7 Prospect and Protect: Syntironomy and Cereals in Early Medieval England

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Introduction

Teleology, derived from the Greek τέλος (end), is defined as 'the interpretation of phenomena in terms of their purpose rather than possible causes' (*Chambers Dictionary*, 2003). In history and archaeology, therefore, a teleological approach is one which interprets the 'earlier' through the lens of the 'later'. The study of medieval English farming between the seventh and thirteenth centuries naturally invites a teleological approach because many of the relevant sources are relatively late. Documentary evidence for agricultural practice is extremely scarce prior to the thirteenth century, and cartographic evidence largely dates from the early modern period. Extant features in the modern landscape and nineteenth-century Ordnance Survey maps offer invaluable palimpsests from which long histories of agriculture and rural settlement may be teased out (Roberts and Wrathmell, 2000; Hall, 2014). The scant – primarily archaeological – evidence for the seventh to twelfth centuries is therefore most readily interpreted with reference to those richer later records: inviting us to explore the 'origins' of open fields, nucleated villages, and other phenomena which later became so prominent in the landscape (Rippon, 2008, 1–26).

This kind of teleological perspective is problematic, not least because of its arbitrary and question-begging assumption that later medieval and early modern landscapes represent the (perhaps inevitable) culmination of earlier medieval endeavours. It might be called a retrospective approach: taking a perceived 'culmination' and looking backwards in time to find the developments from which it emerged. Such a retrospective approach to history encourages us to fixate on emergent moments or accomplishments, and trajectories of progress or failure. It does not encourage us to look at developments on their own terms; but how could we achieve that when the terms available to us date largely from later periods?

Escaping the white bear

A related issue has been explored in a study by the English Landscapes and Identities project (EngLaId), concerning England in the period *c.*1500 BC to AD 1086 (Ten Harkel et al., 2017). This paper challenges the common view of pre-modern agriculture as a 'socio-economic' activity, arguing instead that it was inseparable from ritual or religion. The authors contend that 'agricultural intensification is often regarded as being predominantly about creating surplus … In contrast, the EngLaId project starts from the assumption that in looking at periods before the invention of modern rationalism during the seventeenth century such distinction between pragmatism and ritual is unhelpful' (Ten Harkel et al., 2017, 414). The paper makes a strong, evidence-based case for the inextricability of agriculture and ritual between the Bronze Age and the medieval period, and – in an implicit critique of teleology – argues more generally that the concepts and terminology that pervade much archaeological literature impose a misleadingly modern perspective on the past:

> people probably had no separate categories of agriculture, craft production, trade, religion and so on. These would have been intermingled and mixed in ways we find confounding … For people of the medieval period and earlier, ploughing and prayer were both equally necessary to ensure a good harvest. (Ten Harkel et al., 2017, 416)

Having made this point, however, the authors do not make clear what alternative terms or concepts should be preferred. On the contrary, the concluding discussion refers to 'full-blown agriculture' in the Iron Age, and an 'increasingly complex economic system and a complex mixture of ritual traditions' in the Roman period (Ten Harkel et al., 2017, 432–33). What do these phrases mean if we are not allowed to name 'agricultural', 'ritual' and 'economic' as separate kinds of activity? It seems that, while the authors argue against the distinction between the agricultural and the ritual, they cannot entirely escape it themselves. In order to argue for the complete entwining of the agricultural and the ritual, one must refer at the outset to ritual and agriculture, otherwise the argument could not be expressed or understood by a modern 'rational' scholar.

This paradox could be seen as an instance of ironic process theory, which holds that 'processes that undermine the intentional control of mental states are inherent in the very exercise of such control' (Wegner, 1994, 34). The 'white bear' experiment provides a vivid illustration of the theory: subjects who were asked not to think about a white bear found themselves unable to suppress the thought of a white bear (Wegner et al., 1987). By the same token, the mind would struggle to maintain a complete entanglement of ritual and agriculture without also naming (and thus perceiving) them as two different concepts. Similarly, it could prove near-impossible deliberately to avoid a teleological perspective on early medieval agriculture without, in the process, keeping later phenomena (such as open-field systems) in mind.

How can we escape our teleological bears? It would surely be simpler never to have thought of a bear in the first place, rather than having consciously to discard the thought. What if we could examine the historical and archaeological evidence for plants, animals, buildings and fields without initial reference to modern ideas of agriculture, trade, craft, religion or culture? While such concepts are evidently useful to historians and archaeologists and need not be abandoned altogether, could we nonetheless *start* from a different theoretical perspective: one which is less dependent upon modern categories and which makes minimal assumptions at the outset?

Introducing syntironomy

As an alternative to the white bears of teleology, this paper introduces a novel theoretical perspective: syntironomy. Syntironomy rests upon the minimal assumption that time is linear and therefore, in order for things to exist, they must persist over time. The nature of existence is persistence: existent phenomena, both abstract and concrete, must tend towards persistence even if they eventually cease to exist. This is the syntironomic principle, and it can be stated succinctly as 'nature abhors an ending'.

Derived from the Greek συντηρώ (to sustain or conserve), syntironomy is concerned with interpreting how phenomena are sustained or conserved over time: how their persistence is maintained. It proposes that there are four basic methods by which persistence may be achieved: 'Provision', 'Protection', 'Propagation' and 'Prospection'. These four syntironomic methods are defined below. In these definitions, a 'resource' can mean something material such as food, fuel or clothing, but it can also denote a process, custom, or idea.

'Provision' means persistence through the exploitation of resources which are already available. For example, human respiration depends upon the Provision of oxygen. Foraging activities depend upon the Provision of edible wild plants and fungi. Replicating a style of garment relies upon the Provision of a pattern. Newborn babies are almost exclusively dependent upon Provision.

'Protection' means persistence through the retention of those resources which are already available. Protection can take obviously physical forms, such as the tough hide of a rhinoceros or the impregnable walls of a castle. Other manifestations include the freezing or desiccation of foodstuffs to prevent decay; insurance policies; legal contracts; weaponry; digital backups; and immune systems.

