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Corn-drying kilns in Wales: a review of the evidence

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Corn-drying kilns are becoming increasingly recognised on archaeological sites in Wales, the charred grain and seeds they contain providing valuable evidence of dating, agricultural practices and economic activity. These multi-functional features were used for different stages of crop processing as well as for malting grain for ale-making, and their presence alone, on early sites at least, is suggestive of processes associated with social complexity. This paper examines the form, dating, function and location of recorded Welsh examples dating from later prehistory up to the sixteenth century AD and considers priorities for future research. A gazetteer lists all known examples and is published in conjunction with an online dataset which provides greater detail and is intended to be updated as new information becomes available.

INTRODUCTION

This paper presents the first pan-Wales review of corn-drying kilns dating to the later prehistoric, Roman, early medieval and medieval periods. A gazetteer at the end of the article lists all the know examples recorded in Wales and is published in conjunction with a more detailed online dataset (including plans and sections, dimensions, and summaries of associated archaeobotanical remains) which it is intended will be updated as new information becomes available.[1] Bold numbers in the following text relate to gazetteer entries both in this article and online.

These features — also known as ‘crop dryers’ or ‘crop driers’, ‘grain dryers’, ‘parching ovens’, and ‘drying ovens’ — are a familiar element of the early modern landscape but are increasingly being recognised in excavations of Romano-British, early medieval and medieval sites in Wales. Charred cereal remains found within them provide evidence of the range of crops and indicate particular activities connected with these sites at different periods. They are of considerable interest in their own right but also have a particular significance in Wales in often providing the only clearly dated evidence of activity at early medieval (fifth- to eleventh-century AD) sites, a period when surviving datable material is otherwise infrequent.

This article considers the functions of these structures, the historical references that have been made to them in Wales, their dating, form and location, and the archaeobotanical remains associated with them. Patterns of use over time are set in environmental and social context, and compared with Ireland where corn-drying kilns have been particularly well researched (e.g. Monk and Kelleher 2005).

It is hoped that this article will encourage further research and application of the Welsh evidence which is currently underutilised, thus compounding our poor understanding of the post-Roman and medieval landscape in Wales (Comeau and Seaman 2019b, 1). This is in contrast to Ireland, where the large numbers of corn-drying kilns found in excavations in recent years have become key to understanding the development of agricultural practice and charting social changes (Monk and Power 2012; Monk 2019; O'Sullivan *et al.* 2014, 199–203). In England, similarly, charred grains and seeds, often from corn-drying kilns, provide evidence of changes in agricultural production, consumption and associated economic developments, for instance the extensification of agricultural production in Anglo-Saxon England (Hamerow *et al.* 2020).

Overviews of the evidence from British and Irish corn-drying kilns are given by Rickett (1975), Morris (1979), McKerracher (2014, 296–325), and Monk and Kelleher (2005), with the latter also providing a review of scholarship. Though corn-drying kilns have often been seen as a Romano-British innovation in England and Wales (Van der Veen 2016), in Ireland they are well evidenced from the fifth century BC with a few instances having Bronze Age dates (Monk and Power 2014). In Britain, the use of corn-drying kilns during the Iron Age use is thought likely (Cunliffe 2005, 410), but is generally poorly researched. A corn-drying kiln in Argyll with a Middle Bronze Age radiocarbon date has recently been reported but there are no other instances in Scotland dated to the first millennium BC or earlier (Ellis 2013). The excavated evidence for Scotland is principally eleventh to seventeenth century (Dixon 2011), though some early medieval examples are beginning to be recognised (Ellis 2016). In England, the overall picture for Romano-British and later periods is currently unclear, albeit with abundant evidence being present (Faulkner and Blakelock 2020, 88–9; McKerracher 2014, 392; Van der Veen 1989; 2016), and understanding of Romano-British examples should be improved by a database of corn-drying kilns in the north-western Roman empire that is currently under construction (Lodwick 2020).

The gazetteer towards the end of this article lists the known corn-drying kilns in Wales dating from later prehistory up to the sixteenth century AD according to the types identified below. Some of these are built structures while others are simple pits, but all essentially comprise a drying chamber where grains or other crops could dry or parch in warm air supplied by an adjacent fire. The simpler corn-drying kilns consist of a pit dug into the ground, with the fire in an adjacent pit (possibly separated by a short flue and/or stone baffle) or in some cases underneath the drying crops (e.g. Fig. 1, Bayvil **1.1**; Creamston Road **6.1**, Parc Cybi **22.1**). Timber frameworks to support racks of drying grain are suggested by some excavations and by nineteenth-century descriptions. In the more elaborate stone-built corn-drying kilns, this fire is separated from the drying chamber by a flue that channels heat and reduces the risk of a conflagration from sparks (e.g. Fig. 1, Collfryn **37.1**; Graeanog **27.1**; Whitton Lodge **53.2**). Stone baffles to block sparks may also be present (Monk and Kelleher 2005, 102, 107). The fire was fuelled by the straw and chaff discarded in crop processing, or by gorse, wood, or peat (Hillman 1981, fig. 6; 1982, 138; see also below).

THE FUNCTIONS OF CORN-DRYING KILNS

Corn-drying kilns had a number of different uses (Monk 1981, 217–8; Van der Veen 1989, 303–4), which can be summarised as follows:

- Drying whole ears prior to threshing, particularly after a wet harvest.
- Parching glume wheats (emmer and spelt) after threshing to facilitate glume removal in the winnowing and sieving process.
- Drying processed (threshed, winnowed and sieved) grain prior to bulk storage, to minimise spoilage and kill pests.
- Drying threshed, partially processed hulled barley or oats to facilitate husk removal before milling.
- Drying fully processed grain to harden it before milling.
- Roasting germinated (sprouted or 'chitted') grain to make malt for brewing ale.
- Drying other crops and produce as needed.

These functions could, on a domestic level, be performed without a corn-drying kiln, for instance using a pan on a hearth (Fenton 1978, 375). The appearance of corn-drying kilns in Britain in the Romano-British and early medieval periods therefore signals a scale of processing beyond the domestic, reflecting developments in agricultural distribution, tax, tribute and trade, so that they are effectively indicators of changing social complexity (Van der Veen 1989, 315–6; Monk 2019, 54).

Their usage also varies for different grains, which has implications for interpretations of corn-drying kiln contents. Not all grains routinely require drying or parching. Spelt, widely grown in the Romano-British period, is said to benefit from parching before winnowing to loosen the grain from its spikelets, and roasting or parching is mentioned by classical authors; some research however questions this understanding (Hillman 1981, 153–4; Monk 1981, 218; Meurers-Balke and Lüning 1992; Pena-Chocarro and Zapata 2014). Bread wheat, grown in later periods, does not need parching, although oats, grown in increasingly quantities after the late Roman period, and hulled barley both require heating to loosen and remove husks before milling (Hillman 1981, 132–7; Wiliam 1977, 15). The practice of harvesting oats in a semi-ripe state also means that they benefit from kiln drying before storage to inhibit rancidity (Carruthers 2010, 176; Monk and Power 2012, 40). For malt-making, wheat (including spelt), oats and barley were all used (Hillman 1982; Murphy and Potterton 2010, 313–4; see also below).

It is often assumed that corn-drying kilns were principally used to deal with wet harvests, an argument made in a pioneering mid-twentieth-century discussion that linked an observed westerly and northerly distribution with the likelihood of bad harvest weather (Scott 1951, 196). Since then, excavations have identified corn-drying kilns across drier areas of southern England (e.g. McKerracher 2018, 78), and archaeobotanical evidence suggests that processing damp harvests was not necessarily their primary function. This evidence takes into account the presence or absence of weed seeds and chaff in samples, which indicates the differing stages of processing of crops, while a preponderance of sprouted ('chitted') grains

may suggest malting. Samples from Romano-British corn-drying kilns in England and Wales show clear evidence for drying of partly or fully cleaned, processed crops prior to winnowing, storage in granaries or milling, and for preparing malt for ale, but no evidence of the drying of whole ears, for instance after a wet summer (Van der Veen 1989, 303; 2016, 5). In Wales, a significant level of crop-processing activity has been identified at corn-drying kilns of all periods: details provided in the online dataset show that cleaned or semi-cleaned crops were present at 37 (i.e. nearly half) of the 81 corn-drying kilns with archaeobotanical samples, most of these (22) being of early medieval date. (The variable level of detail in published reports means that this information is not so readily available in the remaining 44 samples.)

More recent corn-drying kiln use shows similar patterns. In nineteenth- and early twentieth-century Orkney and Shetland, corn-drying kilns were principally used for drying oats and barley before grinding and for preparing malt for ale (Fenton 1978, 375). In nineteenth-century Wales, corn-drying kilns were used mainly for drying cleaned oats and barley to facilitate dehusking prior to milling, and only rarely for wheat which developed a 'very strong' flavour when kiln-dried (Wiliam 1977, 15). Seed corn might also be artificially dried in very northerly areas like the Faroe Islands where short summers necessitated harvesting unripe grain, though generally techniques of stooking sheaves and of stack construction would have allowed harvested grain to dry naturally outside even in high rainfall areas like Shetland and west Wales (Fenton 1978, 352–6; Reynolds and Langley 1979, 40; Meredith Morris 1910, 48, 80, 261; Parry-Jones 1948, 64–5). Nonetheless, in Wales, the existence of specific terms for bread made from the kiln-dried corn of damp harvests — *bara cletsh* or reemy bread in Pembrokeshire and *bara ropin* in Glamorgan — shows that wet-weather drying was a familiar practice, albeit associated with 'great distress and sickness' (Meredith Morris 1910, 72).

