of the Church probably drew their inspiration from lost Merovingian royal edicts dating from the seventh century. The Frankish texts concern not only the taxes to be paid in kind, but also the form and the amount of labour service. In 800, Charlemagne also intervened through a judicial order to determine the conditions of the performance of ploughing duty and the maximum amount of work that could be required of smallholders and serfs on the domains of the king, his vassals or the Church (Devroey, 2006: 528–540). In the kingdom of Wessex, King Ine had the content of the royal dues of hospitality and war (the *feorm*) for ten hides inserted into a late-seventh-century law. That meant a dual standardization, namely the rate at which those dues were to be levied (the rate of burden) and the way in which the respective shares of the dues were to be assigned to the different parts of a territory (Faith, 2009). These practices were made possible by the definition of a common unit of taxation, the *hide*, which corresponded to a family holding. With that very simple tool (and with its contemporary Frankish counterpart, the *mansus*), it was relatively easy to levy dues on the basis of methods of allotment of burdens; to determine the endowment of a church or a monastery; to standardize peasants' obligations within the framework of tenure, within a local area or even among several properties; to determine the economic value and the capacity of a territory; or to mobilize workers for the building or maintenance of fortifications or bridges. The simultaneous appearance of the *mansus* and the *hide* in laws and royal charters in Francia and in England in the seventh century and the standardization of dues reflect, in the same way as the major earthworks, the vigour of central power, and the aspiration of sovereigns to affirm and give material form to their authority, besides their capacity for administering the countryside and mobilizing peasants (Squatritti, 2002: 40; Devroey, 2006: 421–425). This shift led to an intensification of the overall levy on the peasant economy, obviously foreshadowing stricter countryside management by the aristocracy and more intensive farming practices (see below). It is tempting to connect the appearance to the *bol* (settlement) and the *toft* (*homestead*) in Scandinavia to a similar regularization with an unwritten system of land management and levies, but the written evidence is scarce ((see Myrdal and Porsmose in this volume).

The great North European plain during the Early Middle Ages may therefore be broken down, historically and geographically, into regions determined by the basins of the major rivers (the Seine to the west, the Meuse and the Rhine) flowing into the sea corridor of the Channel and into the North Sea. Northern Gaul and Roman Germania formed the heart of Frankish power, the broadest and the most powerful political entity in Northwest Europe between the sixth and the beginning of the ninth century. The ninth and tenth centuries witnessed new, dynamic, geopolitical areas coming to the fore: one was Germania, which continued Frankish political and economic expansion towards the Slav East and controlled the Rhine basin; another was the area around the North Sea and the Channel, where new, dynamic

poles crystallized, stemming from the dislocation of western Francia (Flanders, Normandy), from westward Scandinavian expansion (England, Normandy) and from the unification of Anglo-Saxon kingdoms around Mercia (England).

2.2 Natural Constraints: climate and society

The emergence since the middle of the twentieth century of new methods of investigation of ancient environments has made it possible to increase the information base. The resulting enhancement of knowledge obliges the historian to leave the relatively 'simple' field of causality to learn about the complexity of natural phenomena – climate, for example – and their interaction with rural landscapes. Current research by climatologists emphasizes the natural variability of climatic phenomena, due to the complexity of climatic parameters (temperature, humidity) and spatial variability (according to regional conditions of the climate and the circulation of marine and atmospheric currents). Reasoning on the basis of models with global or hemispheric implications therefore has little sense for the historian and the archaeologist whose work concerns subtler spatial and chronological dimensions (weather/climate). On a sub-regional or even local scale, concepts introduced by the first palaeoclimatologists, such as those of the Medieval Warm Period (MWP, AD 950–1200, according to Lamb, 1995), of the Little Ice Age (LIA, AD 450–1850, according to Grove, 1988), and even, recently, of a Dark Ages Cold Period (AD 500–700?, see Cheyette, 2008), are 'simplistic and indeed incorrect' (Jones and Mann, 2004: 58–62). It is preferable to work in calendar years and to specify the region concerned and the geographical parameters of the climate: for example, a decrease in the average yearly temperature by 1.5 °C would not have had the same influence in Scotland, where the upper limit of crop cultivation is situated at 300 metres above sea level, and in the Alps, where that limit is situated at 1000 metres (Grove, 2002: 313–314).

With their overall trend value, the amplitude of average temperatures apparently would have fluctuated by about 1.5 °C only in the Northern Hemisphere during the period AD 800–1400, whereby the temperature would have been slightly warmer (by a few tenths of a degree Centigrade!) than during the periods AD 200–800 and AD 1400–1900. The coldest centuries in Europe were the sixth, the fifteenth, the seventeenth and the nineteenth (Jones and Mann, 2004: 63–64); warm peaks occurred around AD 1000 and 1100 (Moberg et al., 2005). Within those periods, however, there is a very broad temporal variability, connected more particularly with fluctuations in solar irradiation. Heavy concentrations of aerosols from volcanic eruptions may result in severe temperature reductions by more than several degrees Centigrade for several years running; the pattern of winter atmospheric circulation variability, related to the position of the North Atlantic Oscillation (NAO) and the Arctic Oscillation (AO) in the Northern Hemisphere, can cause very considerable seasonal anomalies. Written sources preserve the trace of such events: for example, Prudentius of Troyes mentions the incidence of winds from the North during the entire winter of 846, until the beginning of May, throughout Northern Gaul, with disastrous consequences for cereal harvests and wine harvests (*Annales Bertiniani*, 846).

However, one should beware of any natural determinism. Palynological and geochemical analyses make it possible to show that interactions between man and nature depend on many other factors (Coombes et al., 2008): the climate interacts with human activities; the connection between climate and societal response therefore proves to be a good tool for the use of historical and physical data about ancient climatic events.

AD 500–600

The sixth century appears to have been one of the coldest and rainiest centuries, according to climate models for the Northern Hemisphere. Excellent data exist for the south of our region (the Alps, Northern Italy), confirming a significant expansion of the glaciers in the Alps, with a substantial increase in sedimentation, related to very strong erosion in the Rhône and Saône valleys, as well as in Italy, in the Tiber and Po basins; in this respect, disastrous floods are mentioned in Italian written sources and contemporary sources from Southern Gaul. In the late sixth century, the devastating flooding of the Po created such an upheaval that, until the nineteenth century, the appearance of the area was transformed, its low plains being turned into paludal marshes and forests from which the city of Modena emerged like an island (Squatritti, 1998; Devroey, 2003: 24–26; Cheyette, 2008). Northern Italy had to wait until the eleventh century, with the emergence of municipal power in towns, before society was capable of exercising control over water again.

In Iceland, a period of cooler conditions – from AD 400 to 600 – in which both summer and winter temperatures displayed the same variability, is associated with the unfavourable position of the North Atlantic Oscillation (NAO) and the strength of the Icelandic Low (measured by the carbonate values of the molluscs embedded in marine sediments) during that period. Iceland experienced very rapid and early warming (albeit spatially limited), with a warmer peak in AD 640 (a yearly average of 12 °C), which is the highest measurable for the last two millennia (Patterson et al., 2007). Iceland was settled by Vikings, from Norway and the Northern British Isles in AD 865–880 (displacing the Irish monks probably present since the seventh century); this was two centuries after the appearance of warmer climatic conditions in the high latitudes. Greenland was settled a century later (AD 985), by a small group of Icelanders, probably not for climate-related reasons, but because they had to leave Iceland for mainly political and economic reasons.

Regional pollen diagrams are the best indicators of changing landscapes and habitation movements. The strong growth of beech noted in the Ardennes also indicates a colder and wetter climate (Noël, 1990). Grazed forests, too, favoured beech distribution, since cattle prefer the shoots of other trees, those with a less acid taste, such as oak (Rackham, 1990). Most regions are characterized by strong reforestation and by the abandonment of plateau sites, previously occupied by the ancient *villae rusticae*. Those movements of habitation in favour of mid- or top-slope sites are typical of most early medieval settlements. In Southern Scandinavia, this movement goes back to the first centuries of our era (Nissen Jaubert, 1996), whereas the abandonment of plateau farming in the (Post-) Roman world began in Late Antiquity and went on during the following centuries. The changing topographical preferences probably reflect the increasing importance of breeding and easy access to pastures and hay meadow in the wet areas favourable to the breeding of cattle. In Belgium and Northern France, the continuity of occupation of some characteristic places is generally very strong in the areas most densely populated during Antiquity. Those areas of habitation retained their agricultural purpose, but the cultivated areas shrank quickly and probably substantially. Reforestation of the remotest former farmland also made it possible to concentrate farming activities and manuring around dwellings and ensure forest regeneration, which was important in particular for winter fodder and temporary crops, especially in northern regions. The replacement of a network of farming activities under the firm control of large and medium-sized landowners by communities of more autonomous peasant farmers, grouped in hamlets or villages, shifted the balance and the complementarity between arable and pastoral, thereby serving to enhance the attractiveness of wetlands, propitious to the development of mowing meadows and woodland-pasture. Archaeozoological and

paleobotanical studies in Northern Gaul point to a more diversified culture. The increasing frequencies of vegetables rich in azote as well as oat and rye, probably used as forage, goes with a growing importance for sheep in Île-de-France and cattle in Northern Picardy and Nord-Pas-de-Calais. The pig, easily adaptable to smaller households dominates the Nord-Pas-de-Calais and Alsace, whereas the bones of cattle are often more numerous in Picardy and Île-de-France (Ruas and Zech-Matterne, 2012; Lepetz and Matterne, 2003; Yvinec 2012). The colder and wetter weather of the sixth century must therefore be counted among other crucial factors that influenced farming activities. These included a very marked decline in settlement sites in the western provinces of the Roman Empire – i.e. compared with the maximum densities attained in the first and second centuries AD, but which increased strongly from the third and fourth centuries – accompanied by a probably very profound demographic decline, although impossible to quantify (for more details: Devroey and Nissen Jaubert, 2011) and a social and political crisis that destroyed the exclusive domination of the elites associated with the Roman State and fuelled the disintegration of the network of *villae rusticae*.

An uncertain climate (AD 600–900)

At the present time, models or data for Northwest Europe to allow measurement of the variability of average temperature and humidity parameters on a centennial scale, prior to the warm peaks of AD 1000 and 1100 (Moberg et al., 2005) are just emerging (Buntgen et al., 2011). After the expansion of the glaciers in AD 500–600, alpine glaciers exhibited a synchronous advance in AD 800–900, which probably indicates regional, climatic conditions (cool/wet) favouring glaciers, but which remains very difficult to interpret (Holzhauser et al., 2005: 797). Data concerning Scandinavian glaciers are more scattered: they show great variability in fluctuations on a decennial scale, without indicating any spectacular advance for the AD 800–900 period (Grove, 2002: 315–316), which is even considered by some people as having been one of the warmest periods in the last two millennia, on the basis of a positive NAO (McCormick: 874, according to Meeker and Mayewski, 2002). The key word for the history of climate from AD 600 to 900 could well be ‘instability’, with strong interannual and seasonal variability of temperatures and humidity. McCormick et al. (2007) compared the instances of extreme, multi-regional winters during the AD 750–950 period, with pollution markers in the GISP2 ice core (Greenland). Pollution peaks caused by sulphates indicate massive emissions into the atmosphere, as a result of volcanic eruptions. Such events can bring about decreases in average temperatures by several degrees Centigrade for several years. The results show a good correlation coefficient between sulphate pollution, harsh winters and famines. A passionate discussion got under way in Flaran in 1988, around the interpretation of the data collected from annals by Curschmann (1900), data that indicated a regular recurrence of famines between the eighth and the eleventh century (a famine every six of seven years, on average), during a time currently considered by a majority of historians as an extended and sustained period of agricultural growth in Europe. During the forty-six years of Charlemagne’s reign (768–814), instances of famine and human and animal over-mortality are recorded as having occurred every four years on average! Bonnassie and Toubert proposed that such instances should be interpreted as accidents of growth, which might express the offset between a rapidly increasing population and a rigid social and economic structure, jeopardizing the adjustment between resources and population (Bonnassie, 1990).

The indications provided by McCormick show that serious account needs to be taken of the incidence of such climatic events as the regional impact of volcanic eruptions on solar irradiation, but more elaborate and more detailed analyses have yet to appear.

The general imposition of the compulsory tithe from 765 onwards (Devroey, 2009) introduced a public levy for the benefit of the churches, which saddled peasants with an additional ten per cent tax on the produce of their crops and stockbreeding, although there was a degree of local redistribution, such as the help provided to the poor by the parish (theoretically a quarter or a third of the proceeds). The tithe played its role in the determination to squeeze greater wealth out of the countryside and in the general process of the exertion of intensifying pressure by the elites, which – in a second stage – appears to have stimulated agricultural production in Carolingian times. The imposition of the tithe also played a major part in the system of internal stratification of peasant societies. The tithe encouraged the emergence of local players who handled and retained a portion of the resources it generated, and who indeed came to appropriate those resources unduly. It formed a target (a motive for location) for the activities of the lower strata of the aristocracy in the tenth century, activities that were expressed in the monopolizing of powers of military protection or of judicial prerogatives and parish rights. Those phenomena, in turn, had economic repercussions at village level, with the transformation of the forms of levy, investment and local consumption of wealth, consequent on the regular presence of the aristocracy in the countryside. In the Frankish heartland, Serris les Ruelles or Villiers-le-Sec illustrate rather well this type of social stratification within the rural settlements. Spacious well-constructed buildings, glass vessels, riding equipment, weapons as well and the consumption of meat from young animals, pigs and even peacock (Lizy-sur-Ourq) tell us about the elite way of life. Workshops for textile and metal as well as massive storage accommodation (silos, granaries...) inform us about the economic foundations and the accumulation of yields, notably at Villiers-le-Sec and at Distré, in the Loire Valley (Gentili and Valais, 2007). t. At the scale of the rural settlement, the analysis of the storage pits at Villiers-le-Sec in the region of Paris revealed significant concentrations near the site of the manor house. These concentrations of silos have been observed in other areas – in Southern France recent discoveries of Carolingian sites with outstanding storage capacities seem related to ecclesiastical sites (Schneider, 2010). The distribution of kilns at Villiers-le-Sec gives another hint of increasing seigniorial control. During the seventh-ninth centuries, they are distributed around the settlement, but in the tenth century, the village the only kiln – great and well-built – was on the site of the manor (Bruley-Chabot, 2006). The large kiln inevitably recalls the later seigniorial constraints on baking bread. It is interesting to note that many large farmsteads or manors emerge roughly in the same timespan as the growing regulation and nucleation of settlements. Even if many property boundaries and field limits originate in Antiquity or the Iron Age, they are developed and densified from the late seventh century on, and it is only from this period that the settlements in the Frankish area are planned and regulated on a large scale (Nissen Jaubert, 2012, 2013). It is significant that the recent excavations in village centres and near the churches reveal a continuous occupation sequence since this period (Gentili, 2011). Other chronological trends are noted in the Southern Netherlands, e.g. Kootwijk, Dommelen and Geldrop. The two latter sites, from the Campine area may bear evidence of a new manorial (Frankish) organization and large ecclesiastical estates (Theuws, 1999). It is noteworthy that planned hamlets and villages emerged nearly 400 years before in the peripheral barbarian societies, and since at least c. 250 in the Drenthe region north of the Rhine (above). Nevertheless, the settlement system also changed in the northern part of Europe c. 700 – the planned settlement became more widespread and the farmsteads larger. It should be noted that in these areas, the number of farmsteads declined, but their surface area dramatically increased.