'Propagation' means persistence through the increase of available resources. Human reproduction is an obvious form of Propagation, serving to maintain (among other things) a family and a species. Propagation methods also include the sowing of seed corn to extend the Provision of a crop beyond a single year's harvest, and the breeding of livestock to maintain or increase a herd. The accrual of interest on a monetary deposit can also be seen as a form of Propagation. More abstractly, the printing of books Propagates ideas and knowledge.

Finally, 'Prospection' means persistence through the exploration and acquisition of new resources. This could include the exploration of new hunting grounds, or experimentation with new crop species. Prospection is inherent in the idea of 'divergent thinking' – the simultaneous exploration of multiple solutions – as a key cognitive factor in problem-solving (Runco and Acar, 2012). At an unconscious level, genetic mutation is a form of Prospection, as it creates opportunities for new and potentially advantageous characteristics to emerge within a species, thus increasing the chances of its survival.

At least one of these four syntironomic methods must be at work for any given abstract or concrete phenomenon to exist, but they may occur in any combination or number. Often, there will be more than one application of a method – for instance, a piece of cheese wrapped in aluminium foil and placed in a refrigerator is subject to (at least) two forms of Protection. Cheesemaking itself is a form of Protection because it preserves milk from spoiling. Eventually, however, even cheese will be consumed: by fungi, if not by a human. This example illustrates syntironomic failure, when a phenomenon or entity (the piece of cheese) ceases to exist because it has been *superseded* by another entity's syntironomic methods (an organism obtaining nutrients, i.e., Provision). Such supersession is another key principle of syntironomy: all things tend towards persistence until their syntironomic methods are superseded by those of another phenomenon or entity.

Syntironomic methods are not necessarily consciously exercised, since they apply to sentient and non-sentient, living and non-living things alike. Cell biology offers a good illustration of unconscious syntironomy. Animal cells persist fundamentally through respiration, which rests upon the Provision of oxygen and glucose. The cells also benefit from Protection, offered not only by their own outer membranes but also, ideally, by the immune system of the parent organism. Collectively, cells also persist by Propagating themselves through cell division, and particularly through the replication of their DNA. It is at this level that the cells engage in Prospection, since genetic mutation during replication can be seen as a form of cellular innovation, or exploration, which can contribute to the collective syntironomic success of the cells (as well as the parent organism and, ultimately, the species). Supersession of cells can take many forms – for instance, the Prospection of viruses seeking to Propagate themselves by hijacking the cells' own syntironomic methods.

Syntironomy and human survival

The conscious syntironomy of humans is more complex. The nexus of syntironomic methods employed by a human (or group of humans) is limited only by their ingenuity and environmental constraints. It is not possible, therefore, for this paper to characterize a complete syntironomy of human life. Rather, by way of example, it focuses upon the acquisition of plant foods – above all, cereals – the consumption of which supports the persistence of the body. Local availability of sufficient and accessible wild foods could allow humans to depend strongly upon Provision for their food security, whether attained via fishing, hunting or gathering. The traditional subsistence strategies of the Ju'/Hoansi Bushmen of the Kalahari offer a modern, though diminishing, example of such complete reliance upon the Provision of wild food sources (Suzman, 2017). Where wild resources are less reliable or environments more hostile, other methods may be employed. Alternative terrains can be Prospected for new resources, while abandoned terrains are thus Protected in order for them to recover from potential depletion, perhaps within a seasonal migration cycle such as that practised by the Saami of northern Finland until the nineteenth century: 'the whole way of life aimed at preserving the natural resources' (Hicks, 1993, 138).

Such nomadic or semi-nomadic lifeways might be glossed collectively as 'hunter-gatherer mobility' (Kelly, 1983); but from a syntironomic perspective, a particular *sedentary* practice can be interpreted in a comparable way. The Early Neolithic 'pre-agricultural plant management' of wild perennial grasses, identified at Sheikh-e Abad in modern Iran, is said to have entailed 'weeding, watering, protection *etc.*' without creating 'the selection pressures necessary for domestication' (Whitlam et al., 2018, 828). Domestication is here taken to mean the genetic separation of varieties of plant or animal which thrive in an anthropogenic environment, and which in turn benefit humans: effectively, the evolution of a symbiotic relationship with *Homo sapiens* (Zohary et al., 2012, 20–22).

The common syntironomic characteristic of hunter-gatherer mobility on the one hand, and sedentary non-agricultural plant management on the other, is this: passive human interaction with natural syntironomy. In these models, the syntironomic methods of wild food plants or quarry animals are not harnessed, altered or superseded, but rather (ideally) allowed to continue indefinitely in their own way. Alternatively, humans can interact more actively with the syntironomic methods of wild plants and animals, harnessing and altering those methods to improve Provision for human needs. Domestication, as defined above, offers a prime example. Whereas wild cereals rely upon the shattering of their ears for seed dispersal and thus Propagation, domesticated cereals under cultivation are subject to the opposite selection pressure: non-shattering ears are preferentially harvested and therefore resown as seed corn. The Propagation strategies of humans thus create a new ecological niche, and the genetic Prospection of the cereal plants allows them to adapt to that niche, to the mutual benefit of both the plants and the people.