These considerations will be returned to after examining the historical and archaeological evidence for the use of corn-drying kilns in Wales.

HISTORICAL REFERENCES TO CORN-DRYING KILNS IN WALES

Medieval references

Documents of the twelfth century onwards provide information about the appearance, value, social significance and functions of corn-drying kilns. Twelfth- and thirteenth-century Welsh laws refers to the corn-drying kiln as an *odyn*, literally a 'kiln', and also as a *tritoria*, a Latin term which indicates that its principal usage was for corn (Butler 1987, 53). Three types are mentioned: an *odyn biben* ('piped kiln'; a *piben* being a chimney, flue or fire-hole) within a building known as an *odyndy/odynty* ('kiln-house'); an open 'piped kiln' not within a building; and a kiln which is not 'piped'. Kilns inside an *odyndy* were valued at twice as much as other corn-drying kilns (Wade Evans 1909, 246–7).

Comparing these distinctions with the excavated evidence suggests that a 'piped kiln' corresponds most closely to the 'keyhole corn-drying kilns' with distinctive long flues, described below, that proliferate in the high and late medieval period. Kiln-houses, comparable to the 'drying sheds' noted in Anglo-Norman sources (see below), have been

rarely identified in medieval contexts in Wales, the only clear instance being at Cosmeston (**69.1**), though earlier roundhouses are reused at Graeanog (**27.1**) and Abergwyngregyn (**26.1**). Several Romano-British corn-drying kilns were located within buildings, at Whitton Lodge (**53.2**), Dan y Graig (**59.1**), Parc Cybi (**22.7**), and possibly at Llidiart Yspytty (**67.1**).

Documentary references suggest that medieval kiln-houses were familiar and valuable elements of agricultural infrastructure that also provided warm, dry, but rather smoky accommodation: according to Welsh law, the king's chief huntsman slept in the kiln-house when he visited a *llys* ('royal centre'), while the king's falconer slept in the barn because 'the hawks do not like smoke' (Wade Evans 1909, 154). Looking beyond Wales, the kiln-houses found at Houndtor on Dartmoor (Beresford *et al.* 1979, 141) may be representative of the type of structure that is being referred to.

The Welsh laws also reveal that a corn-drying kiln might be owned by a king or freeholder, or by their bondsmen (Wade Evans 1909, 246–7). It was one of the nine royal buildings that bondsmen were required to erect and repair, and was also an expected communal facility in bond hamlets where it had the same compensation value as other agricultural buildings like barns, cowsheds, pigsties or summer dwellings (Butler 1987, 49; Jenkins 1990, 190; Wade Evans 1909, 208, 348). Together with barns and houses, corn-drying kilns might be used as proof of the right to occupy land — and digging a 'kiln pit' (presumably one of the pit corn-drying kilns found in excavations, or alternatively a water pit used to control kiln fires) on someone else's land was an offence to be settled by compensation (Wade Evans 1909, 195, 210; cf. Butler 1987, 53). Out-of-control fires in corn-drying kilns appear to have been a frequent problem, the subject of claims by lords against their servants and of assessments of liability between multiple users (Jenkins 1990, 168, 170; Wade Evans 1909, 246–7).

These Welsh sources provide little information about how corn-drying kilns operated, but occasional details are found in Anglo-Norman accounts of the late thirteenth century, drying kilns at a number of castles being mentioned in the Ministers' Accounts for West Wales, 1277–1306 (Rhys 1936). These record payments for firewood to dry wheat before storage ('for its better keeping') at Llanbadarn castle, for the labour of the woman who oversaw the drying, and for a 'haircloth' (on which the drying corn was placed) for the *tora[i]llum* or 'drying shed' (Rhys 1936, 151, 177, 189). The 'haircloth' most probably performed the same function as the 'kiln cloths' (*carthen rhawn*) mentioned in nineteenth-century accounts, quoted below, which were normally made of horsehair (Wiliam 1986, 181; Parry-Jones 1972, 20). There is also reference to the 'decrease in measure of the wheat' by drying at Llanbadarn, Dinefwr and Dryslwyn castles 'because it was dried on the kiln (*torallum*) so that it hardened there too long' (Rhys 1936, 468). Storage facilities are mentioned in both Welsh and Anglo-Norman sources. Welsh law notes the corn stack (*das*) customarily made on the post-harvest stubble and presumably preceding any kiln use, as well as the rickyard (*ydlan*) and granary or barn (*horreum* or *yscubor*), with processed grain stored at the latter, judging from the wheat-grain penalty for killing the cat that 'guarded' it (Butler 1987, 51; 1988, 944; Jenkins 1990, 101, 180, 204, 209). The rickyard or 'haggard' is also referred to in Anglo-Norman manorial accounts as well as barns (*grangia*) (Butler 1988, 944–5).

Another medieval reference describes a corn-drying kiln in more metaphorical terms: a poem in the fourteenth-century manuscript called the *Book of Taliesin* refers to a corn-drying kiln (*sawell*, 'chimney, flue') as a 'red-clawed' crested hen that begins the transformation of grain (which grain is not specified) into beer for a king (Lewis and Williams 2019, xxii, 53; poem 16 *An Unfriendly Crowd*). This is a reminder that one of the functions of the corn-drying kiln was the preparation of malt for making beer or (more correctly) ale, the use of hops in beer being first clearly evident in the late Middle Ages (Stone 2006, 23). Ale was significant both practically, as a core element of food rents, and symbolically as a metaphor, together with wine and mead, for the heroic feasting culture and hospitality of royal courts that the food rents sustained. It is in this sense that it is mentioned in *The Gododdin,* the early medieval poem which refers to events of *c.* AD 600 in north Britain, albeit in a text that in its surviving form cannot be dated earlier than the ninth century (Davies 1982, 210). Warbands go out to fight 'in return for mead and ale', and a hero is 'a bedfellow of the beer-hall' (Jackson 1969, 154, 157).

Ale is generally assumed to have been brewed from barley malt, but thirteenth- and fourteenth-century records also note oat malt. In south-west Wales this was only half the value of 'chief' (i.e. barley) malt, and consumed in much greater quantities (Rhys 1936, 123, 163, 227). In Anglesey its large scale production has led to suggestions that oat-based ale may by this date have been the norm (Carr 2011, 63, 139). In northern and western medieval England, similarly, ale was often made from oats or dredge (a mixture of barley and oats), wheat being only rarely used in this way (Stone 2006, 13, 18). In Ireland at this time, ale in the Dublin region appears to have been largely oat-based, with oat malt comprising around three-quarters of oat production on some manors (Murphy and Potterton 2010, 313, 414).

Food rents or renders containing ale, due once or twice a year, are recorded in charters from the seventh and eighth centuries onwards (Comeau 2020, 114, 219–26). Their terminology suggests that many early medieval estates were effectively quantified in terms of their ale-producing capacity (Charles-Edwards 2013, 276–82), and ale was still a core constituent of bond tenant food rents in the thirteenth century (Jenkins 1990, 128; Wade-Evans 1909, 206–8). Bread was another core constituent of these food rents, and the medieval Welsh laws required it to be made of wheat if available or otherwise oats, with each loaf 'as broad as from elbow to wrist' and 'so thick as not to bend when held by their edge'; grain types are not specified in the earlier charter food rents (Jenkins 1990, 128–9; Wade-Evans 1909, 207). Twice-yearly township renders of twenty-six, forty or sixty loaves are stipulated in sources ranging from the ninth to thirteenth century (Comeau 2020, 220–2, 226). Medieval freeholders gave horse-loads of wheat flour rather than bread in their annual November food renders, and both bond tenants and freeholders provided sheaves of oats for horse fodder. Rye is not mentioned in relation to food rents in the Welsh laws, and elsewhere in the laws is noted only briefly, in a north Wales context (Jenkins 1990, 176).

Medieval sources suggest, therefore, that corn-drying kilns were used for drying processed grain (including wheat) before storage, for drying oats before grinding, and for preparing malt from oats and barley. This focus on oats and wheat is reflected in wider reviews of medieval Welsh documentation (Stevens 2019, 36). Information about the corn-drying kilns themselves in medieval sources is limited, however, and for more detail we must turn to later accounts.

Post-medieval references

By the early nineteenth century corn-drying kilns were usually located within mill buildings where barley and oats (less commonly wheat) would be dried the day before grinding (Wiliam 1977, 15–18). Farm-based corn-drying kilns, the so-called *odyn faes* or *odyn fwni* ('field kiln'), or *odyn grasu* ('drying kiln'), had largely gone out of use by this time (Wiliam 1986, 181–2), but are often recorded in field names such as *cae*/*cae'r odyn* ('kiln field'). The occurrence of over two thousand place-names and field-names which include the element *odyn* on Welsh tithe maps provides an indication of how common these structures once were. Although a proportion of these names no doubt refer to limekilns or brick-kilns, it may be significant that a search of the Welsh tithes map database[2] reveals that about 34% of the names related to land classified as arable at that time, and a further 24% to pasture.