Other emblematic texts of the ‘agrarian policy’ of the first Carolingians have been rightly put within the context of the social requirements developed by the ‘programmatic’ capitularies of the years 769–797: the maintenance of law and order, stability and peace, and the reform (*correctio*) of Christian society in its entirety. The *Capitulare de Villis* set out how

the needs of the Carolingian king were to be met from the resources of a network of royal *villae* specially designed for the purpose, on a model of ‘good governance’ of the domestic economy of the countryside. It was close to the spirit that motivated texts such as the *De ordinatione palatii* written by Adalhard in 780 or the statutes of 822 (after two years of overabundant rainfall and a cold summer and the harsh winter of 821–822, as recorded by the chronicles; a peak in GISP2 sulphate deposits for 822–823, the highest in the ninth century; and an advance in the Lower Grindelwald glacier in Switzerland, accurately dated by dendrochronology to the years 820–834). What micro-history enables us to do here is to connect episodes of rapid climate change directly with harvest failure and, above all, to measure society’s response to those challenges, a response that was a mixture of regulatory measures, charity, efforts on the agricultural production front and the increased burden of levies weighing on peasants.

AD 900–1000

The decline in the output of written documents in the West makes it impossible to extend intensive analysis of this kind. Palaeo-climatologists date two warm peaks to around 1000 and 1100 (a time traditionally associated with the MWP), but with strong decennial and regional variability, as is also indicated by the frequency of widespread famines (Curschmann, 1900) and considerable regional diversity (Moberg et al., 2005). For West Central Europe, cross-matching of written sources and dendrochronological data points up the rapid alternation of periods of heavy rainfall (896–910, 942–944, 1003–1033) and of drought (921–941, 974–1003, 1033–1035) (Falque-Vert, 2004: 16–19). An illustration of this is that the people who settled the well-known site of Colletière (in the foothills of the Alps, France) on the shore of Lake Paladru around 1005, after a long period of drought, were forced by rising waters to thoroughly restructure their settlement from c. 1020 and indeed to abandon it sometime between 1035 and 1050. That climate instability further emphasizes the need for a regional or local approach to interactions of climate with rural landscapes and farming practices, and for a careful study of social response. Some of the measures taken in 1125 by the Count of Flanders, Charles the Good, renewed certain aspects of Charlemagne’s agrarian policy (intervention in the production of bread, distribution to the poor); others clearly indicate changes of scale and phase in the development of mediaeval agro-systems: 1) polarization of the economy around the town (in the wake of which the poor flocked to the towns to beg for their food); 2) marketing and interregional circulation of farm produce (the Count, who had banned the production of *cervoise* (barley beer), simultaneously froze the price of wine, in order to divert merchants to the purchase of food); 3) diversification of crops (he ordered that one measure of land be sown with vetch and peas for two measures sown with cereals).

2.3 Technology, agro-systems and agricultural development

In general, historians of techniques typified the pre-industrial societies of temperate regions as having a low level of agricultural productivity. After a long period characterized by very low and abnormal output during the Early Middle Ages (AD 400–950), the adoption of heavy draught tillage and the three course system of rotation would seem to have brought about results two to three times higher being achieved by the end of an ‘agricultural revolution’ (AD

950–1100). Except in regions of intensive agriculture, such as Flanders (Thoen and Soens in this volume), output would have stagnated at that level until the mass introduction of mineral fertilizers in the nineteenth and twentieth centuries. These general statements need adjustments, nuances and clarifications as will become clear in the following paragraphs.

Debating technological innovations, population and agricultural development

Marc Bloch and Roberto Lopez viewed demographic growth and social mobility (leading to land clearance) as the factors triggering the development of mediaeval Europe (Lopez, 1976: 30–33). In the 1960s, with the spread of neo-Malthusian ideas, other historians gave the leading role to technical progress; the fact that decisive innovations, such as the heavy plough, the shoulder-collar harness and use of the horse, and the three-course system of rotation, were already being employed during the Early Middle Ages would have enabled heavy draft tillage to become widespread and so break the output ceiling and therefore feed a growing population (White, 1962).

The great study by Duby, published in 1962, represents an epistemological turning point in that it situates the causes of the West's economic growth *within* the rural world. With his contemporary, Jacques Le Goff, Duby presents ruralization – ‘an economic event, a demographic event [...], a social event’ – as the decisive element in shaping the face of mediaeval society (Le Goff, 1964: 51–53). He takes into account the importance of technological innovations, but delays their main development and exploitation to the eleventh and twelfth centuries. According to him, to understand rural growth, this technical factor needs to be combined with the social dimension; in the final analysis, growth is explained by ‘the pressure that seigniorial power exerted on productive forces’. ‘The expansion of mediaeval Europe, all the demonstrations of exuberance that stood out brightly after the year 1000, the demographic advance, the rebirth of towns and trade, the consolidation of political order, together with the blossoming of culture, undeniably originated in *agricultural success*’, to adopt an expression by Fernand Braudel, (Duby, 1967: 267). Since the 1980s, however, Duby's hypotheses have been subject to criticism from all sides, albeit that a very broad consensus had emerged regarding them.

The history of techniques has become a discipline in its own right. Its specialists, by drawing on ethnology, agronomy and the increasing information provided by archaeology (especially by experimental and landscape archaeology), have emphasized the continuity of the technical know-how of Antiquity and the Middle Ages, the systemic nature of technologies and agricultural practices, and the slowness of these in spreading (Astill and Langdon, 1997), perceptions that are incompatible with the notion of a ‘mediaeval agricultural revolution’, which indeed was abandoned by Duby in 1991 (Duby, 1991: 97).

Duby had, so to speak, contrasted the rural society of the Early Middle Ages with the growth experienced in the eleventh and twelfth centuries. This minimalist view dominated research into the post-Roman countryside of North West Europe, which is a quite interesting contrast to Northern Europe, where, especially in Scandinavia but also in Frisia and Northern Germany, the previous centuries appeared and still appear as a period of expansion. The economy of the post-Roman rural world would seem to have been one of arduous and primitive subsistence, dominated by man's unequal fight against the forces of nature. Set within a Malthusian trap, the countryside was divided between ‘very imperfectly farmed empty spaces’ and ‘pockets of overpopulation, where biological growth stimulated by agrarian prosperity pushed people to the edge of poverty [...]’. The probable natural trend

towards demographic expansion collided with the seizing-up of productive forces [...]’ (Duby, 1962: vol. 1, 69). A profound change was needed if that long stasis was to be resolved. It was, as Fossier wrote in 1982, ‘the break-out (from technical constraints) that gave birth to Europe by enabling an expansion in food production that would become simply a boom. And since that break-out was categorical in the three ‘sectors’ (of the economy), the word revolution does not seem to me to be too strong in this case either’ (Fossier, 1982: vol. 2, 615). Since the 1980s, that tragic picture has been combated by an increasing number of historians and archaeologists who – in turn seizing the fertile concept of ruralization – have pleaded for the dynamism of agriculture and placed the ‘spurt’ put in by North West Europe as having begun in the eighth or even the seventh century (Verhulst, 2002; Toubert, 1990).

At the same time, moreover, habitat and landscape archaeology has provided a fresh view of available data. For instance, it has shown that the most of the early mediaeval sites north of the Loire date from the seventh to ninth centuries. It is an amazing contrast to the Mediterranean area, where the settlements from this period are remarkably few. This may partly be explained by a topographical anchoring of rural settlements in the South. North of the Loire the size and internal organization changed a great deal from what they had been in previous centuries. The layout is often more regular and quite often reveals a communal organization, e.g. through specific collective areas for storage or kilns (Nissen, 2012). These features show that rural communities in the Early Middle Ages were neither economically isolated nor socially undifferentiated, revealing, rather, the complexity of economic and cultural interactions at local and interregional level in North West Europe. Furthermore, the power and the wealth of the aristocracy and of the Church were becoming increasingly based on the farm surpluses generated from land resources and the territorial domination exerted on peasant farmers (Hamerow, 2002: 2–4).

Outside the Romanized – and latterly Christianized – world, settlements and their surroundings developed differently. The countryside there experienced a profound transformation from the end of the second century. In Northern Germany and the central parts of the Jutland peninsula, settlements and farms increased in size. They were surrounded by regular enclosures, and the long house they featured made it possible to house a larger number of livestock. Certain sites, such as Frederiksdal, reveal that the conditions for that transformation began gradually to fall into place from the first century on, the transformation speeding up considerably during the decades around AD 200. Those regular farm plots are observed towards the middle of the third century in the regions around the *limes*, especially in the region of Drenthe. In Southern Scandinavia, changes in habitation coincided with the emergence of warlike elites in a period of conflicts, as attested by the building of maritime barrages and the great sacrifices of weapons, as at Illerup, Vimose and Nydam (Hedeager, 1992). Both in rural settlements and at such central locations as Gudme, Dankirke and, a little later, Uppåkra, Tissø and Lejre, there is evidence of a stronger social hierarchy, more particularly of the elites holding themselves apart, as evidenced both by the imported objects in those sites and within a funerary context. The late sixth and seventh century has for a long time been particularly difficult to delimit in Southern Scandinavia, whereas the ship burials of Vendel and Valsgärde, together with the great tumuli of the royal site of Gamla Uppsala, clearly bear witness to the dominance of a warlike aristocracy in Central Sweden, which also appears to have been engaged in the production of iron. The intensive research on central places during the last two decades leaves no doubt that significant places of power existed during these centuries. In reality, changing funeral practices and large chronological margins of ceramics have created a chronological lacuna, which the re-expansion of natural forest seemed to confirm. Nevertheless, the beech became far more important, most likely because the wood was cultivated. The layout of the settlements changed *c.* AD 700 – they generally numbered fewer farms, but the plots were distinctly larger than those of the previous

centuries and they encompassed far more buildings. In Southern Scandinavia, these transformations were approximately contemporary with such large military works as the *Dannevirke* and the Kanhave canal or even the emergence of commercial centres at Ribe and Hedeby, and of many trading places. All these features indicate the establishment of more powerful territorial authorities (at least during certain periods), accompanied by a strengthening of economic infrastructures that also affected rural settlements. Unlike those of previous centuries, these settlements also reveal domestic imports, such as querns from the regions of the Rhine and steatite vessels from Southern Norway and Central Sweden. The thick layers of manure at Ribe bear witness to the passage of large numbers of livestock, indicating a large scaled trade of cattle (Feveile, 2006).

The question of the players involved in that 'initial expansion' and the increase in agricultural production is still open today. Opinions on the cause of that expansion vary from a) 'top-down' pressure from the State system and the aristocracy (Toubert, 1990); to b) the 'bottom-up' creative response of peasant farmers to the pressure of hunger, whereby the area devoted to agriculture was extended to more difficult soils through the slow spread of new techniques (Bonnassie, 1990); or to c) the pressure of demand fuelled by consumption by elites and the dynamism of trading networks (Wickham, 2005).

Under the influence of the ideas of the development demographer, Ester Boserup, Malthusian mechanisms were gradually abandoned. Her work had a great impact on Scandinavian archaeological research, which uses her both to explain changes in agrarian techniques and settlement organization, and to reflect on the demographic support for the development of commercial centres and then towns (Boserup, 1981). Once the rise in production was under way, bringing about a retreat of hunger, the population grew, in turn making it possible for there to be a further expansion in production with self-reinforcing sequences among the various factors (Boserup, 1965; Baschet, 2004: 96–97).