Syntironomy and cereals

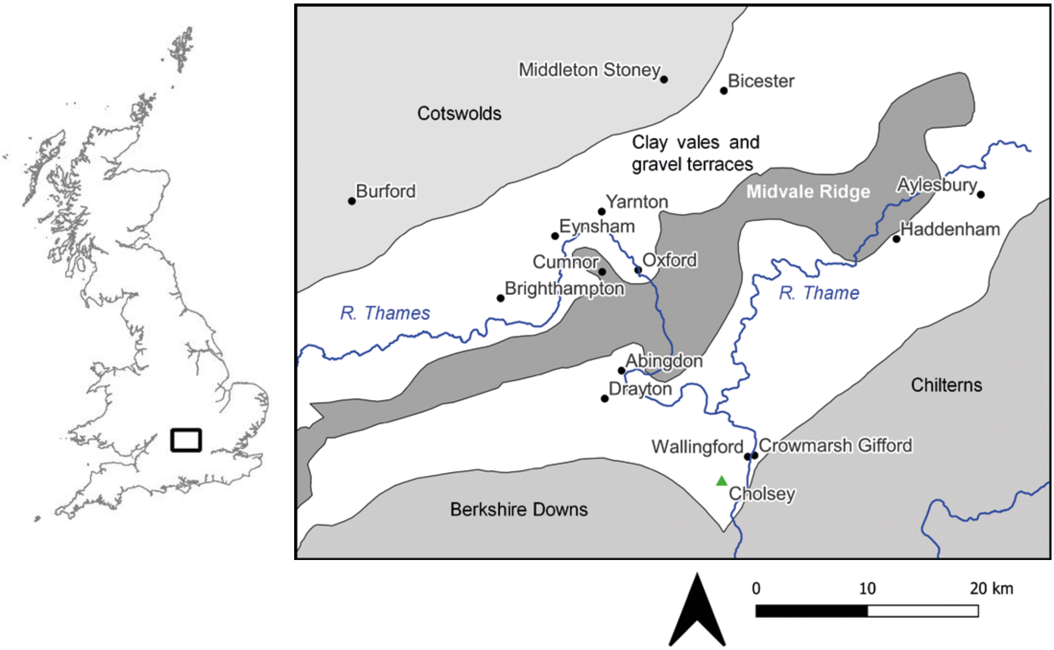
More than 9,000 years after their original domestication in the Middle East, wheat (especially free-threshing bread wheat: *Triticum aestivum* L.) and barley (especially hulled barley: *Hordeum vulgare* L.) were well-established in early medieval England (Moffett, 2006). The genetic Prospection methods of these cereals had allowed them gradually to adapt to environments very different from those of the 'Fertile Crescent' over the intervening millennia. England's early medieval crop spectrum also included oats (*Avena* L.) and rye (*Secale cereale* L.), which had originally been tolerated as weeds of wheat and barley in the Middle East, but came to be domesticated and cultivated in their own right as they were carried into central and northern Europe: an especially successful instance of 'crop mimicry' as a means of Propagation (Behre, 1992; Zohary et al., 2012).

All of the foregoing discussion might seem to be a laborious and tortuous way of describing the origins of agriculture, its spread to the British Isles, and its continued evolution through to the early medieval period and beyond. However, reversion to that paradigm falls foul of the EngLaId critique: that branding certain activities as 'agricultural' blinds us to the nuances of pre-modern times. Instead, the perspective taken above has followed the syntironomic success of cereals as much as the survival of their human cultivators.

The persistence of these cereals in England from the early medieval period onwards goes beyond their continued cultivation through the fifth to thirteenth centuries. The fact that archaeological research projects such as FeedSax can study large datasets of preserved cereals and associated arable weeds (e.g., Bogaard et al., this volume) is testament to the durability of certain plant parts in the archaeological record. The incomplete combustion of grains, seeds and other elements reduces them to carbon, producing the charred plant remains which are the mainstay of archaeobotany (Charles et al., 2015). They are resistant to microbial decay, and often physically robust enough to endure for millennia in the soil. Cereals are particularly apt to be preserved by charring: they are processed in ways that bring them into close contact with fire (e.g., drying or malting), and their suitability for long-term storage and processing in bulk renders them vulnerable to the accidental conflagration of barns, granaries and mills (van der Veen, 2007). The physical persistence of some cereal plants over centuries and millennia has thus benefited indirectly from the Protection methods of humans, seeking and sometimes failing to keep their staple foods safe by drying and storing them in bulk.

Nonetheless, it must be remembered that the seventh to thirteenth centuries in England witnessed some 700 harvests at thousands of settlements, producing countless billions of cereal grains of which only a tiny fraction survives in the archaeobotanical record; the vast majority were consumed at the time by humans, livestock, wild animals, insects, fungi, bacteria or fire. Of the tiny surviving fraction, it is likely that only a small (though increasing) proportion has been retrieved and analysed by archaeobotanists, who must make a working assumption that they have a reasonably representative sample from which to draw conclusions about past environments and practices.

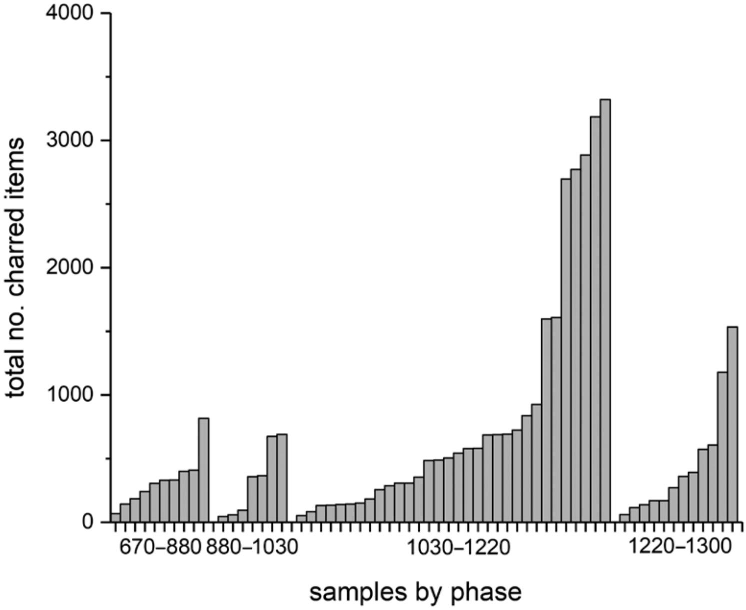
In short, the archaeobotanical remains of early medieval crops and weeds represent the proverbial tip of an iceberg. What does it mean, then, if that tip appears to grow over time: if the archaeobotanical record for a region becomes richer, more abundant? This appears to be the case in the Upper Thames valley, a region in England's 'Central Zone' characterized by heavy clay vales, lighter gravel terraces and alluvial clays on the floodplains (Booth et al., 2007). The wider region



31 The Upper Thames valley case study area. Black dots indicate sites which have produced archaeobotanical data analysed in this paper; the triangle marks Cholsey, the site of a large medieval tithe barn discussed in the text. Contains Ordnance Survey Open Data © Crown copyright and database right 2017, under the Open Government licence. Terrain boundaries after Natural England's National Character Areas (https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making; accessed 23/07/21). Map created with QGIS (http://www.qgis.org; accessed 08/03/2022).

as defined in this paper (Figure 31) also includes the valley of the Thame, a tributary which flows south-westwards into the Thames; the limestone dip slope of the Cotswolds to the north-west, which rolls gently south-eastwards into the Thames valley; the Midvale Ridge of low limestone hills, which bears dry, sandy, acid soils; and to the south, the chalk hills of the Berkshire Downs and Chilterns.