Descriptions in post-medieval sources effectively identify three types of corn-drying kiln — open keyhole-shaped, open oval/circular-shaped, and roofed, described below — which have close similarity with a number of excavated medieval examples.

Open keyhole-shaped kilns

This first type — recognisably the same as the keyhole-shaped corn-drying kilns found on later medieval excavated sites — is described in various accounts (Davies 1815; Meredith Morris 1910; Parry-Jones 1972). The earliest of these accounts is that of the Revd Walter Davies, whose report on early nineteenth-century agriculture in south Wales describes 'open kilns for drying corn before it undergoes the operation of shelling or grinding'.

> The tunnel or flue, to convey the heat, of an easy inclination or ascent, is about 12 feet [3.6m] long; about 30 inches [0.76m] square at the outer aperture, where the fire is kindled; and about 9 inches [0.23m] deep and 30 [0.76m] broad at the upper extremity. This funnel is well covered over with flag stones, and earth closely laid over them, 9 inches [0.23m] thick.
>
> The bed of the kiln at the inner entrance of the funnel, is about four feet [1.2m] wide, curving to 9 [2.74m] or 10 feet [3.05m] at the upper extremity; and about 12 [3.66m] or 14 [4.27m] feet in length, forming the frustrum or base of a parabola of those dimensions. The outer walls, at a height of 14 inches [0.36m], form a bench or shelf from 10 inches [0.25m] to a foot [0.3m] wide : on this bench are laid spars, (*llinwydd*) from 8 [0.2m] to 10 inches [0.25m] asunder: on these are placed reeds or straw covered with a mat, whereon the corn is laid to dry. The outer walls, above the bench supporting the spars, are about a foot [0.3m] deep; making the whole about 26 inches [0.66m] above the ground. The bed continues nearly of the same ascent or declivity as the funnel; as it is found more convenient in putting on grain at one end, and taking it off at the other end, as it dries. (Davies 1815, 469–70)

A schematic reconstruction of an open kiln based on descriptions such as this is given in Figure 2. This form of kiln is clearly recognisable in the form of the excavated corn-drying kiln of probable late seventeenth- to early eighteenth-century date at Llanelwedd, Radnorshire (**43.1**) (Britnell 2013, 183–9, 195–6, where Davies's detailed contemporary description is quoted).

The wooden superstructure put in place to support the drying platform is described in a number of other sources, notably in a late seventeenth-century reference to a '*marchpren odyn: a kil beam*' (Emery 1975, 105), and in the description of a nineteenth-century Carmarthenshire kiln by Canon Parry-Jones (Parry-Jones 1972, 20; Wiliam 1986, 181):

> Across the middle [of the central pit] was placed a pole (called the *March*) on which rested the ends of the stakes, laid on to it from each side. Sometimes, two planks were placed across it at right angles, again to support stakes put on top of them, until the whole kiln was covered. Over the whole, clean straw was neatly and carefully laid; sometimes, instead of straw (or *over* the straw) a coarse rug or cloth was spread, called *carthen rawn* (hair-cloth).

Some of these features can also be distinguished in the excavation of much earlier sites: the bench or shelves in the side that supported the low timber framework and straw of the drying floor can be seen, for instance, at medieval Rhuddlan (**70.1**–**70.3**), while the need for upward-sloping flues has been explored in Irish experimental work (Monk 2013, 4; Monk and Kelleher 2005, 95, 102).

Similar corn-drying kilns, also apparently un-roofed, are noted in nineteenth-century north Pembrokeshire (where it was called the *odyn fwni*) as well as in Carmarthenshire (Meredith Morris 1919, 208–9; Parry-Jones 1972, 20). The length of the flue, 'pipe' or 'gutter' varied, from 6 to 30 feet (2–9m), and a smaller drying chamber of 6 feet (2m) square and locations on sloping ground are mentioned. The Pembrokeshire account notes timber framing with a 30 degree inclination that supported a thatched floor (*cloig*) of wheat straw and a hair cloth or *brethyn rhawn*. The grain lay on this, moved to one end and on to a sheet lying on the ground as it dried. The description stresses the importance of 'a bright, flaming and smokeless fire, maintaining a current or steady blast towards the drying floor', fuelled preferably by 'the straw of the corn itself' or by heath, furze or fern; peat is mentioned in Carmarthenshire. The weather should be dry and breezy, preferably frosty. The Pembrokeshire account concludes with a comment on taste: 'The slight flavour of smoke on the meal was considered a relish by the old people, much as some like the flavour of smoked ham nowadays' (Meredith Morris 1909, 209).

Open oval/circular-shaped

This second type of corn-drying kiln was of simpler pit-type construction, similar to some excavated early medieval examples. Like the keyhole-shaped corn-drying kilns, it was open which (assuming dry weather) would have facilitated operation since both care of the fire and the continual grain-raking were done by just one person. The description comes from Price's *History of Llansawel* (1898), Carmarthenshire.

> Our forefathers prepared corn by means of the *brenau* (quern) and *odyn grasu* (drying kiln). At first the mills had no drying-kilns attached to them, all the corn being dried at home. The last *odyn grasu* in use in this parish . . . was worked as late as 1845 . . . . The shape and the build of this ancient apparatus was certainly primitive. On gently-sloping ground a hollow, three yards [2.75m] long, two yards [1.8m] wide, and two

> deep, was cut similar in shape to a *cladd tato* [‘potato clamp’]. Two planks were placed at right-angles to each other, their ends resting on the surface outside the hollow. These served to support the sticks which were placed regularly over the kiln until it was covered. Over the whole clean straw was laid, upon which the corn was placed to be dried. Underneath all this and at the lower end of the kiln, the fire was placed, so that the heat and smoke went under the straw contrivance above. One man looked after the fire, which was generally of furze and brushwood. He always kept by him a tub of water, and a straw-wisp or a mop, to regulate the force of the fire. He kept moving the corn continually to obtain even drying, with a short-toothed wooden rake, and when ready it was raked off the straw into a large canvas, and was then fit for the mill. Instead of straw some covered the kiln with what was called *Carthen rawn, carthen odyn* (kiln cloth or hair cloth). It is said by the old people that the corn dried after the old fashion makes sweeter bread than that dried in the modern brick-kilns at the mill. (Quoted in Wiliam 1984; 1986, 181–2).

Roofed corn-drying kilns

The third type of corn-drying kiln is roofed and is mentioned briefly in a collection of north Wales folk traditions published in 1908. Whether or not it had a flue is not clear: the text refers to

> low walls of stone, thatched roof, and a loft or a kind of hurdle of poles and twigs across one end with straw spread upon it to hold the corn. Beneath was a place to light a fire. (Scott 1951, 203, quoting translation of Jones 1908, *Llên Gwerin Sir Gaernarfon*, 63).

We can compare these descriptions with those of nineteenth-century Ireland where corn-drying kilns might similarly be either open or roofed, with some having flues while others had a fire underneath the drying crops (Evans 1944, 85). A tendency for hill-slope locations is noted here too. One particularly well-known Irish type, with a flue and a thatched conical roof with an inset wattle door, was called a ‘tobacco pipe kiln’ after its shape in profile (Knox 1906–07). By contrast, most of the nineteenth-century Welsh corn-drying kilns seem to have been open, un-roofed structures, a roof only being mentioned in the north Wales account of 1908. The twelfth-century Welsh references to a ‘kiln-house’ and the Anglo-Norman references to ‘drying sheds’ suggest, however, that covered corn-drying kilns were a familiar but possibly higher-status medieval feature.

EVIDENCE OF CORN-DRYING KILNS ON ARCHAEOLOGICAL SITES IN WALES

The gazetteer towards the end of this article lists the known corn-drying kilns in Wales up to *c.* 1600, a cut-off date selected to encompass the date ranges of medieval instances whilst recognising the impracticability of recording the many corn-drying kilns of the post-medieval period.

A total of 148 corn-drying kilns of various types are recorded from 76 sites, some of them unexcavated, including 5 corn-drying kilns mentioned in records for castles which are excluded from the analysis that follows (Table 1). The gazetteer also lists one post-medieval site, Llanelwedd (**43.1**), since this has been mentioned in the foregoing historic review, but it is excluded from the analyses that follow because of its post-medieval date. As many as 29 kilns are undated and, although some of these are at sites with dated corn-drying kilns, it cannot be assumed that they are contemporaneous unless there are close correlations in style of construction and contents, given the presence at some sites of corn-drying kilns of different dates. Of the 114 corn-drying kilns which are dated, 47 have usable radiocarbon dates (34 from short-life samples), 30 are dated by pottery or other artefacts, and the remainder by context, stratigraphy or morphological similarity to other dated examples at the same site. Six corn-drying kilns (Aberyscir Court **44.1**, Brynwgan **2.3**, Coed Dolwyd **30.1**, Graeanog **27.1**, Parc Cybi **22.5**, Steynton **9.1**) produced radiocarbon dates that are felt by the excavators to be from residual material or are otherwise anomalous and have been disregarded by them in favour of alternative radiocarbon dates or other forms of dating. The use of peat as a fuel, noted in nineteenth-century Carmarthenshire (see above), may be a contributing factor here.