For a long period, rural historians have remained faithful to a systemic, stage-by-stage approach to the development of agrarian societies changing from systems with fallow fields cultivated with light draught tillage to systems of fallow fields plowed with heavy draught tillage (Slicher Van Bath, 1963; Mazoyer and Roudart, 2002). This implies a form of evolutionism. Influenced by German economic history and historical geography, Slicher van Bath considered the Early Middle Ages as a 'natural economy' (*Naturalwirtschaft*) characterized by 'direct agricultural consumption' by small producers and landowners. The transition from Antiquity to the Middle Ages corresponded to a change in agricultural practice. It was the pressure of demand, consequent on demographic growth, that stimulated agricultural production and opened the way to urban development and the appearance of a market for indirect consumption by non-producers. In the sixth century, when the climate became wetter, according to Slicher Van Bath 'went over from the Celtic walled fields (a type of square fields) to strip cultivation, with which better drainage was secured'. Further, Slicher van Bath judiciously opted for a high chronology for the appearance of the wheel-plough with fixed mouldboard. During the eighth century, in densely populated areas, peasants 'changed over to a free three-course rotation, which resulted in an increase in the production of food for human consumption'. With the tenth century came 'the introduction of improved harnesses, which enabled horses to be used for ploughing [...]'. Rediscovering Malthusian causal chains, he concluded that 'In all likelihood, it was through this augmentation of the sources of energy that the ensuing rise in population from the eleventh to the thirteenth century was made possible' (Slicher van Bath, 1963: 64). The notion of 'social agro-systems' makes it possible to break with the linearity of this 'genealogical-like' evolutionary mapping, by showing how different agrarian systems can develop and evolve in space according to soils and specific social relationships (ownership and power structures, work arrangements, the economic strategies of farmers and landowners), which determine the modes of production and

development in a region (Thoen, 2004). Agrarian archaeology shows how several technical ‘agro-systems’ were able to exist alongside one another or dovetail within the same space over the very long term: for example, how, until the nineteenth century, temporary farming practices in forest environments came to complement other production strategies in mixed farming regions dominated by stockbreeding. The picture of the countryside that we can propose today is thus more varied than before and places less emphasis on technical innovation (i.e. in terms of invention, as Duby or Llyn White did) than on the adoption and the diffusion of farming implements and practices, and the way these were combined regionally in time and in space. These implements, draught animals and new farming practices did not spread throughout the entire agricultural area, land closest to the settlement remaining devoted to intensive farming by hand. Furthermore, the ard and the plough existed together in the same localities, depending on farming practices and farm equipment. Among the other features of this picture was the debate regarding the superiority of oxen over horses for ploughing, conducted by agronomists as late as the mid-nineteenth century.

In respect of agricultural technology, one therefore has to go beyond the view that considered processes of change in the mediaeval countryside in terms of a ‘technological complex’ (plough, shoulder-collar harness, three-course system), and rapid and simultaneous changes in land use. In line with Marc Bloch’s reflections on the mill, it is important to emphasize the progressive spread of plants and production tools and techniques throughout the first millennium AD, rather than their ‘invention’ at a particular point in time. Since the Iron Age, there has been considerable continuity in the quality and nature of tools, especially agricultural implements, throughout Northwest Europe (Nissen Jaubert, 2006, Henning, 2009), albeit that notable variations have been observed in the same geographical areas: for instance, traces of the plough being used before our era have been noted in the Netherlands and in Lower Saxony, then a few centuries later in Western Jutland. Recent research suggests that the mouldboard plough became current in Denmark in the fifth century, when the culture of rye became more widely diffused (Agersnap Larsen, forthcoming). It is fascinating to note that the growing use of the plough coincides with the emergence of new territorial powers – or petty kingdoms – and a new type of regulated settlement (above). The presence of the plough does not mean that the ard had been abandoned. The adoption of one tool or the other depended on several factors that we have difficulty in grasping.

The availability of iron and metallurgical techniques

One of the main arguments for the ‘pessimistic’ view concerning agrarian technologies in the Early Middle Ages in fact revolved around the scarcity of metal implements, as posited by Georges Duby on the basis of the analysis of the royal estates of Northern France (*Brevium exempla*, c. 800). In the inventory of the principal of these estates, the palace of Annappes (France, Nord), researchers apparently found, alongside bronze and iron utensils for the fire, lighting and cooking, only the tools of the woodcutter and cartwright and a few farming implements, together with ‘wooden serving utensils’. For Duby, the workers of that enormous estate, one that boasted almost two hundred head of cattle, had only a few iron tools available to them, plus basic implements for making other objects, albeit in wood (Duby, 1962: 77–78). He concluded, moreover, that the effectiveness of such tools and implements would have been middling. The small number of metal objects abandoned on the sites of rural settlements bears witness to recycling practices precisely related to the scarcity of raw materials. The idea of a veritable ‘iron famine’ during the Early Middle Ages, which gained ground in the wake of Duby’s works, has formed one of the strongest and best accepted arguments by historians in support of a low estimate of the production capacities of Carolingian agriculture (Chapelot

and Fossier, 1980: 24). By contrast, those works had little effect on research in North Germany: first and foremost, because there were very significant political and cultural differences in the Early Middle Ages; secondly, because the lack of written sources led to a disciplinary fault line between mediaevalists and protohistorians. The lack of archaeological sites from the sixth and seventh centuries in North Germany was, and sometimes still is, explained by Anglo-Saxon migrations; however, an increasing number of sites and paleo-environmental data testify to a period of agricultural expansion (accompanied by a continuous opening-up of landscapes) during the period from the eighth to the twelfth century.

Duby's ideas have been the subject of a later revision by Verhulst, which indicates that metal implements were not as scarce as once thought (Verhulst, 2002: 76–78). In the first place, Duby did not inquire into what exactly was inventoried in the famous list of Annappes. Far from being a record of the store of implements of a large seigniorial farm, the text should be interpreted as a list of utensils intended not for farm work, but to be carried by the host (or campaigning army), in carts containing, besides provisions, clothes and weapons, all the gear the Carolingian army on the march needed for camps and siege work. Those objects had to be kept in good condition by each of the intendants in the 'chamber' (*camera*) of the main *villae* (*Capitulare de Villis*, chap. 42; Devroey, 2003: 125). Wood remained the main material for agricultural implements until the appearance of the modern iron and steel industry in the nineteenth century (which made possible the mass production of metal objects). Wood, indeed, has such advantages as lightness, its ease of use in the preparation of complex assemblies; its flexibility and its suitability for use as a support for metal parts, etc. If iron implements or metal parts used in combination with wood (iron-tipped spades, for example) were obviously precious, they were certainly not scarce and could easily be repaired or recycled to manufacture other objects. An almost universal one mentioned in the polyptychs, alongside firewood and timber, was the supply of shingles (and battens), which indicates that dependent peasants had the cutting implements necessary to make those small wooden 'tiles'. Iron was involved as a major component in the cutting parts of tillage implements: hoes, iron-tipped spades and ploughshares. Experimental archaeology demonstrates that a heavy wheel-plough could last dozens of years, but the parts subject to the greatest wear, such as the wooden sole, had to be replaced after less than three weeks (seven ha of ploughing); the life expectancy of wooden ploughshares was even shorter (c. three ha of ploughing), because of the wear they were subject to, the obvious supposition here being that it was very easy to procure implements locally (Hansen, 1969, Lerche, 1994 & 2003). Simple village blacksmiths, like those of an estate at Saint-Germain-des-Prés, Boissy, located in a wooded region rich in iron ore, also made weaponry, delivering javelin and spear heads as dues for their tenure (Devroey, 2003: 127). The workshops of the larger monasteries, as at Corbie, Lorsch, Fulda and Saint-Gall, also made weapons sought after by the aristocracy, such as swords. (Stalsberg, 2010). Many of those objects circulated in aristocratic networks, as equipment for vassals and, through gift-exchange, as gifts of honour, on account of their exceptional social value. Within the large farming enterprise and large royal and aristocratic estate networks, iron was essential for public service, especially for fortification and siege works or the maintenance of bridges, the construction of embankments and canals, the manufacture of lumber used in all building work, etc. But it was certainly found everywhere else, too. Unlike Duby's gloomy view, archaeology has shown that, since recent proto-historical times (La Tène period), numerous settlements in Northwest Europe have an ironworking capacity. In Scandinavia and in Lower Saxony, a series of archaeological sites illustrates the diversity of locations of those sites of metallurgical activity: within an area separated from inhabited enclosures and in the vicinity of 'large' farms, as at Flögel-Eekhöltjen, at Feddersen Wierde and at Vorbasse. (fourth to fifth century). Other sites such as Snorup or Drengsted in western Jutland or Joldelund in Northern Germany seem foremost

oriented to a large-scaled iron production (Mikkelsen, Nørbach, 2003, Jöns 2009). Within inhabited areas, several sites show a close association with the largest farmstead, such as the forge of *Sædding* (eighth to eleventh century) or the bronze-making workshop in Vorbasse in Denmark (eighth to tenth century). In France, the manorial site of Villiers-le-Sec housed not only metallurgical activities, but also textile production (Gentili and Valais 2007). According to that typology, metal manufacturing and processing activities (together with other craft activities such as textile production or tanning) are frequently associated with the presence of a broad range of notables, from the most prosperous peasant families of a village to the followings of military elites or local 'kings', one and the other deriving from iron their instruments of social representation and power, such as the heavy plough (in the case of unarmed peasant society) or weapons. At the beginning of the tenth century, the manses in the villages dependent on the abbey of Saint-Pierre-des-Fossés were thenceforth divided between *mansi caroperarii* and *mansi manoperarii*, a distinction that foreshadowed the basic social and economic division in the Central-Middle-Ages village, between ploughmen and labourers (Devroey, 2003: 98–99). In Carolingian times, the same association between blacksmiths and notables continued, but the places of activity shifted or appeared in new centres of powers, such as palaces and monasteries.

Ore was mined and processed locally. In written sources, the case of the Boissy estate, already mentioned, represents an excellent illustration of that rural metallurgy in the forest: ore was transformed into cast-iron ingots by a group of twenty or so tenants living in servile *manses*, who each year delivered together almost a tonne of metal as dues to the abbey. The estate also numbered three blacksmiths active within an estate context. (Devroey, 2003: 127). Archaeological sites such as Warendorf (Westphalia) confirm the existence of such communities of craft metallurgists in rural areas, as indeed does Altenstad (France), the *villa* closest to the abbey of Wissembourg where the lands of the central estate were to be found (*Liber possessionum Wizemburgensis*, chap. 2: 105) and where tiles and a whole series of metal implements were made: axes and hatchets, masons' mallets, shoes for three tillage implements, etc.

Textual evidence is complemented by an increasing number of archaeological finds that have revealed sites where iron ore was produced or processed. There are a great many of these particularly in Germany, though equally in France. Blacksmiths were active in the *villae* of Villiers-le-Sec, Belloy and Baillet-en-France (France, Val-d'Oise), which belonged to the abbey of Saint-Denis. At Vert-Saint-Denis (France, Seine-et-Marne), a few kilometres from Melun, close to the Seine, major infrastructure works revealed the existence of a vast assembly of 2,500 bloomeries in operation between the eighth and the eleventh century. The annual production of cast iron in the excavated part could have been as much as 1.6 tonnes (Daveau and Goustard, 2000)., As in Antiquity, metallurgical activities were characteristic of forest sites where there was an abundant supply to hand of the charcoal necessary for the reduction of metals. Despite the absence of an overall picture for Frankish territory, it may be affirmed today that metallurgy and smithing were part of the family environment of the peasants of Francia. The archaeological syntheses available for Normandy, to the West, and throughout *Germania libera* and Scandinavia show that ore mining and processing was practiced wherever possible during the first millennium. Although the availability of iron probably declined somewhat since Roman times, it was far from inaccessible. At the metal-processing stage, the blacksmiths of Northwest Europe displayed a skill that carried the reputation of Frankish weapons as far as the Arab world and that included damascening, a technique known since the fourth century A.D that made it possible to produce remarkably hard blades. But Frankish blacksmiths also produced high-quality farm implements, such as the 'modern', large scythe blade from the seventh century found at Kerkhove (Belgium),

studied by J. Henning (2009). Iron objects were obviously valued in the countryside, but were easy to maintain and repair, and readily recyclable.

Harnessed ploughing implements: the ard and the heavy plough

In the ecological conditions of temperate regions, the large-scale consumption of cereals implies an improvement in the conditions of production. In strictly manual systems of farming, the area per agricultural worker seldom exceeds one hectare; if the gross yield is in the region of 1,000 kilos per hectare, productivity would consequently be barely sufficient to cover the basic needs (approximately 1,000 kilos) of an average farming household of five persons (Mazoyer & Roudart, 2002: 95). Other implements and animal power are needed to raise work output.

The ard

At the beginning of the first millennium AD, those 'man/animal' conditions of productivity were encountered in our regions thanks to the ard, in association with a series of manual implements for preparing the soil within the context of fallow systems and light draught tillage, which were widespread from east to west and from north to south from 2500 BC on. The ard was well suited to the ecological conditions of Mediterranean rain-fed agriculture into which it was introduced. The ard scratched the topsoil, depositing on each side of the furrow the earth thrown up and crumbled by the shoe. In this way, use of the ard avoided losses of humidity after ploughing (Haudricourt and Brunhes Delamarre, 1986: 26). To prepare the soil, the ploughman could break it up further by cross-ploughing, a practice that posed no difficulties in the square typical 'Celtic' fields. Light and easy to assemble, the simple ard could be handled by a single worker and be harnessed to two or even just one draught animal (an ox, a mule or a donkey). As for all farming implements, a great variety of ards and their tools already existed in Antiquity, exactly which were used being dependent on soil and climate characteristics, and production needs. In the Northwest of the Empire (the Rhine area, Northern and Eastern Gaul, Britain), ploughing techniques diversified from Roman times on through the use of devices that made it possible to widen the symmetrical furrow by using shoes larger and heavier than the pointed sole of the simple ard, or by coupling 'wrests' to the shoe, which turned over the displaced earth, all the while in a process of single-sided ploughing (from the second century AD on). Some of those turnwrest ards were fitted with a sharp-edged blade placed and acting ahead of the shoe, and called the coulter. The coulter had an eyelet, enabling it to be moved according to the ploughing direction). There were also complex ards equipped with wheels, but the only record of their existence is in written documents (Pliny, mid-first century AD). It is possible to obtain a dissymmetrical furrow by simply tilting the axis of penetration of the shoe, or by using a single wrest. However, it is only the characteristic operation of the plough that entirely turns over the earth. Because of the increase in the force the plough applies, this complex implement requires more powerful harnessing. It probably represents (see below) one of the characteristic tools of the modes of production and equipment of large holdings (Marbach, 2007; Margaritis and Jones, 2008). However, the adoption of the plough (which is associated with heavy draught tillage) must not therefore be assimilated with the sudden changeover from the homogeneous use of one type of agricultural implement to another. With their accessories and their setting possibilities, ards

and ploughs came in variants adapted to the many ways of working the soil. Moreover, they existed alongside one another for a very long time in certain regions (until the beginning of the twentieth century and farm mechanization, which eliminated the constraints traction was subject to). Ards and ploughs were used on the same farm holdings, depending on tillage practices, types of farming, economic resources, animal power and regional environments.