The FeedSax project collected archaeobotanical data pertaining to 84 samples from 26 excavated sites in this region, each sample containing charred grains and other plant remains of seventh- to thirteenth-century date (Figure 31; Tables 7 and 8). Each of these samples has a crop component dominated by the four free-threshing cereals which characterize early medieval English farming: free-threshing wheat, hulled barley, oats and rye (cf. McKerracher, 2019). Among these 84 samples are 65 which are datable to one of four phases: *c.* AD 670–880, 880–1030, 1030–1220 and 1220–1300. These 'best fit' phases have been devised by the FeedSax project to



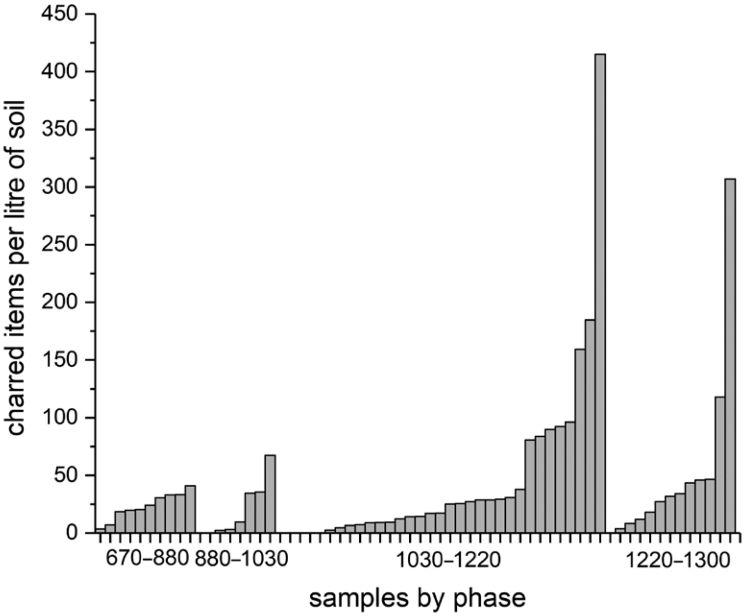
32 Abundance of charred plant remains per sample, grouped by phase. Excludes four anomalously rich samples whose inclusion would obscure overall patterns (see main text).

accommodate both commonly used ceramic phases and radiocarbon date ranges obtained from the IntCal20 calibration curve (Hamerow et al., in prep.; Reimer et al., 2020). The remaining 19 samples cannot be specifically assigned to any one of these phases, but they nonetheless date from sometime between the seventh and thirteenth centuries.

Figure 32 charts the overall abundance of charred plant remains (including cereal grains, chaff items and arable weed seeds) in each of the 65 phased samples, grouped chronologically, excluding four anomalously rich outliers (with more than 4,000 items each) whose inclusion would have obscured patterns among the other samples.[1] This graph shows that, in simple numerical terms, the period 1030–1220 produced significantly more charred plant remains than the other periods: more items in more samples at more sites. Put another way, the cereals of this period have enjoyed greater syntironomic success through to the present day.

Why might this be? Could these results be artificial, an artefact of recovery due to the sampling of larger soil volumes from sites

1 These four samples derive from contexts 3693 at Yarnton (20,157 items; phased 670–880); 113/9 at All Saints Church, Oxford (4,643 items; phased 880–1030); 1590 at Merton College, Oxford (8,680 items; phased 1030–1220); and the 'medieval grain spread' at the Prebendal, Aylesbury (130,921 items; phased 1030–1220).



33 Average density of charred plant remains per litre of soil, per sample, grouped by phase. Excludes four anomalously rich samples whose inclusion would obscure other patterns (see main text).

of this period? We can check this by calibrating the results by soil volume, i.e., by calculating the average density of items per litre of soil. This can be achieved for 56 samples, having excluded those four anomalously rich outliers mentioned above (whose inclusion would again obscure patterns among the other samples) and a further five for which no soil volume data were available. The resulting density data are displayed in Figure 33 and clearly echo the pattern seen in Figure 32, thus demonstrating that the trend is not due to differences in samples' soil volumes.

How should we interpret these results? There are several aspects to disentangle here. First, there is a significantly greater number of sites – and samples – represented for the period 1030–1220 than for the earlier and later periods (Table 8). The greater number of samples in the period 1030–1220 is largely a function of the greater number of sites: no single site contributes an absolute majority to the total number of samples in this period, so the overall trend is not being distorted by one unusually fruitful excavation. In fact, such a bias only occurs for the period 670–880, for which a single well-sampled site (Yarnton) contributes all 11 of the samples, including one of the four anomalously abundant/dense samples which were excluded as outliers from Figures 32 and 33. Yarnton is, in a sense, the exception that proves the rule, demonstrating that sites of that period *can* add rich charred crop assemblages to the archaeological record, but in practice seldom do.