Dating and chronology

The chart in Figure 3A shows the date distribution of corn-drying kilns, using either calibrated radiocarbon dates from short-life samples or other dating methods such as pottery or context. Individual corn-drying kilns may be shown across several centuries since most dating methods provide date ranges that cover two or more centuries (for a discussion of issues in displaying corn-drying kiln dates, see McCormick *et al.* 2014, 33; cf. also the approach used in Plunkett *et al.* 2013).

The existence of prehistoric corn-drying kilns in Wales is currently uncertain and the only suggested instance has been omitted from this chart because of questions over its dating evidence. This is the kiln at Llanddowror (**36.1**), where a possible Middle Bronze Age attribution relies on a single radiocarbon date with no corroborating evidence of either dating or function — there being no associated plant remains other than charcoal. The only other dating evidence for this feature is sherds of late sixteenth- to eighteenth-century pottery in the upper fill which are considered by the excavators to be intrusive (Barber *et al.* 2019, 28). It is described as being of 'figure of eight form' (ibid. 124) but its dimensions are closest to those of medieval keyhole-shaped corn-drying kilns. There is also, it should be noted, uncertainty about whether the Bronze Age dating attributed to some Irish corn-drying kilns is actually representative of their period of use (Monk and Power 2014, 40).

Large numbers of Romano-British corn-drying kilns are evident: 33, with a further 2 of either Iron Age or Romano-British date (Table 1, Fig. 4A). The dating distribution of this group — with apparently high levels present from the start of the Romano-British period — is imprecise since only two corn-drying kilns of Romano-British date have calibrated radiocarbon dates based on short-life samples, and dating is otherwise suggested by typology (in the case of T-shaped corn-drying kilns), pottery, coins or site association. As a consequence it is difficult to track the early development of the practice. There are questions about identification in some cases, and several may be food ovens or have had an industrial

rather than grain-drying function, the rectangular features at Cowbridge (**55**) and sub-rectangular features at Aberyscir (**44.1**) being cases in point. Nevertheless, Romano-British corn-drying kilns are unquestionably present in significant numbers and this is particularly interesting when considering the post-Roman centuries.

For the early medieval period, 42 corn-drying kilns with fifth- to tenth-century dates are identifiable, including 5 with date ranges extending into the eleventh to fourteenth centuries; a further 36 corn-drying kilns are attributed to the eleventh to sixteenth centuries (Fig. 4C–D). Twenty-six of the early medieval corn-drying kilns cluster in the fifth to seventh centuries AD, fifteen of them dated using short-life radiocarbon samples (Figs 3A, 4B). This is a significant peak: there are as many corn-drying kilns in the sixth century AD as in the thirteenth century, albeit not necessarily with the same capacity. In Figure 3A these fifth- to seventh-century corn-drying kilns appear as an apparent continuity from the Romano-British peak, though whether this is coincidental or reflects similarities in practices is a question for further research. There are differences in corn-drying kiln typology between these periods: T-shaped corn-drying kilns are exclusively associated with the Romano-British period, with pear-shaped corn-drying kilns appearing in the post-Roman period (Fig. 3B). These issues notwithstanding, current evidence suggests that a high level of corn-drying kiln usage continues from the Romano-British through to the post-Roman centuries. Corn-drying kiln numbers then declined steadily over the seventh to tenth centuries, increasing again after this to another peak in the twelfth to thirteenth centuries, with an apparent decline in numbers thereafter.

Types of corn-drying kiln

In the gazetteer, corn-drying kilns have been assigned as far as possible to one of the types listed in Table 1 and illustrated in Figures 1, 5–8.

These types largely follow the well-established classifications used in Ireland (e.g. Monk and Kelleher 2005), with one significant departure in the treatment of corn-drying kilns described as keyhole-type in Irish work. Following Monk's discussion about the importance of identifying firing location when classifying this group of corn-drying kilns (Monk 2014), some of these have been assigned to a new classification — 'pear-shaped' — depending on the location of the firing area. In the later medieval keyhole corn-drying kilns this occupies a stokehole at the end of a flue leading to the drying chamber, and is usually at a lower level, which facilitated an upwards flow of hot air to the drying grain. The corn-drying kilns that are termed 'pear-shaped' have a roughly keyhole shape in plan but their firing evidence — heavy oxidation of lining and substrate — is in the deep round bowl element that has hitherto often been assumed to be the drying chamber. The drying area in the pear-shaped corn-drying kilns actually appears to be in the shallower extension to this bowl, previously regarded as a 'flue', and as Monk points out there was probably some sort of timber superstructure, perhaps temporary, over this. Monk makes the important point that, in order to understand corn-drying kiln function and identify corn-drying kiln type, it is necessary to identify the location of firing areas relative to the longitudinal profile of the corn-drying kiln.

Traces of superstructure, such as stakeholes and burnt clay fragments, are present at a number of corn-drying kilns of different types, as are some linings. It is worth noting that the robbing of stone linings can cause difficulties in assigning an appropriate typology. Two of

the rectangular Roman kilns at Cowbridge (**55.10** and **55.12**) are in elongated ovoid cuts and would, in the absence of stones, resemble corn-drying kilns that are assigned to a sub-rectangular/sub-oval type.

As can be seen from Table 1 and Figure 3B, clear changes in styles of corn-drying kiln over time are apparent. Eleven T-shaped Romano-British corn-drying kilns are recorded in Wales. These are generally stone-built with an axial flue, 2.0–3.5m in length, that links the firing area/stokehole with a transverse drying chamber (sometimes called a transverse flue) 1.5–3.2m across (Table 2). Most rectangular instances are similarly of Romano-British date, though as noted earlier their identification as corn-drying kilns is often uncertain.

The elaborate stone-built forms of the T-shaped corn-drying kilns contrast strikingly with the simpler shapes of other corn-drying kilns used in the Romano-British and early medieval periods: oval/circular, dumb-bell/figure of eight-shaped, and pear-shaped. Thirty oval or circular pit corn-drying kilns are recorded in the gazetteer, with dates ranging from the end of the Iron Age until the medieval period, most of the dated examples (11/21) being of early medieval date. Dimensions are given in Table 2. Dumb-bell or figure of eight-shaped corn-drying kilns are somewhat less in evidence: fourteen were identified, with dating also clustering in the early medieval period. They consist of two conjoined pits, sometimes separated (in the dumb-bell forms) by a short flue. Firing evidence is usually found in the deeper pit. Overall length varies from 1.0–3.4m.

The largest group of early medieval corn-drying kilns are pear-shaped and consist of a broad, deep pit with a shallower extension, with firing evidence in the deep pit. Overall lengths range from 0.8–6.7m. There is little evidence for stone linings. In all, twenty-two were identified, twelve of them with early medieval dates and six undated. Some of this group were originally described by their excavators as keyhole corn-drying kilns but (as noted above) have been allocated to the 'pear-shaped' category after consideration of the location of firing area evidence. Some of these, for instance at Sarn-y-bryn-caled (**33.3**, **33.4**, **33.5**) and Rhuddlan (**70.1**, **70.2**), have stepped sides and postholes suggestive of timber superstructures in their shallower elements.

Keyhole-shaped corn-drying kilns, commonly stone-lined, with long flues that link firing areas/stokeholes to circular or rectangular drying chambers, are distinctive of the high and late medieval periods. Overall lengths range from 2.0–9.0m, comprising flues of 0.8–3.5m length, and drying chambers of 0.7–2.9m diameter. Twenty-one of these were identified, all (apart from three undated instances) of medieval or later date. A variant, the six L-/comma-shaped corn-drying kilns, have curving flues, probably to minimise the risk of conflagration from spark-producing fuels like gorse (Kenney 2008b, 109). Their dimensions fall within the range of keyhole-shaped corn-drying kilns and most are of medieval date.

There were twelve corn-drying kilns with less defined sub-rectangular or sub-oval forms and varying dates, and a further sixteen whose morphology could not be readily classified, often because remains were fragmentary. These also, where dated, represented a range of periods. The dimensions of all types of corn-drying kiln are summarised in Table 2.

Location

The gazetteer notes, where possible, information about the setting in which the corn-drying kiln was found. The number found at individual sites varies considerably, some sites having

single examples and others having multiple kilns of different dates. Some corn-drying kilns have fairly clear contexts, particularly those found on Roman-British or medieval urban sites. In other cases very little information is available, especially for excavations of limited scope. Early medieval sites in Wales, as noted earlier, present particular challenges (corn-drying kilns apart) for interpretation, and are often best appreciated through a broader landscape overview using both archaeological and historical sources, as Heather James has demonstrated for some early medieval corn-drying kilns in south Wales (James forthcoming; see also Comeau forthcoming).

Romano-British corn-drying kilns are located at villa-farmsteads, in agro-industrial areas of settlements (sometimes within buildings), and near army camps (Fig. 4A). Spatial relationships sometimes suggest function, as for instance at Whitton Lodge (**53.2**) where the T-shaped kiln is next to a stone-lined tank that may have been used for malting grain or retting flax. It is unclear whether there is evidence for changes recognised in the late fourth-century AD on sites in England which saw the construction of corn-drying kilns within previously residential areas of villa buildings (Gerrard 2013, 256–8): more detailed analysis of location patterns is, we hope, something that the gazetteer will facilitate.