The mouldboard plough

The simple ard has a number of drawbacks in wet, temperate climates, particularly the difficulty it has in coping with fallow fields, which develop a heavy covering of grass and whose soil needs to be turned over several times to prepare it for autumn sowing, impeding the growth of weeds and encouraging the seed to germinate in the turned-over earth, a need that requires asymmetrical ploughing. Cross-ploughing with the ard, so characteristic of protohistoric fossil fields, was a way that peasants found to circumvent the problem. Situated at a higher level and less protected than that of more recent times, the soil of the ploughed land of the Early Middle Ages has seldom been preserved; it has also been less studied than that of around the beginning of our era. Compared with single-sided ploughing resulting from the ordinary operation of the ard, a furrowed soil also retains greater heat from the sun (an advantage in colder climatic conditions). To prevent excess moisture and frost (the major risk for winter sowing), the land could be ploughed in ridges, i.e. the furrows needed to be left open. The plough produced deeper furrows than the slanted ard. By ploughing in lands, i.e. by abutting or by cleaving strips (of several furrows) ploughed alternatively to the left and to the right, ridged fields – i.e. fields with alternating ridges (heads) and hollows (furrow-drains) – were created, improving drainage further. Ploughing began in the middle of a ‘land’, an elongated rectangle approximately 12 metres wide by 120 metres long (or sometimes longer, according to the morphology of the terrain and the pedology), and was continuous, this being achieved by turning to the right without stopping on completion of a furrow. The last furrow was left open; in the passage from one land to the next, a ‘dead furrow’ was created, acting as a channel facilitating field drainage. The area needed to turn the team of horses or oxen (the headland) at the ends of the lands meant that a lot of space was lost (about ten per cent), thus justifying the tendency towards elongation of the shape of the fields (Lerche, 2003).

The constraints imposed on farming by colder and wetter climates had, in the first place, an impact on the landscape, as reflected in the creation of those high-ridged fields which took the form of narrow and elongated ploughed strips (about six to seven meters wide). These had already appeared in Britain within late prehistoric and Roman archaeological contexts, several centuries before the heavy plough became widespread. Dissymmetrical ploughing therefore predates the dissymmetrical implement that the plough is. Such field profiles could be obtained with hand-implements (on small surface areas), with the simple ard, by tilting it to one side, or with a turnwrest ard. However, subsoil traces will necessarily differ according to the technique used, so making it possible to identify the implements used.

From the typological viewpoint, the plough is an agricultural implement whose shape and arrangement of parts (ploughshare and mouldboard) are dissymmetrical, as is the ploughing result. The main components are: the fixed wooden mouldboard (which turns to one side of the furrow the slice of earth cut by the coulter and raised by the ploughshare); the coulter (which slices the earth ahead of the ploughshare); the dissymmetrical ploughshare (which raises the slice); and lastly the heavy wheeled plough (*carruca*) (which made it possible to adjust the ploughing depth) (Haudricourt and Brunhes Delamarre, 1986: 27, 280–282).

The diffusion of the plough probably occurred from several regions and at different periods during the last centuries B.C. – no doubt with the occasional abandonment and re-introduction – and not from one centre in a single chronological sequence (Hägermann and Schneider, 1997: 386–387). Although, exceptionally, a few ards have been preserved in wet environments (nevertheless, except for the Dabergotz ard (ninth century), they date from before our era), there is a lack of ancient ploughs in a state of complete preservation. The first clear iconographic evidence of wheel ploughs concerns late-tenth-century England. The Stuttgart psalter from the early tenth century currently identified as an ard is probable a swivel plough: a coulter is fixed on the beam and a mouldboard may figure on the heavy share. Ploughing traces able to be associated with the work of ploughs (more open and uneven profiles) are attested by archaeology in the coastal regions of the North Sea, notably in Lower Saxony from 400 BC, and in the Nordic regions since c. 400 B.C. (Zimmermann, 1995). Fowler argued convincingly for the use of the plough in Roman times in Britain, if not before (Fowler, 2002: 182–204). Furthermore, the significant increase of annual weeds, more resistant to the plough, in Anglo-Saxon samples from the sixth-seventh centuries gives a further hint of a new farming system based on heavy tillage and field rotation (Hamerow, 2014). Coulters also found in Merovingian graves in Central Europe prove the use of heavy tillage tools and, in the Frankish heartland, a coulter has been discovered at Carolingian high-status sites at Orville near Paris. *Lex Salica* and *Leges Alamannorum* indicate heavy fines for the theft of coulters – the latter explains that the penalty foremost recompenses the immobilization of the plough (Thomas 2012, Henning 2009, Nissen Jaubert, 2006). The real distinction between ard and plough is the mouldboard turning the soil; the wheels are merely ensuring its stability. In Gaul, Pierre Ouzoulias has drawn attention to passages of Pliny and Sidonius Apollinaris (†486) which clearly indicate tillage turning the soil (Ouzoulias forthcoming). Even in Italy, the plough appears older than hitherto supposed, dissymmetrical shares can be dated to the Trajanic era in Northern Italy (Gelichi, 2012). The evolution of labour service and field morphology also indicate a widespread use of the heavy plough in the early Middle Ages. Dissymmetrical ploughing of strips is attested by Frankish written sources and, for example, the records of the regular tillage practices of large landholdings from the mid-seventh century on (*riga*: see below), and the requisitions, from the end of the eighth century on, of several pairs of oxen for ploughing *corvées* (statute labour) (*corrogata*: see below).

It is interesting to note that the modern broad-bladed scythe appeared in the same zone of contact between Romans and barbarians and at the same time; this scythe, too, was an implement of extensive farming and its use might have been stimulated by the need to increase surface areas and agricultural productivity (Sigaut, 2003). In Sweden, Janken Myrdal has showed significant evolutions in the form and the size of more agrarian iron implements, notably the scythe and the sickle, during the late Roman Iron Age and the Viking Period. It should be noticed that the agrarian tools change at the same period as the field and settlement systems (Myrdal, 1982). Other contemporary instances of cross-cultural dissemination regarding links between tools and farming practices, cultivated plants and cultural demand existed between those zones, too, and included the early introduction, on the basis of Roman technologies, of the water mill in Ireland, a country never occupied by the Romans, but won over very early to Christianity and to its Mediterranean food model based on wheat and bread (Montanari, 1995: 18–37). Rather than such tools being claimed as ‘barbarian’ or ‘Roman’ ‘inventions’, their progressive adaptation and their spread appear to be more the result of the cross-fertilization of cultural and economic influences, and technological know-how adopted by farmers to deal with environmental conditions specific to European landscapes north of the Alps (Margaritis and Jones, 2008: 170). The bread culture, which spread progressively throughout Northwest Europe during the first millennium AD, to the detriment of other modes

of cereal consumption, such as gruel, simultaneously changed the hierarchy of cereals. The culture of wheat and rye, requiring heavy ploughing and efficient field drainage, increased whereas the spelts, (which grains had to be hulled), declined.

The mouldboard plough and new social agro-systems

The increased demand exerted by the system coming even more under central administrative or aristocratic control during such periods as the fourth century (defence of the western provinces beginning with Germania, Britain and Gaul) or the years from AD 765 to 840 (height of Frankish hegemony) also contributed to changing farming practices, to favouring tools suited to extensive cereal growing, and to selecting cereals grown for consumption. Those agro-systems increased the social pressure on farmers (including requirements by way of both production and tools). At the same time, the landscape became transformed as a result of both the sway exercised by the large estate in certain regions and tight management of the countryside. If working the soil in narrow high-ridged strips belonged to the ecological traditions of the Northwest, the increased number of these, set alongside each other and thereby forming open fields, was the result of new areas being brought under cultivation or of a systematic reorganization of land by the elites. That development varied appreciably over time from one region to another, probably in connection with the management of large landholdings. In the expanding Frankish world, those phenomena began to be seen at the end of the sixth century and became more general during the seventh and eighth.

The word *riga* (from which the French *roye* or *raie* – the ploughman's furrow – is derived) appeared in Gaul around AD 600. It referred to a tied peasant's obligation to cultivate, for the benefit of the lord, a designated, small, elongated plot of arable land in the fields of the lord's demesne. In the law of the Bavarians, that 'legal' furrow corresponded to a very elongated strip of ploughing, in the ratio of 1 to 10, the long side corresponding to the linear *bonnier* (*furlong*: *furrow long* in English, *cultura* in French) of forty perches (117.7m), i.e. the length of the furrow, from the point where the plough engages to the point where it disengages (the strip had an area of approximately fourteen ares or, according to experimental archaeology and traditional agrarian measurements, the equivalent of a third of a day of draught ploughing). The contribution by smallholders was organized into fixed '*lots-corvées*' (plots of demesne land that smallholders were obliged to cultivate) for winter cereals. For spring cereals, the surface area to be cultivated was determined in terms of quantity of seed sown (the equivalent of sixty ares' worth). The *lot-corvée* was also used as standard unit of work in respect of mowing meadows, but was tiny, being an areal *arpent*, i.e. a little less than eight ares. Such meadows permitted hay to be produced for winter and were part of a system of intensive farming. As regards vines, Bavarian law merely enumerated the tasks to be carried out, without determining the extent of the plot (subsequently, the size became one areal arpent): those tasks were planting, fencing, digging, layering, pruning, harvesting. Seigniorial vines were therefore entrusted to specialized wine growers (Wickham, 2005: 286–288). Words related to ploughing that peasants had to work by (*riga*, the furrowed field; later on, *cultura*, see below) suggest that those new practices were first established in the fields cultivated directly by the lord (in the lord's *inland* – *demesne* or *reserve*) within a context of intensification. The area contained within the *riga* remained fairly insignificant: for a demesne of thirty or so family holdings, cultivation on the basis of the *riga* would produce less than four hectares of winter cereals in the *reserve* (Delatouche, 1977: 95–96).

At the end of the eighth century, another ploughing service appeared in the Frankish kingdom. Defined as an amount of work and no longer as an area to be worked, this was the *corvée* or statute labour (*opera corrogata*). It was set on the basis of a complete ploughing

team (varying from two to four yokes of oxen, according to region), which was put together by the peasants and through the simultaneous mobilization of all the teams of the dependent farmers. The pulling power used indicated that the *corvée* was intended for implements of heavy draught tillage, such as the wheel plough. The weeks of ploughing requested by the lord collectively involved all dependent peasants equipped with oxen, while associating peasants and their oxen, if necessary, from two or three holdings to form the complete team for the plough. The work carried out extended over much greater areas than those worked on the basis of the *riga*. This deployment of energy coincided with the appearance of the word ‘*cultura*’ in Frankish texts (*cultura* refers to land subject to ploughing, and is from the same origin as the word ‘coultur’, which refers to the cutting-blade of the plough) (Hägermann and Schneider, 1997: 328). The term was used in respect of the components of a seigniorial micro-open-field, which consisted of several large units of arable land covering scores, or sometimes hundreds of hectares. In the French Ardennes, the reserve of the *villa* of Beine comprised four small enclosed fields (the former seigniorial *inland*?) sown with twenty muids of rye (about twelve hectolitres) and six *culturae* sown with 1,204 muids of spelt (the cereal of extensive seigniorial cultivation in Northern France) (c. 720 hectolitres) (*Polyptyque de Saint-Remi de Reims*, chap. 18: 29). The appearance of coulters is associated by Verhulst with land regrouping or clearing operations carried out from the eighth century on within the context of the large royal and aristocratic estates at the heart of the Frankish kingdom, between the Seine and Rhine rivers (Verhulst, 1966). Toponymic study of the geographical distribution of the words ‘*cultura*’ and ‘*corrogata*’ reveals the outlines of a ‘France’ of open and elongated fields to the north of a line running from the Charente to the Jura (Billy, 1998; Devroey, 2003: 121). Phenomena of similar expansion of old ‘inlands’ were also identified by Rosamond Faith in England, in parallel with the strengthening of power structures in the Anglo-Saxon kingdoms at the end of the ninth and in the tenth century (Faith, 1997).

If the spread of the mouldboard plough appears to be related to seigniorial initiative, the players in that mobilization of implements and animal power were the peasants (or, more exactly, that part of the peasantry well equipped with oxen, the ploughmen). The old demesnes under direct management were worked by small groups of landless, dependent labourers (often slaves), but in the Frankish world, from the eighth century on, the tilling of the large estates was undertaken by peasant ploughmen working within the system of the collective *corvée*, thereby enabling those estates to supply considerable quantities of cereals. England experienced a parallel evolution, developed at first through a specific rural proletariat (in respect of the tenth century, ploughing is consistently associated with slavery); in the expansion of seigniorial inlands, increasing recourse was had to the yokes of tied peasants undertaking boon work (Faith, 1997: 65, 112–114).

In the ninth and tenth centuries, the large seigniorial manors would have had two or three pairs of oxen to meet everyday needs (transport within the demesne). On this aspect, the Italian polyptychs detailing the work force and the draught animals on seigniorial farms are the only available source: at the beginning of the tenth century, the *curtis* of Miliarina (Italy, Modena, had 140 hectares of arable land, for which the proprietor, the Abbey of Santa Giulia of Brescia had twenty-one prebendaries (including five adult men) and three pairs of oxen. The forty-four dependent holdings supplied the main part of the equipment and animal power to cultivate the seigniorial fields: forty-four pairs of oxen, on the basis of twenty-five days’ ploughing per year. With one ploughing team for approximately three hectares, Miliarina was particularly well equipped. The ratio across the entire polyptych was still very good: one ploughing team for four to five hectares of the reserve. These figures show that, within the context of large seigniorial production, Santa Giulia had no shortage of oxen or hands for the cultivation of its cereal-growing lands, as long as it could benefit from the services of tenants

and their yokes. As Pierre Toubert opportunely remarked: ‘There is no domanial system without statute labour (*corvée*)’ (Toubert, 1983: 6; Devroey, 2006b).