Table 7 Upper Thames valley sites included in the dataset used in this study

Site	Samples	References for data
Abingdon: 75 Ock Street	2	Hull, 2006
Abingdon: Morlands Brewery	3	Pine and Taylor, 2006
Abingdon: West Central Development	4	Brady et al., 2008
Aylesbury: The Prebendal	1	Moffett, 1989
Bicester: Chapel Street	1	Harding and Andrews, 2003
Bicester: Langford Park Farm	1	Pine and Mundin, 2018
Brighthampton: The Orchard	1	Ford and Preston, 2003
Burford: 47–53 High Street	7	Coles et al., 2008
Burford: Priory	1	Thompson, 2010
Crowmarsh Gifford: Lister Wilder Site	2	Laban, 2013
Cumnor: Dean Court Farm	6	Moffett, 1994
Drayton: 54–80 Abingdon Road	1	Anthony and Taylor, 2006
Eynsham: Abbey	2	Hardy et al., 2003
Haddenham: Fort End	2	Bray and Weale, 2014
Haddenham: Townsend	1	Bray and Weale, 2014
Middleton Stoney	1	Rahtz and Rowley, 1984
Oxford: 113–119 High Street	1	Walker and King, 2000
Oxford: All Saints' Church	2	Dodd, 2003
Oxford: Jesus College and Market Street	3	Bashford and Ford, 2014
Oxford: Lincoln College	12	Kamash et al., 2003
Oxford: Merton College	5	Poore et al., 2007
Oxford: Nun's Garden	1	Teague et al., 2015
Oxford: Sackler Library	2	Poore and Wilkinson, 2001
Oxford: St John's College	2	Wallis, 2014
Wallingford: 51–53 St Mary's Street	1	Preston, 2012
Yarnton	19	Hey, 2004

Table 8 Distribution of sites and samples, by period

Period (years AD)	Excavated sites	Samples
670–880	1	11
880–1030	3	8
1030–1220	10	34
1220–1300	5	12
No single period	13	19
Totals	**26**	**84**

Nonetheless, there is an artificial modern bias contributing to the predominance of evidence from the period 1030–1220: three of the ten sites represent excavations within Oxford. The city of Oxford is systematically over-represented in the early medieval archaeological record for this region, first because of the high frequency of excavations consequent on urban development there, and second because of Oxford's central roles through the tenth to thirteenth centuries, from a Late Saxon *burh* to a revived post-Conquest town (Dodd, 2003, 19–63). By contrast, urban settlements elsewhere in the Upper Thames valley were much less developed in the period 880–1030, and non-existent in the period 670–880. Hence, a comparison between the evidence for 670–1030 and that for 1030–1300 is, to a large extent, a comparison between rural and urban, with the latter usually yielding richer, denser charred crop deposits.

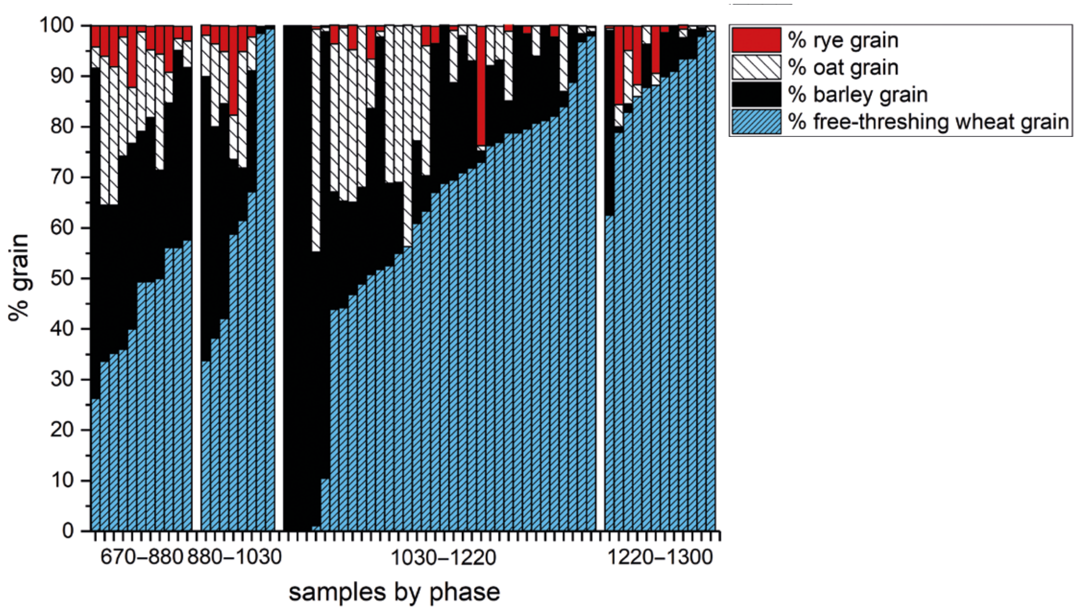
What may explain the greater syntironomic success enjoyed by the cereals that were imported into towns? The high concentration of modern excavations in urban centres helps to explain the greater overall *number* of samples retrieved, but not necessarily the *density* of charred plant remains within those samples. It is not necessarily the case that, as more and more samples are retrieved, the chances of discovering very dense deposits must increase; that is only true as long as there are dense deposits still awaiting discovery. There is, however, some correlation between density and settlement type. It is significant to note that among the denser samples from *c.*1220–1300 are not only samples from Oxford but also some from Abingdon – home to a wealthy medieval abbey – and its grange at Dean Court Farm, Cumnor. These assemblages share a common historical context: the supply of surplus crops to 'consumer' (i.e., non-harvesting) monastic and urban populations, which were generally much larger by the thirteenth century than they had been in the seventh century. Relatively dense concentrations of consumers (as in towns and monasteries) create relatively dense concentrations of food (as also in related production and storage contexts, such as monastic granges and tithe barns), and thus create dense archaeological concentrations of food remains.

Witness, too, the development of crop storage facilities and mills across England over this same period. No specialist storage structures appear to have been built between the fifth and mid-seventh centuries, a dearth which suggests that harvests typically did not exceed what could be stored within households (Hamerow, 2012, 51–52; McKerracher, 2018, 70–76). But then, somewhere between the later seventh and late ninth centuries, granaries were constructed at Yarnton covering an area of some 125 square metres (Hey, 2004, 124–27). Some five centuries later, probably around the turn of the fourteenth century, a huge tithe barn covering some 1,500 square metres was constructed for Reading Abbey at Cholsey in Oxfordshire (Figure 31; Horn, 1963). The construction of mills, which indicate a scale of crop processing well above that of individual farms, followed a similar trajectory. They are absent in the archaeological record of the fifth to mid-seventh centuries; around 60 watermills are known from archaeological and documentary sources for the late seventh to tenth centuries; more than 5,000 watermills are recorded in the Domesday Book of 1086; and perhaps 10,000 or more mills (including windmills) were in use by 1300 (Historic England, 2018).