Early medieval corn-drying kilns, by contrast, are rarely clearly associated with structures. Most, however, are in areas that can be identified as early medieval focal zones (Fig. 4B–C; Comeau ibid.; James ibid.), and some have indications of nearby settlement complexes. Therefore, although some may have been deliberately located a little distance away from dwellings because of the risk of fire, others may have been relatively close, as at South Hook where a group of seventh- to ninth-century kilns are surrounded by clusters of small postholes suggestive of fences or walls of light timber structures, some of them related to sunken-floored buildings of probable domestic type. The group was only 4m from one such building of similar date, with one kiln so close that it cannot have operated contemporaneously. Within a 30m radius were a number of other domestic buildings of ninth- to eleventh-century date (Crane and Murphy 2010, 120, 136–7, 186).

From the twelfth and thirteenth centuries corn-drying kilns appear in towns, Wales having had no urban development before the Norman Conquest (Davies 1982, 57–8). Medieval corn-drying kilns are sometimes within a building, as at Cosmeston (**69.1**), or built against or close to one, as at New Radnor (**40.1**). Their location at foci of settlement or agro-industrial activity suggests communal or larger-scale enterprises, and the same can be said of those at early medieval focal zones. At the same time, corn-drying kilns continued to be used in rural settings, as at Four Crosses, Llandysilio (**62.1**) which was close to a barn (Fig. 4D).

Contents of corn-drying kilns: archaeobotanical remains

The archaeobotanical remains found within corn-drying kilns represent crops, weeds of cultivation and fuel, which (like the kilns themselves) changed over time. Such assemblages are recorded at 81 corn-drying kilns of which 72 are dated, five of these — at South Hook (**11.1**, **11.2**, **11.3**, **11.4**) and Dolbenmaen (**21.4**) — deriving from external, closely related contexts rather than from within the kiln itself. Summary details are given in the online dataset, where species names are quoted in the form provided by the original analyst, and species-level identifications for wheat, oats and barley are included, as well as some ambiguous species-level identifications for wheats, such as *Triticum dicoccum/spelta*. It

should be noted that terminology in reports can sometimes conceal important differences. 'Bread-type wheat', for instance, might indicate spring-sown club wheat rather than autumn-sown bread wheat. The former is often difficult to distinguish from surviving crop remains but is significantly different to bread wheat in its growing habits, since it copes with poor soils and rain. It is present from the prehistoric period and, being spring-sown, could indicate the use of infield-outfield systems (Carruthers 2010, 172, 178–80; Comeau 2019, 138). The presence or absence of weed seeds is noted in the online dataset: these are significant for assessing the level of processing of crops, the quality of agricultural land and crop husbandry practices including sowing times. Researchers should refer to the original reports for further detail.

Assemblages, it must be noted, cannot be assumed to provide a full picture of crops that were grown, since not all crops need to be kiln-dried and there can be problems with differential preservation of some crop remains. Moreover, the charred remains derive both from the raked-out material from drying areas, which includes accidental burnings and grain fallen from drying trays, as well as the spoiled crops and chaff from grain processing that were used as fuel; distinguishing between them may be difficult (Hillman 1982, 138; Jones and Milles 1984, 192–3). Nonetheless, given the number of samples from corn-drying kilns that are now available, a fairly clear picture emerges of (at the very least) what crops were dried, and therefore grown. Comparison with the contemporary documentary references to grains, discussed above, suggests that this picture may be reasonably representative, with the caveat that kilns at urban sites may contain crops sourced from wide areas.

The principal grain crops that have been found within corn-drying kilns in Wales are summarised in the bar charts in Figure 9A–C. Where several assemblages are recorded for a corn-drying kiln these bar charts show the earliest dated layer, although it should be remembered that this may not represent the earliest use of the kiln, which would usually be cleaned out between uses. As in Figure 3A, individual corn-drying kilns may be shown across several centuries since most dating methods provide date ranges that cover two or more centuries.

Some initial observations can be offered, which it is anticipated will prompt more nuanced analysis: minimum thresholds in grain counts, for instance, have not been used in the analysis. Figure 9A shows patterns of cereal dominance in grain assemblages, in other words which cereal is numerically greatest within individual assemblages. Each column shows the dominant grain in corn-drying kilns with dating ranges covering that particular century. Wheat (mainly spelt or emmer) dominates assemblages of the Romano-British period. In the fifth and sixth century AD, barley became the most dominant cereal, with oats dominating from the seventh century AD onwards until the end of the medieval period.

The varying mixes of cereals found in corn-drying kiln contents are shown in Figure 9B, which shows the presence of different types of cereals at all dated corn-drying kilns with reported archaeobotanical assemblages, while Figure 9C shows this information for corn-drying kilns with calibrated radiocarbon dates from short-life samples. Figure 9B, for all 72 dated corn-drying kilns with archaeobotanical assemblages, shows that wheat and barley are widely present from the Roman period onwards, with oats becoming the most frequently encountered cereal after the sixth century AD. Between the seventh and eleventh centuries, oats and barley are more commonly represented than wheat, which becomes more common

again in assemblages after the Norman Conquest of Wales, though quantities in samples are sometimes very low. Rye is either not present or found only in trace amounts in one or two corn-drying kilns until the eleventh century, when its incidence increases somewhat. Figure 9C, for the 34 corn-drying kilns with calibrated radiocarbon dates from short-life samples, shows a broadly similar pattern, albeit with no rye present from the seventh to tenth centuries and minimal levels thereafter. Wheat types, where identifiable, show hulled wheat (spelt or emmer) as the main wheat type for the first to fourth centuries AD, with free-threshing wheats, such as bread or club wheat, being the most commonly identifiable wheat type after this.

As noted above, cleaned or semi-cleaned crops are specifically noted in reports upon nearly half (37/81) of the corn-drying kilns with archaeobotanical samples. Three of these were Romano-British, 22 early medieval, 1 early medieval/ medieval, 8 medieval, with 3 being undated. Possible malting activity was also noted in reports for 6 corn-drying kilns, 4 of them Romano-British (Plas Goch **42.1**, Whitton Lodge **53.2**, Dan-y-Graig, **59.1**, Llidiart Yspytty **67.1**), the others being either early medieval (South Hook **11.1**) or undated (Parc Cybi **22.9**). Given the evident significance of ale in early medieval society and the fragility of the archaeobotanical evidence, this is almost certainly an under-representation of likely malting activity due to the fragility of archaeobotanical evidence (Moffett 2006, 52; cf. Faulkner and Blakelock 2020 on an Anglo-Saxon malthouse site). Sprouted grain was observed at a further 4 corn-drying kilns where it was linked to crop spoilage.

DISCUSSION

To appreciate the evidence from Welsh sites in context we need to compare these patterns with those observed elsewhere, a comparison with the well-studied Irish evidence being particularly illuminating. The significant number of Romano-British kilns found in Wales is comparable to the number of contemporary sites in Ireland, albeit with some notable differences: Ireland has little evidence for T-shaped kilns, and barley rather than wheat predominates (Monk and Power 2014). How these numbers relate to antecedent patterns is, as already noted, currently unclear in Wales, although in Ireland increasing use of corn-drying kilns is evident from the fifth century BC onwards (ibid.). In Roman Britain the growth of corn-drying kiln use has been linked to the demand for grain generated by the Roman army, urban consumers and imperial trade networks (Van der Veen 1989, 315–6).

For subsequent periods there is a remarkable similarity between Wales and Ireland (Figs 3A and 10). In both areas the numbers of corn-drying kiln rise to maximum levels in the sixth century AD, thereafter declining until the tenth century in Wales and the eleventh century in Ireland. Numbers rise again to a minor peak in the thirteenth century, with some Irish work also showing an eight-century intensification of kiln use (Fig. 3A; McCormick *et al.* 2014, 33; Monk and Power 2012, 38–9; Monk 2015, fig. 27.1). Crop patterns also show similarities, though this is an area that requires further specialist analysis in Wales. Ireland's pattern of barley dominance in the early part of the early medieval period, giving way to oat dominance in the latter part of the period (McClatchie *et al.* 2019, 66), can also be seen in

Wales, albeit with wheat dominance in Wales during the Romano-British period (Fig. 9A). The minimal Welsh evidence for rye has similar parallels in Ireland (ibid. 59, 71).

The sixth-century AD peak is intriguing, given contested assumptions of post-Roman socio-economic collapse, palynological indicators of an overall decrease in arable activity in Wales at this time, and longstanding assumptions that increased kiln use was a response to damp harvests and deteriorating climate conditions (Davies 2019, 181–4; Gerrard 2013; Scott 1951, 205). In Ireland, climate data provides only ambivalent support for the latter theory, with the increase in corn-drying kiln use actually beginning during a drought period in the third to fifth centuries AD (Coyle McClung and Plunkett 2020, 12–13; Monk and Power 2012, 39; Timpany *et al.* 2011, 80). In Wales the continuing presence of large numbers of kilns from the Romano-British period through to the sixth century presents similar challenges of interpretation.