Coherence and balance of the domanial model

The relationship between the farming of the reserve and the ploughing teams of the tenants raises the question of the equipment of those peasant holdings and the capacity of these to balance seigniorial requirements regarding assets (draught oxen, plough, carts for transport) with the size of the holdings and the availability of forage (for the winter) and pasture (throughout the year). Leaving aside the question of its equipment and maintenance (metal pieces quickly became worn), the usual full ‘plough’ team was one of four to eight oxen. Its work would take up two or three months of the year, but the oxen had to eat all year round. A part of the initial capital was probably placed with the tenants by their masters at the time when their tenures were being fixed, together with responsibility for the upkeep of the livestock and the maintenance of ploughing implements. But, even in those circumstances, it is likely – although informal social customs such as these have left few traces in seigniorial sources – that several small holdings combined their oxen to form the complete ‘plough’ and that a village of ten ploughs (to use the vocabulary of the *Domesday Book*) worked an equivalent area, although it may have been equipped with only a few ploughs, which the peasants would lend out or hire among themselves. This explains the semantic choice of the term *opera corrogata*, communal ploughing, to refer to the classic *corvée*. The basic tools of a dependent family holding were probably a simple ard (useable with a yoke of oxen), a light cart, hand tools for working the soil (spades) and harvesting (billhook, sickle, scythe) and a good provision of cutting tools for woodworking. To carry out the long-distance cartage that was required of them, the peasants of Saint-Germain-des-Prés (in the vicinity of Paris) and those of Prüm (in the Ardennes and the Rhine valley) provided two oxen per manse; heavy carts were drawn by four oxen from two associated manses (Devroey, 1979 and 1984). Two oxen able to be put to work already represented an important asset in family farming, and implied the raising of a herd of six to ten animals in all, which had the additional advantages of making dairy produce (seldom mentioned in the charges on peasants) and meat products (from old animals) available for consumption and, above all, of producing considerable amounts of manure. The manure provided by peasants is moreover frequently mentioned among domanial customs as being required to be spread by them over the lord’s fields. Phosphate or heavy metal soil analysis of soils (phosphates and metallic components), as well as ceramics, mixed in with the manure and deposited outside archaeological sites, inform us about the importance of this time-consuming work. The early medieval peasant did not exhaust, but enrich the soils.

2.4 Crop rotations

This matter was the subject of much discussion among historians during the second half of the twentieth century, in respect of the debate about the importance and the consequences of mediaeval technical innovations and the spread of the three-field system (Verhulst, 2002: 61–63). The increasing use of environmental studies has offered a fascinating and more detailed view of agrarian systems. They have proved the skill of the early medieval peasants and in Gaul, they have dated the rotation of cultivation before the Roman Conquest (Matterne, 2001, 121–123). Furthermore, they have highlighted regional differences as well as

chronological trends corresponding to a wider social and economical context. The weeds are highly informative – their presence indicates the season of sowing and the nature of the soils, the cornflower thus accompanies winter crops. In Northern Europe, the cornflower accompanies rye and the introduction of a rotation system. In Denmark, rye appeared in the late third century (Berglund, 1992, Mikkelsen, Nørbach 2003). Weeds in seed samples also reveal if the harvesters cut the crop at the base or near the ear (Matterne, 2003: 127). Sowing was preceded by the fallow being ploughed at least three times in succession: a first time to clear the stubble after the end of grazing (*proscindere*); a second time to rid the field of the weeds that germinated after the first ploughing (this second ploughing – harrowing, in fact – could be repeated several times, if necessary); a third and last time immediately before sowing (Sigaut, 2007).

That farming system therefore meant that, during a crop year, the permanent fields were occupied more or less half the time by what was sown in autumn and half the time by fallow- grazing-ploughing. In the northern regions, where the climate favours spring cereal growing (with a short plant cycle), such as spring barley, oats and leguminous plants, a form of temporary cultivation (*Feldgraswirtschaft*) was used by peasants on the *outfield* – the land cleared, tilled for a few years, then allowed to return to waste. The intensification of production is revealed by the permanent cultivation of an *infield* composed of continuously cultivated field gardens, which was made possible by a considerable admixture of dressing. Fossil fields in several Swedish and Norwegian regions attest to an *infield* and *outfield* system from the end of the second century. In other areas such as Gotland, large ranging systems of collapsed stone walls overlap former Celtic fields. The system's implementation accompanied a new organization of the habitat, which corresponded roughly to that observed in Southern Scandinavia and the continental regions stretching along the North Sea. In Gotland and Öland the new settlement system coincides with a growing importance of sheep. Long stone walls delimited an *infield* and formed cattle paths or drove-ways to conduct livestock daily from the farmsteads to the pastures (Pedersen, Widgren, 2011). In many cases the stone walls also link apparently isolated farmsteads together, showing that dispersed settlement is not at odds with the idea of rural community. It is more difficult to detect such systems where the barriers were wooden, but, in Denmark, traces of paths for animals were excavated at Foulum and Vallensbæk, dating from the fifth century. Moreover, at Forsandmoen in Norway extended concentrations of phosphates indicate the passage of animals, although no archaeological structure had been preserved (Nissen Jaubert 1996). In Northern Germany, the first occurrences of turf-manuring – the regular addition of a mixture of manure, peat, sand, etc. – dating from the beginning of our era were identified at Archsum. However, it was from the seventh century on that this sort of manuring favouring the continuous growing of rye on poor and sandy soils was applied in Lower Saxony, and then progressively in the coastal regions of the North Sea and the Baltic (Slicher van Bath, 1963: 58–59; Hamerow, 2002: 140). The cultivation of nitrogenous legumes such as field beans, peas and lens are an efficient means to fertilize the soils. High frequencies of these plants indicate intensive rotation-systems on both side of the Channel (Matterne, 2001, Ruas 2010, Hamerow 2014). The increasing cultivation of legumes appears somewhat earlier and more substantial in the Frankish area.

It was at that time, too, that sources for the old settlement areas of the West, where two-course rotation for winter wheat was practised, began to mention crops of cereals sown in autumn and spring (oats, spring barley). This was considered common practice by the Archbishop of Mainz and Abbot of Fulda, Hrabanus Maurus, as seen in his definition of the *aratio* in his famous encyclopaedia (*De rerum naturis*, AD 842–846, book 19, chap. 1: *de cultura agrorum*): ‘The land is ploughed twice, once in the summer and once in the autumn. There is a break because in the second year, the empty field recovers its strength’. But that did not imply adoption of full three-course rotation (with a third of the farming area given over to

fallow grazing and two thirds to autumn and spring sowing). While reserving half of the area for fallow grazing, farmers could divide the sown areas between the two seasons. Such practices were advantageous since they reduced the risk of a failed yearly harvest and allowed diversification into other products, more particularly the introduction, alongside 'bread cereals', of other cereals that could be used as forage for animals (in our opinion, an option explored chiefly by large landowners) or secondarily for human consumption. In both cases (two-course or three-course rotation), the introduction of spring cereals into growing cycles laid stress on the production of bread cereals (of a much higher cultural and financial value) to produce as a matter of priority grain and forage for animals (war and journey horses, work oxen). For climatic reasons, winter and spring sowing was a different issue in more northerly regions, where the longer and harsher winters imposed a different calendar. There, the introduction of rye also marked the introduction of winter sowing. In the late Middle Ages, the ridged furrows were tightly related to the culture of rye and the Danish even named them *rugrygge* (rye-backs). They facilitated drainage, thereby protecting the seedlings from frost.

Most of the energy spent by men and animals in ploughing was devoted to the growing of winter cereals, which were, moreover given priority in the rotation system after the stubble was cleared, in order to take maximum advantage of soil fertility.

These remarks lead us to qualify the distinction between two-course and three-course rotation. The introduction of spring cereals made it possible for peasant farmers to spread risks over several seasons and it also met the production objectives of large landowners. It meant that less energy was expended in tillage connected with the weeding of fields and harvesting; the fields were ploughed twice for spring barley (instead of three times): a first time in winter for clearing the field and a second time before sowing; they were ploughed only once for spring barley (just before sowing in February-March); oats (often planted in a mixed crop with other forage plants) could, for their part, be harvested with the scythe.

Thus it was that three-course rotation spread from the large seigniorial landholdings of the Northwest of the Frankish world in the second half of the ninth century. Such a system was not applied to the whole of a local area, but was probably a means of organizing the land of the reserve, introduced to achieve both the regrouping of fields into large '*culturae*' (see above) and new land clearance, locally constituting forms of the micro-open-field (Verhulst, 2002: 63–64). On lands belonging to Saint-Remi de Reims at Nanteuil-la-Forêt (late ninth century, France), the fields were divided into three plots on which 'between one and the other season' rye and wheat were sown in autumn, and spring barley in March (*Polyptyque de Saint-Remi de Reims*, chap. 11: 74). The lands of Saint-Amand in Maire in Hainaut (before AD 872, Belgium) were divided into three plots of ten *bonniers*; two were sown with winter and spring wheat; the third, the text says, was placed (*interiacet*) between the other two, forming 'a small plot of fallow land' (for eight months) in a three-course rotation system (*Polyptychon von Saint-Amand*, chap. 3: 104). The culture of nitrogen legumes as part of the rotation system may be suggested by their increasing importance in Late Antiquity and the Early Middle Ages, indicating agrarian systems, changing towards an intensive agriculture (Matterne, 2001). It is noteworthy that the cattle and pig, respectively in Picardy and Île-de-France progress in the same period. In this region, the increasing importance of the cereals rye and oats and the legumes vetch and peas during the sixth and seventh centuries indicate changing agrarian strategies. Most likely, they attest the evolution of a three-course rotation system. Some centuries later (c. 800–1000), legumes become even more frequent in the samples of seeds of the same area probably as a result of a more intensive agriculture (Ruas, 2010; Ruas and Zech-Matterne, 2012). Legumes also appear in the framework of intensive agriculture at Yarnton in the late eight and ninth centuries. Other Anglo-Saxon sites – Raunds and Pennyland – also suggest heavy tillage from the mid-Saxon period and the introduction of a rotation system. Furthermore, new sites invest the heavy soils whereas the early Saxon

settlements preferred the light gravel soils (Hamerow, 2003 and 2014). In areas where temporary forest crops could be grown (assarts or freshly cleared ground), it was much more interesting to sow oats (or other cereals) on the very fertile burned soil in the 'waste' for several years running (with a high return at the beginning), than to devote a significant proportion of permanent fields to them. In peasant farming, hay and pasture were priorities for the feeding of animals; different production choices arose only if the pressure of work animals on the family holding became too strong. Where there was time and space for growing, peasant investment had rather to be oriented towards such other spring crops as leguminous plants, flax (*Linum usatissimum*) or hemp (*Cannabis sativa*), etc. Even within the very different context of the farming of seigniorial reserves, where the production of fodder was an essential requirement for feeding horses and ensuring the logistics of war and transport, spring wheat often took up less space than winter wheat. The same phenomenon was also reflected in the work service provided by tied peasants: the plots planted and grown by these tenants were often smaller for spring sowing than for autumn sowing (Morimoto, 1994).

When discussing three-course rotation (here as much as elsewhere), caution has to be exercised and attention paid to the regional, or even local, context, to geographical parameters and to the economic and social aspects of production processes. For example, Derville noted that, at Anappes around AD 800, there was a balance between the two dominant cereals, spelt and springtime barley, but he hastily concluded that, on the basis of other local texts from the end of the ninth century, there was widespread diffusion of three-course rotation in Northern France from Carolingian times on. It has to be said, though, that the *villa* of Anappes – with ninety-nine horses, two donkeys, 177 head of cattle, over 365 pigs, 620 sheep and ninety-three goats – was oriented chiefly towards stockbreeding. The chronology of the spread of the three-course system in Northern France has therefore to be brought forward to the eleventh century, and for this he provides sound and well-documented arguments (Derville, 1999; contra Morimoto, 1994: 121). During the Early Middle Ages, both the introduction of autumn and spring cereals into the crop cycle, and the duration of the alternations between growing and fallow grazing-ploughing therefore corresponded to local parameters and to diversified production strategies, rather than to a development in production techniques marked by progress over time, whereby there was a switch from two-course to three-course rotation.