Taken together, all of this archaeobotanical, archaeological and documentary evidence indicates a continued escalation of surplus storage, processing and consumption between the late seventh and late thirteenth centuries. In syntironomic terms, we could see all of these trends as avenues of Prospection and Protection for the security of those producing the crops. Prospection entailed the exploration of new storage and processing technologies. Protection entailed the use of such facilities to protect harvests from the depredations of rodents, insects and damp; but Protective methods also encompassed the sale of corn to urban consumers which allowed the conversion of perishable harvests into less perishable possessions and wealth. In addition, by the twelfth century, Provision of labour and surpluses to landlords Protected tenants from dispossession (Dyer, 2003, 107).

The persistence of wheat

Returning now to the archaeobotanical evidence from the Upper Thames valley and its wider environs: what of the cereal crops themselves? Which species contributed to these growing surpluses? We can address this question by taking the 65 phased samples (Table 8) and calculating for each one the relative proportions of wheat, barley, oat and rye grains, as a proxy for the relative proportions of crops harvested and/or stored in each period and locality (Figure 34). More specifically, a working assumption is made that the cereals in these samples represent crops intended for human consumption, rather than animal fodder, thatching, bedding or other uses. This assumption is made on the basis that cereals intended for human consumption are inherently more likely to be preserved by charring – in malting kilns, for instance, or whilst being dried prior to milling – than are fodder or thatching crops. In addition, the great majority of these samples can be classed as grain-rich 'product' samples (cf. McKerracher, 2019, 37–48), representing harvests which had already



34 Percentages of free-threshing wheat, barley, oat and rye grains in samples, grouped by phase.

been threshed, winnowed and therefore probably earmarked for human consumption.

In the periods 670–880 and 880–1030, the percentages are very variable, with wheat and barley – and occasionally oat – constituting relatively high proportions of the total grain counts. The main exceptions to this variability are two wheat-dominated samples, dated *c*.880–1030, from the excavations at All Saints' Church in Oxford.

To some extent, this variability continues among the 1030–1220 samples, with three samples (from Oxford) containing 100 per cent barley, and others containing significant proportions of wheat, barley and oat grains (in comparison, rye generally registers only a negligible presence in this period). However, what is most striking about the data for 1030–1220, and for the following period (1220–1300), is the large number of samples clearly dominated by wheat grains. Of the 46 samples collectively spanning 1030–1300, wheat grains constitute more than 60 per cent of the total grain count in 32 of them. Excavations in Oxford, Abingdon and Cumnor (specifically the monastic grange at Dean Court Farm) are well represented among these 32 samples, but other sites such as Burford – a town with an ecclesiastical hospital, at the edge of the Cotswolds – are represented too. It is difficult to escape the conclusion that, of all four cereals in cultivation, wheat contributed most of all to the growing surpluses produced and consumed from *c*.1030 onwards. This chimes well with the documentary evidence for the central importance of wheat. The

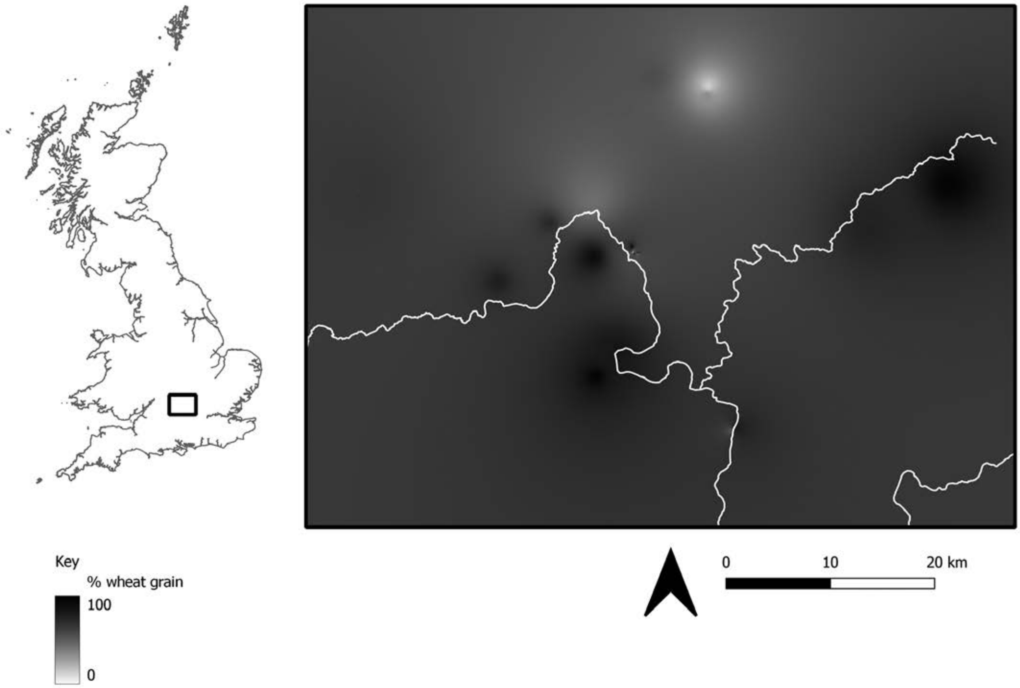
Anglo-Saxon Chronicle, for instance, illustrates the severity of the 1044 famine with reference to the inflating price of wheat, implying that the latter was a common index of food security and exchange – and therefore that wheat was the key staple and/or highest value cereal food of the time, at least in the eyes of those responsible for writing such documents (Banham, 2010, 181; Banham and Faith, 2014, 24–25).