Subsequent wetter conditions may nonetheless be reflected in changing choices in the crops grown and may explain the increasing favouring of oats, a crop that is particularly suited to poor, acidic soils in areas of high rainfall (Carruthers 2010, 166; Monk and Power 2012, 40; Monk 2011). This does not explain the sixth-century AD peak, however, since it is barley that is dominant in both Ireland and Wales at this point. Barley, like oats, is tolerant of damp conditions though it requires better soil conditions (Miles 1994, 62; for analysis of how these relate to long ley/infield-outfield husbandry practices see Comeau 2019, 145). The increasing presence of oats over the seventh to tenth centuries also has an uncertain relationship with the decline in corn-drying kiln numbers at this time in both Wales and Ireland (Figs 3A and 9).

Increases in the use of corn-drying kilns may therefore reflect other factors apart from climate change. In Ireland, the sixth-century AD corn-drying kiln boom is attributed to increased production in response to the tribute demands of elite groups, and/or the need to support non-agrarian specialists, or population growth (Monk 2019, 54). The first of these factors — the tribute demands of elite groups — is suggested by the concentration of corn-drying kilns around Tara, an early medieval royal demesne area in the lower rainfall area to the east (Kinsella 2008; Monk and Power 2014, 42). In Wales all the fifth- to seventh-century corn-drying kilns cluster at focal zones that coincide with sites of prehistoric or Roman significance or later estate centres, and have characteristics typical of places of assembly (Comeau forthcoming; cf. Comeau 2020, 18–23, 117 et seq.; Gleeson 2018 for Ireland). Such associations with assembly sites echo the patterns observed around Tara and are consistent with the presence of processed crops that imply either bulk storage at an estate centre or food and drink production for gatherings. The possibility of malting activity is also significant in Wales, despite relatively limited archaeobotanical evidence, ale being a key element of food rents and of lordly hospitality, and central to the support of warriors in the non-monetised early medieval economy. Ale for feasting, and localised control over its production, has been suggested as a reason for the appearance of corn-drying kilns at elite centres in the late Roman period (Gerrard 2013, 257).

The decline in corn-drying kiln numbers between the seventh and tenth/eleventh centuries presents challenges to interpretation, given apparently divergent social and climate factors. On the one hand Irish peatland and tree-ring data show that the period between the mid-sixth to the early ninth centuries AD was marked by wetter conditions, with drier

conditions from the later ninth to twelfth centuries; annalistic records additionally indicate droughts in the seventh and eighth centuries (Coyle McClung and Plunkett 2020, 15, 17). On the other hand an expansion in ecclesiastical estates is accompanied in Wales by palynological evidence from the seventh to ninth centuries showing steady or increased arable activity, though the picture for Wales during the ninth to eleventh centuries is more mixed (Davies 2019, 185, 189). In Ireland an increased use of watermills in the eighth century coincided with pollen indicators for expanding grain production, but this happened at a time when kiln numbers were generally in overall decline, apart from a cluster of sites in the eighth century (Coyle McClung and Plunkett 2020, 21, 23; McCormick *et al*. 2014, 33). Suggested explanations for the decrease in numbers of corn-drying kilns in Ireland include a change to more effective, larger capacity types of corn-drying kiln, and greater centralisation and elite control, which might have the effect of reducing corn-drying kiln numbers at lower status sites (Monk and Power 2012, 40). Whether these might also account for a similar dip in numbers of corn-drying kilns in Wales is a question for further research, including, for instance, the question of kiln capacity. Another factor for consideration is the impact of ascetic monastic regimes that eschewed ale in their food rents, a practice that must have impacted on kiln use.

A peak in the number of corn-drying kilns in the eleventh to thirteenth centuries coincides with the medieval warm period, the new Norman urban centres, increasing population and the growth of market structures, and comes to an end with the Black Death. This is a time when arable production underwent expansion in Wales, leaving traces in relict upland strip fields (Silvester 2000). In Ireland, expanding output supported Anglo-Norman armies in Wales and elsewhere (Murphy and Potterton 2010, 467). Accounts produced for castles in south-west Wales during this period show the buying and selling of large amounts of grain and malt for consumption by their garrisons (e.g. Rhys 1936, 133, 213).

CONCLUSIONS

As demonstrated in this article, corn-drying kilns provide a rich source of evidence about agricultural practices and economic activity in the Roman, early medieval and medieval periods in Wales. The gazetteer at the end of this article and the online dataset allow trends in their changing incidence, form and content to be identified and compared, and it is hoped will stimulate future research and analysis. Excavators are invited to submit information to the authors to allow this dataset to be updated. Some of the key areas for future research which have emerged from the present study can be summarised as follows:

- The dating and development of Roman corn-drying kilns and their relationship with possible prehistoric antecedents.
- The reasons for the sixth-century AD peak and subsequent dip in corn-drying kiln use.
- Patterns of crop remains and make-up of fuel sources.

- Experimental archaeology of the kind undertaken in Ireland (Monk and Kelleher 2005), to shed light on how different types of corn-drying kiln functioned, their efficiency and capacity.

Two further key points emerge for excavations:

- The desirability of obtaining at least two radiocarbon dates from short-lived samples from each kiln, given the problem of anomalous dates as well as of kilns with different dates at multi-kiln sites.
- The benefit of a rigorous approach to recording areas of scorching within corn-drying kilns, in order to interpret the function of kiln elements and identify kiln types.

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APPENDIX: GAZETTEER OF LATER PREHISTORIC TO SIXTEENTH-CENTURY CORN-DRYING KILNS IN WALES

This abbreviated gazetteer gives details of all corn-drying kilns recorded in Wales which pre-date the sixteenth century AD. The complete dataset is published online on the ADS website, which gives a fuller summary of dimensions, dating evidence, plant remains and drawn plans and sections where available. Sites are given by reference to recorded site names, Community and Unitary Authority. Radiocarbon dates are calibrated using Oxcal v4.3 running the IntCal13 calibration curve and are quoted at 95% probability. An asterisk after the kiln number indicates the presence of archaeobotanical samples, and the excavation context reference follows it, in parenthesis.

The gazetteer has been compiled from a review of the published literature and of data contained in the Historic Environment Records for Wales[3] and the National Monuments Record for Wales,[4] together with information provided by colleagues.

Abbreviations: CPAT, Clwyd-Powys Archaeological Trust; DAT, Dyfed Archaeological Trust; GAT, Gwynedd Archaeological Trust; GGAT, Glamorgan-Gwent Archaeological Trust; HER, Historic Environment Record (maintained by the Welsh Archaeological Trusts); NMR, National Monuments Record of Wales (maintained by the Royal Commission on the Ancient and Historical Monuments of Wales), PRN/NPRN, primary record number/national primary record number.

1. Bayvil (Pembrokeshire), SN 10288 40559
Location: in area of medieval bond settlement and *llys*. *Type and dating*: **1.1*** pear-shaped; early medieval, dated by radiocarbon dates from secondary fill: cal. AD 410–550 (UBA-40923, 1578±25 BP, *Hordeum* sp. grain) and cal. AD 380–540 (UBA-40924, 1617±25 BP, *Avena* sp. grain). *References*: DAT HER, PRN 118128; Pearson *et al.* 2018; Comeau forthcoming.

2. Brynwgan (Site 25.07), Llandeilo (Carmarthenshire), SN 6407 2470 (nos 2.1–3), SN 6403 2462 (no. 2.4)

Location: four kilns within the medieval home estate of church of St Teilo, Llandeilo. *Type and dating*: **2.1*** (257001) pear-shaped, undated. **2.2*** (257010) oval/circular; medieval, dated by radiocarbon date from lower fill: cal. AD 1030–1250 (Beta-257722, 880±40 BP, *Avena* sp. grain). **2.3*** (257014) oval/circular, early medieval, dated by radiocarbon date from fill: cal. AD 890–1030 (Beta-257724, 1070±40 BP; *Avena* sp. grain), a date of 3950–3690 cal. BC (Beta-257723, 5000±40 BP, hazelnut shell) also from the fill is probably from residual material; **2.4*** (257021) pear-shaped, early medieval, dated by radiocarbon date from basal fill: cal. AD 890–1030 (Beta-257725, 1070±40 BP, *Avena* sp. grain). *References*: DAT HER, PRNs 125605, 125606, 125607, 125608; Hart 2013a; Darvill *et al*. forthcoming, site 25.07.

3. Brynwgan (Site 25.08), Llandeilo (Carmarthenshire), SN 6413 2482
Location: three kilns within the medieval home estate of the church of Llandeilo. *Type and dating*: **3.1*** (258005) sub-rectangular/sub-oval; ?early medieval (plant remains suggest Roman or post-Roman date). **3.2*** (258011) oval/circular; early medieval, dated by radiocarbon dates from secondary and tertiary fills: cal. AD 410–560 (SUERC-57294, 1569±30 BP, *Hordeum vulgare* grains), cal. AD 420–600 (SUERC-57293, 1531±30 BP, *Triticum aestivum* type grains), cal. AD 420–560 (SUERC-57296, 1563±30 BP, *Triticum aestivum* type grains) and cal. AD 530–650 (SUERC-57295, 1479±30 BP, hulled barley grains). **3.3*** (258012) oval/circular, ?early medieval (on basis of similarity of plant remains assemblage to dated examples at site). *References*: DAT HER, PRNs 125609, 125610, 125611; Brannlund 2013; Darvill *et al.* forthcoming, site 25.08.