2.5 Cereals and other cultivated plants

The main plants grown by the peasants of Northwest Europe at the beginning of the first millennium were barley, spelt and other hulled grain (einkorn wheat, emmer wheat), wheat, peas and vetch, together with plants grown for their fibres, such as flax and hemp. From Antiquity, wheat (*Triticum aestivum/compactum* L.) had held a dominant cultural place as a cereal in the Roman world and perhaps in part of the barbarian world, too (Montanari, 1995). Growing wheat required deep ploughing and well-drained land; those requirements and a great sensitivity to climates too cold or too wet explain a certain amount of fragility and more irregular yields. Bread-wheat was the favoured food of the powerful; its grains, transformed into flour, gave the white flour that, from the eighth century onwards, Eucharistic hosts were exclusively made from. Barley (*Hordeum* L.) was and, even today, is, the most widely distributed of cereals, its spread ranging from Egypt to Tibet and as far as Sweden; it grows in flat, open country and in mountains up to an altitude of 4,000 m. Barley was the dominant cereal of temperate Europe in Neolithic times and slowly, but gradually, gave way to bread-wheat, though without losing its importance in cold and wet regions (the North Sea and Baltic

coasts), where it was consumed in porridge and gruel (in the same way as oats), and used as a main ingredient in the brewing of beer. Hulled grain, einkorn wheat (*Triticum monococcum* L.) and emmer wheat (*Triticum dicoccum* L.), together with barley, made up the basic cereals of the European Neolithic Age. Their gradual decline started in the Bronze Age, in face of the advent of compact, soft wheat and a new hulled cereal, spelt (*Triticum spelta* L.). Genetically very close to wheat, spelt spread throughout Western Europe along a broad corridor running from Southern Germany to Belgian Gaul and to Jutland, and was firmly established in Britain in Roman times. Its robustness and its quality of being able to keep made it the favourite cereal of the large-scale, extensive farming of those regions from late Antiquity on. It retained that leading position until the ninth century, before declining rapidly in importance in the tenth (its retreat had already begun in the eighth century in what had become England) to continue to be grown in the second millennium in a few sanctuary areas only. Rye (*secale cereale*), long cultivated in Eastern Europe, was initially regarded as a crop introduced from Slav lands during the final centuries of the first millennium; it was first identified in potteries of the camp of Fyrkat dating from the late tenth century. However, later research has served to put its presence in Denmark and in Northern Germany back to an ever earlier date. In those regions, the introduction of rye accompanied the inception of winter sowing and a different organization of crop rotation. Its cultivation is attested from the third century, and clearly gained ground during the following centuries (Mikkelsen and Nørbach, 2003 and Zimmermann, 1995). After AD 1000, Europe in terms of cereals could be divided between the South, holding fast to the growing of wheat and barley, and to winter crops with two-course rotation, and the Northwest, where wheat predominated and was grown in association with rye (*Secale cereale* L.) and oats (*Avena sativa* L.). These latter species originated from harvest wild plants, i.e. simple weeds that grew among cereal crops and from which new edible species were derived through hybridization. Known to classical agronomists, they were still considered by the Romans as curiosities, eaten by barbarians, despite their marked taste (rye), or used as forage for animals (rye and oats). Rye occurs in the first century in Northern Gaul, perhaps as forage for horses, probably under the pressure of demand for grain for consumption by the army. But it is only observed in *villae* in the fourth century (Lepetz, Matterné 2003, Ruas, Matterné-Zech 2012) Rye also became widespread from Late Antiquity onwards in many areas of *Germania libera*. In the northernmost areas (for example, beyond the 'porridge/bread' line in the north of the British Isles), oats, planted in springtime, were the only cereal suitable for cultivation, on account of their very short period of growth.

Since they were well suited to difficult soils and to the hazards of climate and land (involving such factors as humidity, brevity of the growing period, hardness), rye and oats played a key role in the expansion of cultivated areas (from the eighth century on) and in the cerealization of Northwest Europe between the eighth and the twelfth centuries, where they appeared as pioneer plants in the vanguard areas of land clearance (Devroey, 1990; Mitterauer, 2003). The march of rye and oats to the west of the Rhine during the Early Middle Ages can be gauged from both written and archaeological sources. In regions of central France where crops of hulled barley and wheat had dominated during Antiquity, the average proportions of the grain being provided by peasants in the seventh century were approximately: barley, 38 per cent; wheat, 27 per cent; oats 18 per cent; and rye, 15 per cent (as it can be seen for the lands of the great abbey of Saint-Martin of Tours). Excavations carried out at former seigniorial estates of Saint-Denis, at Villiers-le-Sec and Baillet-en-France, indicate rye as being the chief cereal crop in the ninth century in the Paris region. The advance of rye and oats (in combination with wheat and barley), was appreciable throughout Northwest Europe in those centuries and was accompanied by the decline and gradual disappearance of the old hulled grains and particularly spelt. In the mid-ninth century in the region of Reims, spelt was accounting for over 90 per cent of the cereals sown on the

seigniorial fields of the demesne, ahead of rye (7 per cent) and wheat (1 per cent). At Saint-Denis, production imperatives – according to cereal allocations for the capitulary income and according to carpological data – leant towards rye in preference to spelt from the ninth century on. The characteristic features of cereals grown within the context of the large estate, as well as the aims of production, may explain those choices, since such qualities as hardiness, regular yields and good grain preservation (spelt) met not only the needs of the monks, the stability of their institution and the charity they disbursed, but also the state requirements placed on the monks to build up stocks and provide food for the army.

On the basis of the rents paid in kind by the abbey's mills (on the basis of the grain brought for grinding by the inhabitants), the polyptych of Reims enables a comparison between the production choices on the lands of the demesne lands and these on peasant holdings. The composition of the milling dues certainly confirms the importance of spelt in the Champagne area (68 per cent), but also indicates substantial quantities of rye (16 per cent), barley (12 per cent) and wheat (5 per cent). However, the importance of oats cannot be measured in this way, because they were not usually ground into flour. Peasants diversified their production to take advantage of the various planting requirements, to utilize resources over a longer time span and to reduce risks arising from climatic hazards. The most recent (beginning of the eleventh century) chronological strata of the Reims polyptych make it possible to record the rapid and irreversible decline of spelt after the year 1000. It was from then on that – in the same region of the chalky plateaus of Champagne, where spelt had previously dominated on the reserves, in company with (spring?) barley – rye now came to be sown (and wheat on the best lands), in company with spring oats. Oats formed part of the rentals due from peasants, especially of those due to the secular aristocracy. The decline of spelt in Champagne resulted from a change in production choices, dictated by the monks of Saint-Remi who, from then on, preferred the more profitable wheat and rye to hulled cereals such as spelt (Devroey, 1990).

2.6 Stockbreeding and pasture

Palaeozoological research has shown that, with very few exceptions, the taller cattle kept chiefly for slaughter – traces of which have been observed at several sites in Roman Gaul – disappeared in the course of the fifth century AD (indeed, within just a few decades), their place being taken by smaller and sturdier species (twenty to thirty cm shorter at the withers) reminiscent of the indigenous types of the Late Iron Age. This was indicative of a radical change, whose extent was further emphasized by its global character and whose effect was apparent in all domestic species throughout the western provinces, whether they were species of mammal (cattle, sheep, pigs) or of poultry (even cockerels decreased in stature!). A 'great historical narrative' would perhaps have given us a low level in Merovingian times, followed by a levelling-off or a slow increase from the tenth century on, but nothing of the sort occurred: between the fifth and the thirteenth century, all domestic animals of the Early Middle Ages (with the exception of the horse) in fact decreased in stature (Audouin Rouzeau, 1995) to revert to the same size as protohistoric animals, albeit with sturdier bones. How should those profound changes be interpreted? Stockbreeding is dependent on the complexity of economic systems. It responds to agricultural practices and to technical and social uses that are as important to analyze as ecological parameters. In the case of cattle, one has first to address economic constraints and cultural practices. For example, the slaughtering of taller cattle – one animal was enough to feed 200–300 persons – was inseparable from concentrations of human beings and forms of feasting that became inexorably eroded in the

course of the fourth and fifth centuries, a situation brought about by the ending of the standing army and of military consumption, as well as by depopulation of the large towns and by the cultural domination of a Christianity whose practice was not to offer great feasts of meat-sharing in its social liturgies (unlike pagan practice or the Muslim practices of a later time). The general reduction in the stature of domestic animals was one of the indications of the predominance of the family holding in agricultural production throughout the Middle Ages (Devroey, 2003: 94–101). Smaller stature was not a disadvantage in cattle, especially when the strength of the animals was used with high-harnessing equipment (head or bow yokes) for animal-drawn tillage. The smaller size of the draught animals was reflected throughout the livestock necessary for reproduction and the breeding of new generations, and favoured species capable of feeding on pastures and fallow land (even if the working animal always required suitable feed). The hypothesis of a mental block regarding technical know-how must be discarded, since taller cattle continued to be reared within contexts of consumption and specific cultural demand. Rich English palaeozoological data demonstrate the existence of ‘large cattle’ on the aristocratic site of Flixborough. ‘Unusually tall cattle’ are found at the *wics* of Hamwic-Southampton, Ipswich and London, and at other high-status centres, as well as on the continent at Dorestad on the Rhine and at Birka (only cows) in Sweden (Hatting, 1992, Loveluck, 2007: 122–123). Otherwise, the stature of horse breeds remained by and large similar to that of ancient types. In respect of other species of domestic animal, the horse fitted well within the divergent logic of, on the one hand, production and, on the other, use, owing to its symbolic and military function in mediaeval society. Cavalry represented an increasingly important constituent of armies in the Early Middle Ages; from the beginning of the eighth century on, the Frankish army in particular, counting an increasing number of horsemen. A general idea of the social burden of such a horseman on peasants can be gained in the first place from a capitulary of 806, in which the land assessment basis for a landowner to equip an armoured horseman to take his place in the host was fixed at twelve manses (*Ghaerbaldi Leodiensis episcopi capitula*, MGH Cap., 1, No. 123, chap. 6). The range of that assessment basis remained the same (ten to twelve manses) up to the twelfth century for the *fief de haubert* (land capable of supporting a horseman equipped with a hauberk – the equivalent of the ‘knight’s fee’) (Devroey, 2003: 288–289). A warhorse could eat twelve kilograms a day – half fodder and half grain. The Carolingian capitularies echo the incessant complaints of peasants against horsemen in their neighbourhood destroying fenced meadows by allowing their mounts to graze on them. From the tenth century on, moreover, oats were the preferred due required of villagers by the secular aristocracy in exchange for its ‘protection’. It was a fact, too, that travelling by horse was also a sign of distinction that set the horseman apart from the mass of lesser people and simple peasants. Within the rural world, specialized tenants entrusted with raising post horses evidently belonged to the rural elites, since they were granted a manse appropriate to their function and exempt from part of the customary dues – as at Saint-Germain-des-Prés – or might head a small estate of several manses – as at Saint-Bertin (Devroey, 2003: 96–97). In Northwest Europe, horses were not used as ploughing animals before the year 1000 and the practice only really took hold from the twelfth century on. Maybe the earliest general use of horses as draught animals was in eleventh century Flanders. This has been explained by a fast diminishing amount of natural grazing fields suitable for feeding oxen as a consequence of intensive reclamations in this area where population was increasing fast; growing fodder in the arable fields, especially oats, made it possible to use horses from that period (Thoen, 1993). In the England of the *Domesday Book*, the ox was still the principal working animal, the percentage of horses used in farming varying between 1.2 and 9.8 per cent (an average of 5.8 per cent) and here it remained important until the late Middle Ages (Langdon, 1986: 28–29). Horses were probably used earlier in the northernmost areas of Europe for such light farm work as

harrowing, where their speed of movement was valued. Buried under the aeolian sands at Lindholm Høje are the imprints of horses' hooves and the harrow, providing a snapshot of the final work carried out on the field around the year 1000 (Ramskou, 1960).

In northern France, bones of donkeys appear very sporadically at antique settlements; in the Carolingian period they are more frequent, especially in Île-de-France. The increasing importance of the donkey may reflect a growing need for a flexible way of transporting different goods (Clavel, Yvinec 2010).

Cattle and horses had a direct influence on the production of cultivated areas where they were either direct consumers (of grain, in competition with man, and of straw), or indirect consumers (by way of the space required for hay and grass). Working cattle were well integrated into farming, since, when at rest, they could be fed in the cultivated areas with the other cattle during the fairly long periods of grazing interspersing the crop cycle – grazing, that is, on stubble after harvesting and on weeds between fallow ploughings. ‘Uncultivated areas’ – natural pastureland, fallow land and wooded areas – contributed to the balance of cattle-rearing practices, in that they represented the main resource for the two other main focuses of stockbreeding, sheep and pigs. In Great Britain, the dividing line between areas devoted chiefly to stockbreeding and areas of mixed farming was more clear-cut than on the continent, owing to the general highland/lowland divide imposed by climatic constraints on cereal growing (possible only below an altitude of 250–300 metres). Despite the image of an early-mediaeval rural world crushed by hostile natural forces and eking out a miserable existence from subsistence farming, there was – mainly along the North Sea and Baltic coasts (the Netherlands, Northern Germany, Southern Sweden) where local economies had a strong pastoral element during the first millennium – a regional specialization in husbandry, a fact that indicates the existence already of regional economic integration and regular trading relations. In those regions, the traditional longhouse, known since the Bronze Age, was the key feature of rural settlements which concentrated the family living and working space, cereal storage and the cattle byre all under one roof (Nissen Jaubert, 2003, Zimmermann, 1999). The size of the byre emphasizes the importance of cattle. Nevertheless, it remains difficult to quantify the livestock; the existence of, or even better the number of, stalls may however give some hints. As mentioned above, the size of the byre increase significantly during the late second and third centuries in the framework of new agrarian systems and profound social transformations. The number of stalls grows from 10–15 to about 20. Some large long-houses at Feddersen Wierde or Vorbasse could even accommodate 38 and 30 animals. The stalls were not preserved in the unusually long buildings at Fosie VI (Scania) Peelo in the Netherlands (60 m), Flögeln, Stuvehøjmark (51 m), Bennekom (50 m) but they possibly had place for about 50 animals or more. In other sites, the byre tends to diminish in the fifth to seventh centuries, before the changing settlement patterns *c.* 700, when the long-house currently could accommodate *c.* 20–30 animals. In the late tenth century, Omgård and Vorbasse have evidence for large-scale animal husbandry. The enclosure of the greatest farmstead of Vorbasse had 10 to 12 buildings beside the dwelling-house – altogether the byres encompassed about 100 stalls. At the fenced manor-site at Omgård, which also had one of the earliest water-mills in Scandinavia, the byres could accommodate *c.* 80 animals. Nevertheless, the low phosphate values in some parts of the byres at Flögeln indicated that, just as in later times, some stalls did not accommodate animals permanently (Nissen, 1996a).