Hence, the syntironomic success of wheat – culminating in its strong archaeobotanical representation in urban excavations – is attributable to its being an important and particularly desirable staple of human diet, especially from the eleventh century onwards. An exhaustive discussion of why wheat should have achieved this central status is beyond the scope of this paper; the reasons are likely to be varied and complex, including such factors as its flavour and baking qualities (Banham, 2010). But an environmental factor also deserves consideration. The percentages of wheat grains per sample, as graphed above in Figure 34 but now also including the 19 samples which cannot be assigned to any single phase, can be mapped using a technique called Inverse Distance Weighting (Chapman, 2006; McKerracher, 2019, 82). This approach interpolates geographical trends from the sample-by-sample data, taking account of geographical distances between the parent sites, and produces a shaded matrix in which the darker shades indicate higher percentages of wheat grain per sample: black corresponding to 100 per cent wheat, white corresponding to 0 per cent (Figure 35).

The resulting map clearly illustrates that the greatest concentrations of wheat-rich samples are among the sites nearest to the rivers Thames and Thame: that is, well within the clay vales rather than on the limestone dip slope to the north, where barley and oat are more prominent. There may be an ecological reason for this pattern: barley, oat and rye are more tolerant of poorer and drier conditions, whereas wheat thrives on richer, heavier soils such as clayey loams, as long as they are sufficiently well-drained (Moffett, 2006, 48; Banham, 2010, 182–83). For towns such as Oxford and Abingdon, then, situated advantageously on the water source and transport route of the Upper Thames, wheat may well have been the most abundant local crop – the crop of greatest Provision – as well as a desirable, tradeable good for a riverine market town.

Expansion and disturbance

If wheat was preferentially imported by urban populations, and urban populations were growing, then it stands to reason that



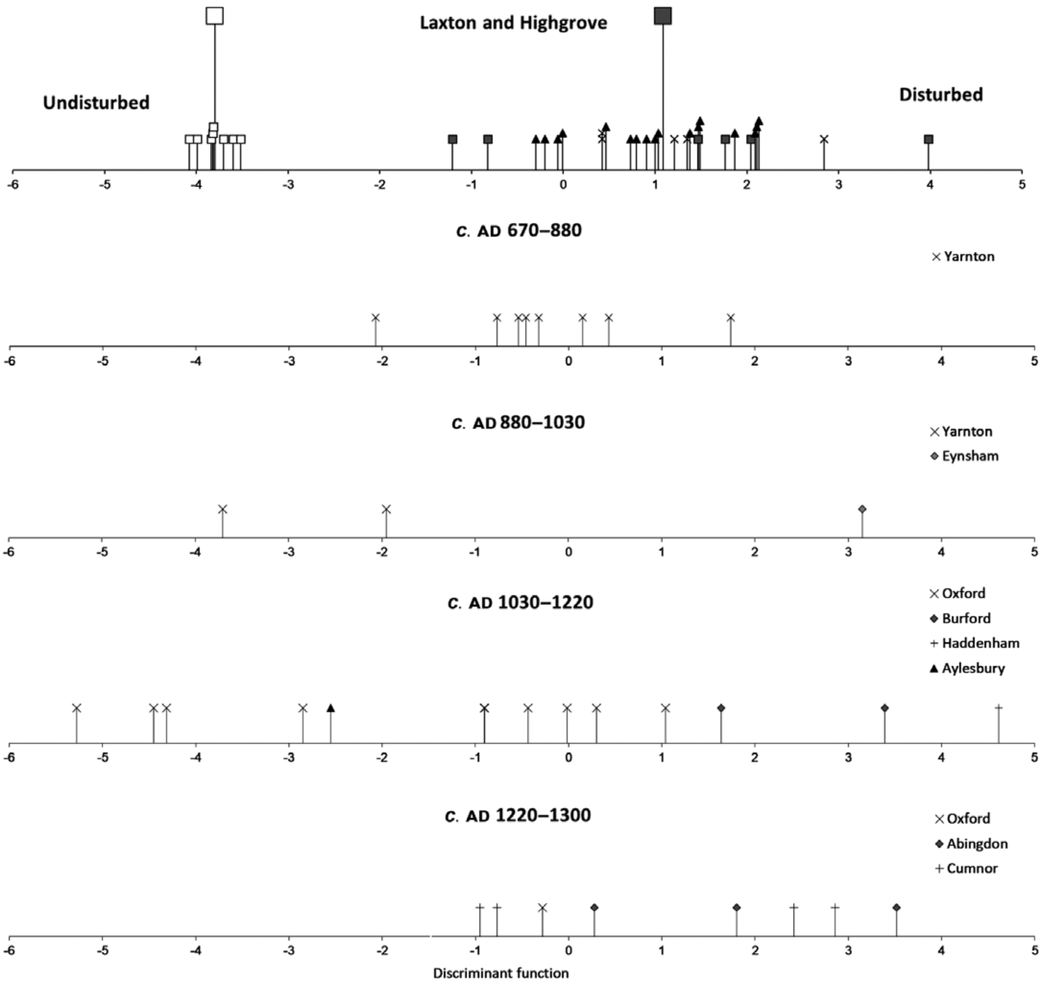
35 Interpolated map of percentages of free-threshing wheat grains in samples from all phases. Map created with QGIS (http://www.qgis.org; accessed 08/03/2022).

the cultivation of wheat – and perhaps other crops too – must have expanded over this period. The Provision, Protection and Prospection methods discussed so far cannot alone explain the twinned syntironomic successes of cereals and humans between the seventh and thirteenth centuries. Surely there must also have been a Propagation method which worked to increase the available surpluses both for consumption and for seed corn? The most obvious manifestation of Propagation in this context would be the physical expansion of arable land, a process which can leave traces in the pollen record. The broad palynological picture from sub-regions in central, east and south-east England, as investigated by Forster and Charles (this volume), highlights a significant increase in arable land use in the eighth century, a slight increase in arable and pasture but with more of an emphasis on pasture at some sites in the tenth century, and a decline in land use around the eleventh century. In other words, despite archaeological and archaeobotanical evidence for a continuing growth in crop surpluses from the seventh century onwards, there is no definitive palynological evidence for a steady expansion of arable land unfolding *continuously* through this whole period. On the contrary, it is likely that much of the arable land in use in the thirteenth century had already been cultivated since at least the eighth century. Therefore, the persistent growth of crop surpluses between the seventh and thirteenth centuries cannot be explained in terms of a continuous, general expansion of arable land through this period.