4. Maes-y-Llan, Llanddowror (Carmarthenshire), SN 2615 1420
Location: probably in area of an early medieval monastic estate. *Type and dating*: **4.1*** pear-shaped; early medieval, dated by radiocarbon dates from secondary fill: cal. AD 430–640 (SUERC-54694, 1496±29 BP, *Hordeum vulgare* L. grain) and cal. AD 470–650 (SUERC-54693, 1486±29 BP, *Avena* sp. grain). *References*: DAT HER, PRN 125612; Hart 2013b; Darvill *et al.* forthcoming, site 221.

5. Tynycoed, Myddfai (Carmarthenshire), SN 7461 3133
Location: in hilly countryside with medieval common land nearby; possibly an assarted area. *Type and dating*: **5.1*** oval/circular; medieval, dated by radiocarbon dates from fill: cal. AD 1260–1390 (SUERC-57284, 684±30 BP, hazelnut shells) and cal. AD 1310–1440 (SUERC-

57285, 550±30 BP, *Avena* sp. grains). *References*: DAT HER, PRN 125613; Busby 2013; Darvill *et al.* forthcoming, site 33.01.

6. Creamston Road, Uzmaston (Pembrokeshire), SM 977 51554
Location: in a lowland area of medieval open fields. *Type and dating*: **6.1*** oval/circular; early medieval, dated by radiocarbon dates from primary fill: cal. AD 710–940 (SUERC-57289, 1202±30 BP, *Avena* sp. grains) and cal. AD 710–940 (SUERC-57288, 1200±30 BP, *Hordeum* sp. grains). *References*: DAT HER, PRN 125614; Sausins 2013; Darvill *et al.* forthcoming, site 251.2.

7. Felindre Mawr (Swansea), SN 6344 0232 (no. 7.1), SN 6341 0231 (no. 7.2)
Location: two kilns plus the possible truncated remains of a third, above a river valley on edge of uplands; part of possible early estate. *Type and dating*: **7.1*** (293003) pear-shaped; early medieval, dated by radiocarbon dates from upper fill: cal. AD 390–550 (SUERC-56388, 1592±35 BP, *Hordeum* sp. grains) and cal. AD 400–580 (SUERC-56389, 1567±38 BP, *Avena* sp. grains). **7.2*** (290010) pear-shaped, undated. *References*: GGAT HER, PRN E000086; Leonard 2013; Darvill *et al.* forthcoming, site 293.

8. Conkland Hill, Wiston (Pembrokeshire), SN 0188 1766
Location: in a lowland area of mixed agriculture containing possible hilltop multivallate enclosure and sunken-floored dwelling of 7th–11th-century date. *Type and dating*: **8.1*** oval/circular; undated. *References*: DAT HER, PRN 125615; Hart 2014; Darvill *et al.* forthcoming, site 508.

9. Steynton (Pembrokeshire), SM 9147 0833
Location: in area with probable medieval open fields. *Type and dating*: **9.1*** sub-rectangular/sub-oval; early medieval, dated by radiocarbon dates in secondary fill: 1750–1540 cal. BC (SUERC-55486 3359±30 BP, *Corylus* sp. charcoal) assumed to be intrusive; cal. AD 660–870 (SUERC-55492 1268±30 BP, Cytisus/Ulex charcoal); and cal. AD 670–880 (SUERC-55493, 1247±30 BP, *Alnus*/*Corylus* sp. charcoal). *References*: DAT HER, PRN 125616; Barber *et al*. 2015; Darvill *et al.* forthcoming, site 512.

10. Newton, Llanstadwell (Pembrokeshire), SM 9295 0497
Location: two kilns found beneath a 16th-century dovecote in a lowland arable area. *Type and dating*: **10.1*** (656/Kiln A) dumb-bell/figure of eight-shaped; early medieval, dated on basis of similarity to 10.2. **10.2*** (642/Kiln B) dumb-bell/figure of eight-shaped; early medieval, dated by radiocarbon date from basal fill: cal. AD 690–970 (Beta-182946, 1190±40 BP, grain). *References*: DAT HER, PRNs 102357, 125617; Crane 2004.

11. South Hook, Herbranston (Pembrokeshire), SM 8722 0675
Location: group of four kilns (11.1–11.4) and one separate possible kiln (11.5) found in an area containing early medieval settlement including timber buildings and iron smelting furnaces. *Type and dating*: **11.1*** (650) pear-shaped; early medieval, dated by association with adjacent hollow dated by radiocarbon date: cal. AD 670–880 (Beta-222370, 1250±40

BP, barley grain). **11.2*** (719) oval/circular; early medieval, dated by association with feature noted in 11.1). **11.3*** (131) sub-rectangular/sub-oval; early medieval, dated by association with feature noted in 11.1). **11.4*** (507) sub-rectangular/sub-oval; early medieval, dated by association with feature noted in 11.1). **11.5*** (907) possible corn-drying kiln, sub-rectangular/sub-oval; early medieval/medieval, dated by radiocarbon date from basal fill: cal. AD 970–1160 (Beta-255068, 1000±40 BP, oat grain). *References*: DAT HER, PRNs 125618, 125619, 125620, 125621, 125622; Crane and Murphy 2010.

12. Ty Isaf, Llanwnda (Pembrokeshire), SM 9330 3950
Location: two probable kilns and remains of enclosing ?structures in area adjacent to early medieval ecclesiastical site. *Type and dating*: **12.1** ('Western') pear-shaped; undated. **12.2** ('Eastern') oval/circular; undated. *References*: DAT HER, PRNs 125623, 102356; Crane 2006a.

13. West Angle Bay (Pembrokeshire), SM 8526 0302
Location: possible kiln within ?annexe to 6th/7th-century rectangular enclosure which contained cemetery enclosure containing 7th–12th-century burials. *Type and dating*: **13.1** possible kiln of uncertain form; early medieval, dated by radiocarbon date from fill: cal. AD 610–770 (SUERC-32877, 1365±30 BP, *Prunus* sp. charcoal). *References*: DAT HER, PRN 125624; Schlee 2010; Groom *et al.* 2011, 171.

14. Brownslade Barrow, Castlemartin (Pembrokeshire), SR 9054 9722
Location: possible kiln near large ?Bronze Age/Romano-British barrow, early medieval cemetery, and area of Iron Age cultivation marks. *Type and dating*: **14.1** uncertain form; undated. *References*: DAT HER, PRN 102360; Hughes *et al*. 2007.

15. Tanyreglwys, Blaenporth (Ceredigion), SN 2616 4891
Location: possible kiln in lowland area of mixed farming. *Type and dating*: **15.1** uncertain form; early medieval, dated by radiocarbon date from near base: cal. AD 720–990 (Beta-213001, 1160±50 BP, unidentified charcoal). *References*: DAT HER, PRN 125625; Crane 2006b.

16. Heol y Myny, Beulah (Ceredigion), SN 2918 4645
Location: in lowland area of mixed farming. *Type and dating*: **16.1*** uncertain form; medieval, dated by 12th–16th-century pottery and radiocarbon date of fill: cal. AD 1020–1190 (Beta-436333; laboratory measurements unpublished). *Reference*: DAT HER, PRN 125626; Sambrook 2017.

17. Wiston (Pembrokeshire), SN 0212 1804
Location: in area of Anglo-Norman (Flemish) burgage plots SW of Wiston Castle, founded before AD 1112. *Type and dating*: **17.1*** oval/circular; early medieval/medieval, dated by medieval pottery and radiocarbon date in lower fill: cal. AD 690–1020 (CAR-1441, 1150±70 BP, unidentified charcoal). *References*: DAT HER, PRN 125627; Murphy 1995.

18. Love Lodge Farm, Llandeilo (Carmarthenshire), SN 62251 21576 (18.1), SN 6218 2161 (18.2–3)
Location: one certain and two possible kilns on site adjacent to Llandeilo early medieval monastic centre and 12th-century Welsh royal centre. *Type and dating*: **18.1** (1265) possible oval/circular kiln; early medieval/medieval, dated by radiocarbon date: cal. AD 1020–1190 (UBA-27747 930±33 BP, *Quercus* sp. charcoal). **18.2*** (2004) oval/circular; early medieval, dated by radiocarbon date from basal fill: cal. AD 660–780 (UBA-27754, 1282±28 BP, *Avena* sp. grain). **18.3** (2008) possible oval/circular kiln; undated. *References*: DAT HER, PRNs 109222, 109221, 125641; Hourihan *et al.* 2015.

19. Cwmbrwyn (Carmarthenshire), SN 2537 1213
Location: possible kiln within Romano-British enclosure with stone and timber buildings and a bath-house. *Type and dating*: **19.1** possible rectangular kiln; Romano-British, dated on basis of context. *References*: DAT HER, PRN 125628; Ward 1907.

20. Gurrey Cottage, Llandeilo (Carmarthenshire), SN 6264 2385 (no. 20.1), SN 6266 2384 (no. 20.2)
Location: two kilns close to post-medieval farm in a lowland river valley. *Type and dating*: **20.1*** (246001) keyhole-shaped; medieval/post-medieval (fill contained post-medieval pottery). **20.2*** (246002) keyhole-shaped; medieval/post-medieval (fill contained post-medieval pottery). *References:* DAT HER, PRNs125629, 125630; Hart 2013c; Darvill *et al.* forthcoming, site 24.06.