In other areas, where the constructions are more varied, the identification of buildings notably the byre is a crucial problem. It does not mean that the livestock lived outside. Anyhow, the traditional explanations about the byre to warm the house and the need for shelter cannot bear a close examination (Zimmermann, 1999). Anglo-Saxon as well, as Frankish written sources mention different buildings for livestock (Nissen, 2006). At Lauchheim, in Southern Germany phosphate analysis indicate that the main buildings (about

16 to 18 metres) accommodated dwellings and byres (Stork, 1997). Besides, remains of litter (for instance in sixth-century Herblay), and the rather frequent manure-pits give archaeological hints of the accommodation of livestock. Some of the large buildings on the manor-site at Serris, could be byres. At Saleux, a large enclosed area connected with a fenced path may suggest that the cattle were kept inside at night. Such features also occur in legal texts, e.g. *Edictus Rothari* § 253, 291 et 372 (Schmiedt-Wiegand, 1979). Besides a possibly symbolic significance, especially in the non-Christian coastal region, the byre is the most efficient means to gather manure and increase the production of milk.

The coastal regions of the Channel and North Sea had built up a specialization in stockbreeding very early on. According to Alcuin (c. 780), the bishop of Utrecht was ‘mighty in cows’. The lands offered to the abbey of Fulda in the ninth century by many Friesians in memory of Saint Boniface, who had been murdered in their country in 754, were measured in number of animals: a land ‘of sixteen ewes’, ‘of fifteen cows’, of ‘twelve oxen’ or ‘of forty sheep’ (Lebecq, 1997: vol. 1, 367). In England and Ireland, the milder and less snowy winters also favoured the rearing of cattle and sheep: for example, the law of Ine of Wessex that stipulated the content of the royal tribute (the *feorm* or farm) laid down that to the king should be delivered loaves of bread, honey, two types of beer, adult cows or sheep, cocks, geese, cheese, butter, salmon and eels, as well as hay for the horses; a list that strongly suggests the existence in late-seventh-century Wessex of peasant farming firmly oriented towards stockbreeding and the exploitation of outfield resources (Faith, 1997: 38–39).

Farms in regions favourable to stockbreeding on account of rich grassland and a winter climate of little snow, thus permitting permanent pasture, were (in the same way as the vineyards of Northern France, the Rhineland and the Moselle valley) integrated into the supply networks of the big Frankish monasteries. Besides the herds of cattle and flocks of sheep in those networks, those monasteries also possessed cattle- and sheep-breeding farms; from all these, they obtained animals, cloth and such dairy produce as cheese and butter (not to mention other products typical of those coastal regions, such as honey or salt). Lobbes had a cattle-breeding farm in Flanders; Echternach, Werden and Fulda had many possessions in Friesland from which they drew supplies of animals or products derived from stock breeding: around 830, the possessions of the abbey of Fulda were yielding over 750 pieces of cloth per year! In the Flemish coastal plain, huge flocks of sheep were raised, not only by nearby abbeys such as Saint-Pierre and Saint-Bavon of Ghent, but also by abbeys in France and Germany. Specialization in pastureland resulted in the production of enormous amounts of wool, which exceeded domestic needs and served to encourage the production of cloth; alongside intense production in rural areas, some cloth was already being made in the ninth century in burgeoning Flemish urban centres and circulated widely in the flourishing trade organized by merchants from the Friesian *wics* and by their Anglo-Saxon counterparts beyond the seas (Verhulst, 2002: 66). In Northern Europe, more sites have evidence of comprehensive textile production from wool or plant fibres. In Denmark, the landing place at Selsø, in Roskilde Fjord, not far from the royal site Lejre, has a great number of pit-houses with evidence for craftwork, notably a large-scale manufacture of fabric, possibly sails for ships (Ulriksen, 1992, 48–78). The weaving of sails consumed huge quantities of wool and demanded highly skilled craftwork. The sails of the fleet of Knut the Great probably totaled a million square metres of wool – the equipment of Viking ships must have affected the rural production (Bender Jørgensen, 2012). On the other side of the North Sea, an unusually high proportion of bones from calves at the Pictish monastery at Portmahomack indicate a workshop of parchment, which needs the skin of very young animals. (Carver and Spall, 2004; Loveluck, 2008).

Judging from the age of slaughtered animals, sheep were reared chiefly for their wool and milk; goats were kept, but in small numbers. Within rural and urban settlement contexts

of Roman times, the chief source of meat (up to 80 per cent) was cattle, with sheep and goats forming a subsidiary source. Similar proportions of cattle have been observed in the Anglo-Saxon *emporia*, Hamwic, York and Ipswich, whereas the quantities of pigs and poultry which could have been bred on site are rather small. This may indicate that the big estates furnished the *emporia*, this seems also to have been the case in Dorestad and Ribe, whereas the age of the butchered animals are more wide-ranging in Saxon London (Hamerow, 2007). The menu of urban societies is quite different in the Frankish heartland – the proportion of pigs is high, its meat was highly appreciated and the animal was therefore strongly represented in the collections of bones in high-status sites, particularly at the palace of Compiègne, but also at Distré and Serris (Yvinec, 2012). Pigs were raised solely for meat, but were easy to feed on waste food and on pannage resources (acorns, beech mast, chestnuts, etc.) where these were available locally in wooded areas. As a ‘low risk animal’, the pig could be fed ‘on the fringes’ of the rural economy; during the Early Middle Ages, that meant mainly in woodland (Ervynck, 2008).

2.7 The issue of yields

The mixed farming practiced by the peasant farmers of Northwest Europe did not solve the basic problem of pre-contemporary farming, i.e. of maintaining fertility. Faced with permanent fields, the farmer in temperate regions had to practise crop rotation, alternating between cereal crops, periods of animal pasture and fallow ploughing in preparation for future crops; transfers of fertility were needed to avoid the gradual depletion of the soil (a very widespread reality and one that was still being denounced in France in the eighteenth century). Stubble grazing and ploughing rid the fields of weeds and sped up the recycling of nutrient elements in the soil, but was seldom sufficient. The input of outside elements (manuring, night-time penning of livestock grazing elsewhere in the daytime, fodder) or green fertilizer (interspersal of leguminous plants among the crops) was mostly insufficient. Stubble fields had therefore to be allowed time for the grass to grow again for several years before being cleared by ploughing. That was ‘the vicious circle of farming in the old days’: poor yields, leading to only small quantities being produced and then to the necessity of extensive farming, whereby soil use was to the detriment of pasture or other crops, which further reduced transfers of fertility to cultivated fields and held back yields. At a certain point, thus, clearing was a necessary option in adjustment to increasing demand. Such imbalances explain the low level of productivity achieved in cereal farming in pre-industrial societies, a situation that would undergo profound change only with the end of peasant farming and the massive introduction of mineral fertilizers (Slicher van Bath, 1963: 7–25).

When it comes to assessing yields, historians obviously turn to written sources.¹ However, sources for the Early Middle Ages are limited almost exclusively to one single document, the famous inventory of the royal estates of Northern France preserved in the codex of the *Capitulare de Villis*, dating from around AD 800. In setting about calculating yields, historians based themselves on the amounts of grain noted by the inventory commissioners as being stored in the granaries, and on the quantities that had been sown – the model being the ratios furnished by ancient and mediaeval agronomic texts, which always considered yields in terms of grain sown. The results have given rise to sterile controversy, since, in addition to the major drawback of the inventory being an almost unique source, the commissioners’ criteria in drawing it up are not known. The points of interpretation emerging

¹ Output was initially expressed by historians as the ratio of grain sown to grain harvested, but is today estimated in quintal/hectare. A quintal = 100 kilograms.

in the controversy concern: a) deduction of the quantities sown from the year's harvest (Duby, 1962, 1966); b) underestimation of the harvest by 8–15 per cent, if the harvesters were paid with part of the yields (Sigaut, 1985); c) addition of the tithe that would have been levied before harvests were gathered into store (Comet, 1992); and d) the quantities to be sown for the next harvest year were already deduced (Slicher van Bath, 1966; see also Henning, 2009: 165–166). The various hypotheses (see table 2.1) can lead to the ratios varying by as much as 100 per cent, without the arguments being sufficiently compelling; moreover, they place yield ratios from the Early Middle Ages within a low range, albeit one that ultimately is not so remote from that of the 'normal' yield ratios indicated by Roman agronomists, i.e. between 3:1 and 5:1 (Devroey, 2003: 115–117). Given that large quantities of spelt from the previous harvest year were left in the granaries of Annappes (year one: 1080 muids; year two: 1320 muids), Georges Duby came to the common-sense conclusion, i.e. that 'from that single document, it may [...] be deduced that the productivity of fields varied enormously from one season to the next and that it could be extremely low' (Duby, 1962: vol. 1, 84–87). That interannual variability is confirmed (see below) by the alternation of years of famine and years of exceptional harvests, as recorded by the Carolingian Chronicles during Charlemagne's reign.

TABLE 2.1 Interpretations of the yields deduced from the inventory of Annappes (c. 800)

	spelt	wheat	rye	barley
Duby	1.83:1	1.66:1	1.00:1	1.63:1
Sigaut	1.98/2.11:1	1.80/1.91:1	1.08/1.15:1	1.76/1.88:1
Comet	2.03:1	1.85:1	1.11:1	1.81:1
Slicher van Bath	2.83:1	2.66:1	2.00:1	2.63:1

Source: Devroey, 2003: 116.

Experimental archaeology confirms the great variability of cereal yields (according to sowing density and land maintenance) and the vulnerability of harvests to climatic hazards and the agency of predators. Without manuring and with an input of ash, careful cultivation can yield from 500 to 2,000 kilos per hectare, with very low sowing levels (only 100 kilograms per hectare) to encourage plants to develop tillers (shoots from the base of the stem) (Firmin, 1998). If nothing else, that experimentation at least illustrates the great variability cereal production is subject to, depending, as it does, on human input and its own sensitivity to weather conditions (interannual variation of 1 to 5). Both those variables represent basic production parameters in pre-contemporary European farming.

Agronomists have proposed cereal-yield models according to agrarian systems (see Table 2.2):

TABLE 2.2 Productivity models in peasant agrarian systems²

² Typical peasant household: one farming man per five persons, with a consumption of 1,000 kilos of cereal per year.

agro-system	productivity per farming man (hectares)	gross production (kilograms) per ploughed hectare	production per farming man (kilograms)	optimum size of holding (including fallow) per farming man and total production
manual cultivation	1	1,000	1,000	1 ha 1000 kg
ard: light draught tillage	3	500	1,500	6 ha 1,500 kg
plough: two-course, heavy draught tillage	6	800	4,800	12 ha 4,800 kg
plough: three-course, heavy draught tillage	6	1,400	8,400	9 ha 8,400 kg (bread wheat) 1,800 kg (fodder)

Source: Mazoyer and Roudart, 2002

Table 2.2 is a salutary reminder that caution has to be exercised in the face of the imprecise and often hypothetical nature of the information we have concerning farming implements and practices in the Early Middle Ages. Nevertheless, it does make it possible usefully to clarify analysis of archaeological and historical data by making modelling possible. Let us examine, for example, the question of the size of the holdings of dependent peasants in the patrimony of a large ecclesiastical landowner such as Saint-Germain-des-Prés (beginning of the ninth century AD). Firstly, there were the *hospitiae*, temporary tenancies that individual farming men or young childless couples were allowed to take up; these were generally around one hectare in area, bore a requirement to perform one day's manual work per week and came with a food grant from the lord. Secondly, there was the typical manse of free peasants required to provide draught tillage; this type of manse had an average area of 6.7 hectares and we know that the number of farming men on a manse was slightly higher than one per holding (several households could live together on the same manse); within the geographical context of the Paris region, moreover, peasants also practised more intensive and profitable activities, such as vine growing or stockbreeding. Thirdly, there was the typical manse of serfs, who were compelled to provide manual labour (on the basis of 50 per cent of one person's working time per manse); such a manse had an average area of 4.3 hectares. Although the sizes of these two types of manse tenancies would put such peasant holdings more into the category of light draught tillage (which would confirm the notion of each holding at Saint-Germain-des-Prés being equipped with two working oxen), the inventory of the situation of land shows that there were great differences in size in peasant holdings from one region to another, from one demesne to another within the same patrimony (in the *villae* of Saint-Germain-des-Prés – strongly oriented towards viticulture – the average size of holdings was between two and five hectares; elsewhere, between five and fifteen hectares), and indeed within actual peasant groups, between local elites at the head of large manses or of several tenancies and tenants working quite small holdings. This suggests that, within the same village, some used heavy ploughs and others ards; that such implements could circulate among several holdings; that some lands were farmed by hand and others by draught tillage; and that regions of agricultural intensification, such as the viticultural areas close to Paris, probably used principally ards, whereas mainly cereal-growing areas were organized into large manses where the land was

well suited to the productivity that the heavy plough could provide. The heavy plough was also used during the great collective ploughing *corvées* for working the lands of the reserve, which was structured into compact units of several dozen hectares. A large manse could also have considerable human resources. The Frankish parish priest had a regulatory manse of twelve hectares and four farm workers to provide for his subsistence, which suggests that those large tenancies might have been areas of intensification. As an eminent member of the peasant elites, the priest enjoyed a relatively high degree of prosperity. Lay persons within the peasant community could also be well off: estate officers, such as mayors, or the upper fringe of groups of tenants, often composed of former freemen who had sought the protection of ecclesiastical lords. The size of those very large tenancies probably implies the presence of servants to cultivate the lands.