If there was not a continuous, general expansion of arable land between the seventh and thirteenth centuries, could changes in crop husbandry strategies help to explain the overall persistence – and particularly the Propagation – of surplus crop production through this period? The functional weed ecology method developed by Bogaard et al. (this volume) allows us to shed some light on this issue. Bogaard's method for gauging soil disturbance from archaeobotanically preserved weed flora can be applied to the data from the Upper Thames valley, with a significantly wide range of results (Figure 36).

As with previously studied data from Stafford (Hamerow et al., 2020, 598, fig. 8) the samples from the Upper Thames valley return a wide range of discriminant scores. Those for the period 670–880, all from Yarnton, reflect a moderate level of disturbance. For the subsequent period, 880–1030, there is a polarization between Yarnton's two samples with low disturbance and Eynsham Abbey's one with high disturbance. The samples from 1030–1220 show the greatest variability of all, registering low, moderate and high disturbance with no clear correlations between disturbance levels and settlement status. Indeed, a very wide range of low and moderate disturbance signatures is represented by the samples from Oxford, perhaps unsurprisingly for an urban centre drawing in corn from various sources. Higher disturbance is registered by two samples from Burford – the town with an ecclesiastical hospital – but the highest of all is represented by a sample from a supposed croft (i.e., a cultivated plot attached to a house) excavated at Haddenham. Finally, although none of the samples from 1220–1300 registers low disturbance, they nonetheless cover a range from moderate to high disturbance, with the two principal sites – Abingdon, and Abingdon Abbey's grange at Cumnor – represented at both ends of this spectrum.

It thus appears that in the period of greatest apparent growth in cereal surpluses (*c.*1030–1220), a potentially very wide range of husbandry practices contributed to the syntironomic success of cereals and their cultivators: practices which may have spanned heavy and light ploughing, two- and three-course crop rotations, different degrees of fallow ploughing, and a variety of terrains – different combinations of these factors resulting in a wide range of disturbance signatures. This variety is exactly consonant with a syntironomic model, in which Prospection seeks out and fills available 'niches' in both human and natural ecosystems and continues to do so as opportunities and restrictions change over time: like water percolating



36 Weed ecological discriminant analysis of soil disturbance (analysis by Amy Bogaard, following method of Bogaard et al., this volume). Topmost plot shows the relationship of Laxton sykes (low disturbance) versus Laxton and Highgrove arable fields (high disturbance) to the discriminant function; lower plots show the relationship of archaeobotanical samples from the Upper Thames valley, phase by phase, to the discriminant function (larger symbols indicate centroids for the modern groups).

down through a soil matrix, branching and changing course in response to obstacles, apertures and textures. The sparse but polarized data for 880–1030 could indicate that the main spreading, ranging or percolation of crop husbandry practices had occurred (or at least begun) by the late ninth century. The result, taken collectively, resembles a form of overall, long-term Protection: the greater the range of strategies employed across the landscape, the less likely it is that all will fail in a given year. Such large-scale Propagation methods as may have been employed by cultivators are likely to have occurred in discrete, episodic events, such as the claiming of new arable lands by assarting (Dyer, 2003, 161), rather than in a general, continuous, year-on-year investment of intense labour.

A syntironomic perspective on the medieval 'agricultural revolution'

Syntironomy thus offers an alternative perspective on the paradox discussed by Bogaard et al. (this volume), whereby medieval farming combined aspects of both low-input and high-input cultivation strategies (essentially, low fertility and high disturbance), such that a strict distinction between 'extensification' and 'intensification' begins to break down. In syntironomic terms, the evidence presented here indicates an active pursuit of Protection strategies and a much smaller emphasis on Propagation methods throughout most of the period under investigation. The most conspicuous general expansion of arable land use – that is, the most energetic phase of both Prospection and Propagation – appears to have happened comparatively early in the period, around the eighth century (Forster and Charles, this volume). This broadly coincides with the diversification of crops and renewed construction of mills, granaries and grain ovens which can be identified in the archaeological record for much of England between the late seventh and late ninth centuries (Hamerow, this volume; McKerracher, 2018).

Expansion, diversification, renewal: in syntironomic terms, these are the hallmarks of Prospection, which explores, experiments and invents in order to bolster Provision (by finding new productive terrains), Protection (by devising new granaries, for example) and Propagation (by expanding areas of cultivation). In this way, we can see the period *c.*670–880 as a time of great and wide-ranging Prospection in terms of cereal production. But around the end of the ninth century, in areas of central and southern England such as the Upper Thames valley, the trajectory of Prospection changed. Prospective strategies for Propagation and Provision began to peter out as land shortages loomed, and the ingenuity of both producers and consumers alike was turning instead to Protection: overturning weeds, improving drainage, building bigger barns, focusing on local marketable staples, exchanging perishable produce for less perishable wealth, or imposing obligations upon tenants to preserve lordly might – this latter strategy bolstered in particular by a shortage of land in the thirteenth century (Dyer, 2003, 141). In short, more energies went into 'keeping' than into 'creating'; both of these can be means of increasing surpluses. Despite the general success of this approach, however, none of these Protective methods could be entirely secure against crises such as war, famine, disease or flood. And, ultimately, tragically, the grand syntironomic sweep of medieval 'cerealization' was widely superseded in the fourteenth century by the Propagation and Prospection of *Yersinia pestis*: the Black Death.

It might be that a wider syntironomic study of medieval England, reaching beyond the relationship between humans and cereals, could find parallel trends of Prospection and Protection. For instance, it could be argued that, after the creative Prospection that led to the emergence of England's first illuminated manuscripts in the seventh to eighth centuries, the persistence of hand-copied books as rare, expensive and often devotional possessions served to Protect rather than Propagate literacy and knowledge – until Caxton's introduction of the press to England in the fifteenth century triggered the mass Propagation of the printed word.

Further exploration of such ideas lies beyond the scope of this paper. However, by recasting early medieval agriculture in the independent framework of syntironomy, this study has presented a new model for integrating biological, technological, economic, taphonomic and any number of other considerations in future archaeological studies, thus escaping the white bears of teleology.