Following extensive research on Burgundy still unequalled today, André Deléage proposed a system of manses of eighteen, twelve and six hectares in area, corresponding to a ploughing implement drawn by six, four and two oxen (Elmshäuser and Hedwig, 1993: 506–509; Deléage, 1941: 349–354). In cool, temperate regions, two heavy beasts, fed properly, can produce twenty or so tonnes of manure a year. If yields of the order of 800 kilograms per hectare are to be obtained, about 15 tonnes of manure need to be ploughed in per hectare of fallow land (45 tonnes for three hectares of fallow ploughing), before the first cereal (Mazoyer and Roudart, 2002: 370–371). These agronomical data clearly indicate that the growing of cereal crops must have faced a structural imbalance arising from insufficient transfers of fertility, an imbalance that, as a matter of crucial importance, had to be offset by other means of enriching infield soils, such as stubble grazing, night-time penning of animals grazing during the day on the outfield (wasteland or woodland) or even the input of materials only regionally available, such as marl or peat (turf-manuring). But this approach to the problem focuses too much on cereal production. According to the productive context of the polyptych, most of the peasants of Saint-Germain were, for example, small peasant farmers, working family holdings within the context of mixed-farming, in which the production of cereals (for subsistence, seigniorial dues and the tithe) was substantially underpinned by intensive, potentially highly lucrative activities (cultivation of grapevines and textile plants, specialized stockbreeding), by the rearing of animals for work, for meat (pigs) and for wool (sheep), and by craft production (fabrics, wooden objects, etc.). This is obviously an additional reason to put discussions around cereal yields into a wider context! During the Early Middle Ages, profitable intensification practices were linked to environmental potential in spheres of activity subject to strong overall demand: viticulture, stockbreeding and textiles. Cereal production was spurred chiefly by two different factors of demand: 1) the subsistence needs of peasant households; and 2) cereal production within the networks of the large landholding to cover the needs of this last and to supply the institutional circuits of consumption (for example, supplies for the army) and trade channels. The surpluses necessary to meet institutional and commercial demand were generated through extensive cereal growing on the reserves (whose area increased through land clearance or the reorganization of lands), made possible by significant transfers of labour from peasant holdings (*corvées*).

2.8 The cultural landscape

The notion of ‘the cultural landscape’ was brilliantly dealt with for Italy by Vito Fumagalli in his book *Landscapes of Fear*, albeit that he was too ready to romanticize the danger of the early medieval landscape. Furthermore, mediaeval clerics – our main source in this matter – used the landscape principally to contextualize spiritual experiences in metaphorical terms.

Consequently, the study of ‘real’ landscapes can in particular take advantage of the way in which people of the Early Middle Ages were capable of measuring and organizing space (Devroey, 2012). In respect of the non-Romanized world, mention has to be made of the increasing systemization of parcels of farmland (including the so-called ‘Celtic fields’), as well as of the regular enclosures around farms according to a regular network, as at Vorbasse.

Nature running wild? Forests and wilderness

For intellectuals from the Renaissance on, the collapse of the Roman system was felt as a distressing return by the world to the state of nature, where ‘populated sectors were as if lost in an ocean of wood and wasteland’, in which ‘the few human beings were dominated by a hostile nature’ (Fourquin, 1975: 297–306). Without being a pure metaphor of the history of individual events, the idea of a nature running wild refers to the ‘nature vs culture’ dilemma. We may suspect that it espouses fairly unswervingly the presumptions of an *interpretatio romana* of the world, opposing ‘civilization’ and ‘barbarism’, *cultus* and *incultus*, ‘urbanity’ and ‘savagery’.

In Christian culture, the assessment of how uncultivated areas could be developed varied according to whether they were perceived as a barren wilderness or as areas Christianization could render fertile. The ambiguity of such thinking is clearly illustrated in the search, from the seventh century on, by Benedictine *monastic* communities for tree-filled wildernesses to transform into enclosed spaces, protected by sacred borders and, at one and the same time, separated from the profane world and made doubly fertile by faith and by the monks’ toil. The fiction of ‘the dreadful wilderness’ transformed by the presence of the monks (often from the time of foundation) is contradicted by the reality of the conflicts entailed by the proximity of peasants or by their practices, which drew those peasants deep into the forest areas, seeking pastureland, clearing land permanently, growing temporary crops, taking advantage of the many resources of the woods (firewood, timber, extraction of peat or green fertilizers, pruning, gathering and picking fruit, collecting honey, etc.). For secular lords, woods were the favourite ground for the autumn hunting of big game, deer and wild boar (springtime was reserved rather for waterfowl and other birds). In the same way and at the same time that monks established sacred circles around monastic lands, the Merovingian kings enclosed areas of woodland (the oldest ‘forests’ were recorded in the Ardennes in AD 648) to form chases reserved especially for stag hunting. This twofold interdiction no doubt reflects the polarization between the values of the aristocracy (including the monks), for whom the forest was an area of life experience, and those of the peasants, for whom the woods represented a basic resource. The warrior enters the forest to become wild and assimilate the virtues of wild beasts; the saint to put his faith to the test (Le Goff, 1980).

Woodland was still relatively abundant in the Early Middle Ages (except in certain regions, such as Britain, where reforestation remained very limited), and was already reflecting a legal dichotomy between ‘forests’, monopolized for aristocratic uses, and ‘wooded commons’, reserved areas where peasants exercised their rights of use. As an extension of cultivated land, woodland was then an area shared (according to written or unwritten rules) among the partners of the rural community, allowing them to derive additional resources indispensable for building, for making wooden objects and implements, and for cultivation and stockbreeding practices. Wasteland was not necessarily abandoned to be covered willy-nilly by a thick mantle of trees. The mature woodland – dense and shady – we see in our climes is the result of chiefly human agency, planted and maintained by the *Eaux et Forêts* (the equivalent of what is the Forestry Commission in the United Kingdom), and in existence for barely three to four centuries. On the other hand, studies of tree growth

rings and archaeological wood provide evidence of forest management and tree-cutting operations over a very long time. For example, the timber of the Irish crannogs provides evidence of a Neolithic sylviculture (Rackham, 1990). For the Early Middle Ages, the study of several hundred samples of wood from the seigniorial site of Pineuilh (c. 1000) in Gironde shows that regular tree-cutting operations took place in the ninth century (Nissen, 2006: 166). At one and the same time, mediaeval woodland was an area of nourishment for humans and animals, a threat and obstacle to the extension of cultivated lands, an area of land to be taken into cultivation during periods of demographic growth, and an object of illicit clearing (Wickham, 1990; Husson, 1995; Devroey, 2003: 83–94).

In the long term, the elites tended to restrict rights for forest use. As early as the ninth century, Jonas, Bishop of Orléans, had clearly seen that, by barring access to nature, the powerful had despoiled the poor of the resources that God had made available to everyone. In Western Francia, exclusion became sufficiently threatening for the enjoyment of rights of use to figure as a central demand of Norman peasants in revolt against their duke. The progressive confiscation of uncultivated land by lords had a huge traumatic effect on the countryside that was to reverberate until the end of the *Ancien Régime*. From the beginning of the Middle Ages, Germanic sovereigns increased alienations of public land ('public' in the eyes of ancient Roman law) for the benefit of aristocrats and the Church. Through the subsequent circulation of such assets within elites, a property came no longer to be conceived as being without its share of natural resources, its 'waters and forests' enumerated in the clauses pertaining to legal ownership. Frankish sources of the sixth and seventh centuries appear to indicate that the former public dominion of uncultivated areas (that is, allowing free use of vacant lands) continued, subject to the payment of dues, especially on pastoral areas. However, the fragmentation of crown lands and the extent of royal donations already referred to inevitably led to the progressive appropriation of the land (according to the later principle 'no land without a lord'), which explains that logic of restriction.

Mediaeval landscapes and Romanness

After its institutional disappearance during the fifth century in the West, the Roman Empire continued to hold sway over contemporary imaginations through the strong influence it had over urban development and spatial planning, and the mark that it left for centuries afterwards.

In the Romanized country areas of Northwest Europe, the monumental architecture of the large *villae rusticae* disappeared within one or two generations, in most cases having been abandoned; this occurred at the same time as the disappearance of mass-production workshops and large-scale networks for the circulation of materials for permanent building. *Villae* in Merovingian times prolonged the use of ancient models to the south of the Loire, examples being at Gramière and La Ramière in the region of Nîmes or at Vernai near the Alps (Buffat, 2005; Royet et al., 2007).

Romanness was more alive to the south, although social factors also played a role, as demonstrated by the varying developments, at c. 15 km distance, at the large *villae* of Arpent Ferret, Servon and Saint-Germain-lès-Corbeil in Île de France. The Roman layout was definitely abandoned at Arpent Ferret in the third century, whereas the inhabitants of the second villa built Roman baths as late as in the fourth century (Gentili and Hourlier, 1995; Ouzoulias and Van Ossel, 2001; Balmelle and Van Ossel 2001).

The structuring of ancient agricultural landscapes – routes and land division – continued for much longer (see above), although it seems evident that, once the *villae* were abandoned, the logic of land use was no longer underpinned by an hierarchical network

organized top-down by the large estate, but by the fabric of peasant settlements and holdings that ordered the use of uncultivated land. The importance of houses in the structuring of the rural landscape appeared clearly from the seventh century on when ‘hamlet-villages’ adopted more co-ordinated schemes and the spatial organization inherited from ancient landscapes was abandoned in favour of a new organization of rural land.

Most of the early medieval manor sites emerge during these centuries, when many sites indicate a growing regulation and an increasing internal hierarchy (above). In some cases, these large farms are isolated as at Nétilly, Ingré-les-Rousses, Planchebrault or in the Loire Region. Nétilly and Ingré-les-Rousses were surrounded by palisades or ditches. These features cannot be described as defensive works, but they illustrate an increasing tendency to draw a symbolic limit. During the tenth-eleventh centuries, the defensive element becomes more and more visible, and accompanies new trends in the settlement systems which developed further in the following centuries (Nissen Jaubert, 2010).

Those changes identified by archaeologists coincided with a profound renewal of the vocabulary of rural institutions in written sources, which introduced new forms of land units with which to bracket peasant populations, examples being the Frankish *mansus* and the Anglo-Saxon *hide*, words that were used to refer to the family holding, the universal basis of peasant agriculture. It is interesting to look at the semantic field of these denominations: *mansus* refers back to the verb *manere* and to the idea of dwelling permanence; the same meaning is to be found in the Scandinavian word *bol*, which appears in toponyms from Viking times. Indeed, Latin texts translate *bol* by *mansus*. The Old English *hide* belongs to a vast group of words derived from the Indo-European root *kei*, present in the Greek *keîtai* (‘he is lying down’), which refers both to the couple and to the place of residence (Faith, 1997: 127–148; Devroey, 2006: 412–441). The *mansus/hide* group stands against another family of words connected with tenure, which, on the other hand, refer to the sharing of land: the Latin *sors* (share or lot), the High German *hoba* (from ‘haben’: to own), the Breton *ran* (frequently glossed as *pars terrae*), the Late Latin of Western France *factus* (literally ‘the amount worked’). It was through the language of administration that, at the end of the ninth century, the translation of *hoba* by *mansus* was diffused or the term even introduced into the vocabulary of Bavarian and Italian rural institutions (replacing respectively the Latin *colonica* and *sors*). The idea of parcelling local land also appears in the Scandinavian word *deld* (share), which is to be found elsewhere in microtoponyms in England and Normandy, where Nordic populations settled (Nissen Jaubert, 2013). *Mansus* and *hide* have a larger significance, since this expresses both the idea of the house inhabited by the head of a peasant family, fully participating in the rights and obligations of the community, and the centrality of the dwelling and of the plot of land surrounding it (which is also to be found in the notion of *curtis*: the enclosed land around the centre of the holding) vis-à-vis the territory and the parcels that form the family holding: ‘21 days of arable land (i.e. the amount of land that could be ploughed in twenty-one days) and 4 cartloads of meadow (1 cartload = 15 *ares* or 1500 m²) and a manse where the *servus* can establish his home, his barn and his garden’ (quoted by Hägermann, 1985: 57–59). The importance of the enclosed plot of land appears in the Danish and Swedish *toft*, which, like *bol*, served to define the farmers’ rights and obligations and is to be found in Scandinavian toponyms in England and Normandy. However, in regulating its size and its location in the village, Scandinavian regional laws reveal *toft* to have a more substantial material reality than *bol* (Nissen, 2013).

Aside from the aspect of tenure, the *manse* and the *hide* also bear on the definition of the portion of the wilderness whose use their inhabitant shared with his neighbours. The rules governing use of ‘common land’ were the subject of precise stipulations in regional laws, according to the prerogatives of the various categories of inhabitant. Distinguished here were: a) those with full prerogatives – neighbours or consorts [jointly interested parties] (Visigothic

Code), men, occupiers of manses; b) other parties with a right to variable prerogatives – *accolae* or outsiders; c) those merely being made welcome by another – guests (*hospites*); d) excluded persons. In its Carolingian version prior to 768, Salic law permitted neighbours to object to the installation of a newcomer (Devroey, 2003: 83–84; id., 2006: 419–432). Inherent in *manse* and *hide* therefore was the possibility both of regulating the use of space in favour of peasants entitled to use it and of apportioning among them the obligation to pay dues and to perform services. In England, land was divided between the exempt *inlands* (not measured in *hides*) of landlords and the taxable *hides* of peasants, who were compelled to pay the royal tribute (the *feorm*), which formed the physical support system of Anglo-Saxon kings (Faith, 1997: 8, 40–41, 49). In Francia, there was the same dichotomy between the seigniorial manses of the *domini* (*mansi indominicati*) and the peasant tenures, manses, *accolae* and *hosticiae*, as is clearly demonstrated in the royal tributes hastily levied in the second half of the ninth century to pay for the departure of or alliance with Scandinavian chiefs.

This organization of cultivated land and wilderness around the peasant's holding and his family is reminiscent of the situation that existed in Northern Europe and in non-Romanized Germania before AD 400. Nevertheless, the transformation of the rural landscapes of the former Romanized provinces, after the beginning of the migrations and invasions, was not reflected in a 'Germanization' of the dwelling: in Britain, for example, the migrating Jutes, Angles and Saxons did not bring the model of the long house-cum-byre with them (see Devroey and Nissen Jaubert, 2011: 17–18). That said, houses of the early Saxon period had approximately the same dimensions as the residential part of the long house and seem to have been similar to comparable models (Zimmermann, 1999). The functional utility of the byre was in fact limited – animal warmth does not really spread through a long house, but parasites do. Symbolic motives are mentioned increasingly frequently and might explain the reason why the dwelling of this sort was abandoned on the other side of the Channel. It should be pointed out that the byre was gradually separated from the longhouse from the sixth century on in the region of Drenthe (Nissen Jaubert 2003), where new forms of living space and land use, with great regional diversity, appear to have developed.

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