21. Dolbenmaen (Gwynedd), SH 4985 4305 (no. 21.1), SH 4984 4306 (no. 21.2), SH 4996 4301 (no. 21.3), SH 4999 4303 (no. 21.4)
Location: three certain and one possible kiln near *maerdref*/*llys* and motte, and adjacent to a natural mound thought to be an early medieval assembly site. *Type and dating*: **21.1*** (1622 and 1624) pear-shaped; undated. **21.2*** (1678 and 1681) keyhole-shaped, medieval, dated by radiocarbon dates from secondary fill: cal. AD 1210–1290 (SUERC-68346, 764±34 BP, *Triticum aestivo/compactum* grain) and cal. AD 1030–1210 (SUERC-68347, 909±34 BP, *Avena* sp. grain). **21.3*** (1547) dumb-bell/figure of eight-shaped, early medieval, dated by radiocarbon dates from fill: cal. AD 420–590 (SUERC-70637, 1544±33 BP, *Avena* sp. grain) and cal. AD 400–550 (SUERC-70638, 1588±33 BP, *Hordeum var vulgare* grain). **21.4*** (1683) possible kiln of uncertain form; medieval, dated by *c*. 15th–17th-century sherd and radiocarbon dates from associated features: cal. AD 1280–1430 (SUERC-68327, 592±64 BP, *Avena* sp. grain) and cal. AD 1400–1480 (SUERC-68328, 461±34 BP, *Avena* sp. grain). *Reference*: GAT HER, PRNs 62643, 62648; McNichol *et al.* 2017.

22. Parc Cybi, Holyhead (Anglesey), SH 2564 8083 (no. 22.1), SH 2567 8081 (no. 22.2), SH 2566 8067 (no. 22.3), SH 2567 8078 (no. 22.4), SH 2566 8077 (no. 22.5), SH 2566 8085 (no. 22.6), SH 2566 8076 (no. 22.7), SH 2548 8078 (no. 22.8), SH 2567 8070 (no. 22.9)
Location: up to nine kilns found in area of late Roman fort and early Christian site. *Type and dating*: **22.1*** (80056) dumb-bell/figure of eight-shaped; early medieval, dated by radiocarbon dates from fill: cal. AD 430–610 (SUERC-85159, 1513±24 BP, wheat grain) and cal. AD

420–550 (SUERC-85160, 1563±24 BP, barley grain). **22.2*** (21051) dumb-bell/ figure of eight-shaped; early medieval, dated by radiocarbon dates from basal fill: cal. AD 420–590 (SUERC-85168, 1535±20 BP, barley grain) and cal. AD 420–560 (SUERC-85169, 1555±24 BP, oat grain). **22.3*** (21229) dumb-bell/ figure of eight-shaped; early medieval, dated by radiocarbon dates from lower fill: cal. AD 420–580 (SUERC-85161 1541±21 BP, wheat grain) and cal. AD 410–540 (SUERC-85162, 1591±24 BP, barley grain). **22.4*** (80924) dumb-bell/ figure of eight-shaped; early medieval, dated by radiocarbon dates from basal and secondary fills: respectively cal. AD 420–550 (SUERC-85158, 1577±24 BP, oat grain) and cal. AD 420–580 (SUERC-85154, 1538±24 BP, wheat grain). **22.5*** (80835) sub-rectangular/sub-oval; ?early medieval, dated by radiocarbon dates from fill: 360–190 cal. BC (SUERC-85152, 2193±21 BP, wheat grain), assumed to be from residual material, and cal. AD 470–640 (SUERC-85153, 1498±24 BP, barley grain). **22.6*** (80137) oval/circular, early medieval, dated by radiocarbon dates from basal fill: cal. AD 420–560 (SUERC-85163, 1555±24 BP, wheat grain) and cal. AD 420–550 (SUERC-85164, 1577±24 BP, oat grain). **22.7*** (81137) possible oval/circular kiln; ?Romano-British, dating suggested by location within Romano-British roundhouse. **22.8** (30048) dumb-bell/ figure of eight-shaped; undated. **22.9*** (22158) pear-shaped; undated. *References*: GAT HER, PRNs 31601, 31603, 31604, 31596, 76100, 31602, 31596, 14599, 81343); Kenney *et al.* 2011; Kenney *et al.* 2020.

23. Parc Bryn Cegin, Llandygai (Gwynedd), SH 5913 7043 (no. 23.1), SH 5931 7048 (no. 23.2)
Location: two kilns on ridge beside a river valley on a probable boundary between arable and pasture land in area with occupation evidence from the Neolithic to Romano-British periods. *Type and dating*: **23.1*** (3671) L/comma-shaped; medieval, dated by radiocarbon dates from primary fill, upper fill and two dates from adjacent feature: respectively cal. AD 1020–1210 (Wk-20036, 917±36 BP, oat grain), cal. AD 1040–1260 (Wk-20035, 867±39 BP, oat grain), cal. AD 1030–1210 (Wk-20037, 912±36 BP, oat grain) and cal. AD 1010–1160 (Wk-20038, 966±36 BP, hazelnut shell). **23.2** (1850) pear-shaped; undated. *References*: GAT HER, PRNs 31787, 31788; Kenney 2008a; Kenney 2008b.

24. Glan Morfa, Llanystumdwy (Gwynedd), SH 4186 3670
Location: on sandy ridge overlooking marshes and a valley in farmland probably adjacent to a medieval coastal road. *Type and dating*: **24.1*** L/comma-shaped; medieval, dated by radiocarbon dates from lower fills: cal. AD 1040–1220 (SUERC-44175, 891±26 BP, *Triticum* sp. grain), cal. AD 1050–1260 (SUERC-44174, 851±25 BP, *Avena* sp. grain), cal. AD 1160–1260 (SUERC-44177, 839±25 BP, *Avena* sp. grain). *References*: GAT HER, PRN 34081; Kenney 2014a.

25. Ysgol yr Hendre, Llanbeblig (Gwynedd), SH 4897 6240
Location: in area of coastal pasture, near Roman fort and early medieval cemetery. *Type and dating*: **25.1*** L/comma-shaped, medieval, dated by radiocarbon dates from fill: cal. AD 1050–1260 (SUERC-42596, 858±29 BP, *Hordeum* sp. grain) and cal. AD 1220–1290 (SUERC-41961, 756±19 BP, *Hordeum* sp. grain). *References*: GAT HER, PRN 34071; Kenney and Parry 2012; Kenney and Parry 2013.

26. Abergwyngregyn (Gwynedd), SH 6674 7038
Location: built into an Iron Age hut circle in river valley on edge of uplands. *Type and dating*: **26.1** form uncertain; undated (awaiting full publication).
References: GAT HER, PRN 38298; Kenney 2014b.

27. Graeanog, Clynnog (Gwynedd), SH 4579 4938
Location: Iron Age to Romano-British enclosed hut group with some reuse in the medieval period set on gravel ridge with well-drained arable soils between mountains and the coast. *Type and dating*: **27.1** L/comma-shaped; early medieval/medieval, dated by radiocarbon dates from various fills (all based on unidentified charcoal): cal. AD 780–1160 (CAR-934, 1040±60 BP), cal. AD 890–1160 (CAR-933, 1020±60 BP), cal. AD 1040–1280 (CAR-932, 840±60 BP). Middle of fill (318) dated to cal. AD 140–550 (CAR-1156, 1680±70 BP).
References: GAT HER, PRN 55493; Fasham *et al.* 1998.

28. Ty'n Ddol, Dolwyddelan (Conwy), SH 6941 5192
Location: upland valley. *Type and dating*: **28.1** unexcavated, keyhole-shaped; undated, but considered to be probably post-medieval. *Reference*: GAT HER, PRN 4523.

29. Cefn Du, Llanfihangel Ysgeifiog (Anglesey), SH 4914 7229
Location: in lowland arable area. *Type and dating*: **29.1*** L/comma-shaped; medieval, dated by radiocarbon date from ?stokehole: cal. AD 990–1270 (WK-9275, 903±78 BP, cereal grain). *References*: GAT HER, PRN 33505; Cuttler *et al.* 2012.

30. Coed Dolwyd, Llansanffraid Glan Conwy (Gwynedd), SH 8142 7623
Location: in area of agricultural land in valley. *Type and dating*: **30.1*** keyhole-shaped; medieval, dated by radiocarbon dates from fills: 7590–7520 cal. BC (SUERC-55150, 8490±31 BP, oat grain, assumed to be residual), cal. AD 1160–1270 (SUERC-55156, 819±31 BP, hazelnut shell), and cal. AD 1210–1290 (SUERC 55157, 764±31 BP, hazelnut shell).
References: GAT HER, PRN 60153; Davidson 2015.

31. Penrhos Leisure Village, Holyhead (Anglesey), SH 2716 8166
Location: in area of burnt mounds, Romano-British activity and early field boundaries. *Type and dating*: **31.1*** oval/circular; early medieval, dated by radiocarbon dates from fill: cal. AD 420–580 (SUERC-58609, 1544±28 BP, barley grain), and cal. AD 420–570 (SUERC-59068, 1554±29 BP, wheat grain). *References*: GAT HER, PRN 44659; Kenney 2012; Wessex Archaeology 2015.

32. Tai Cochion, Llanidan (Anglesey), SH 4808 6562
Location: within Roman settlement in coastal agricultural area. *Type and dating*: **32.1*** oval/circular; Romano-British, dated by context and unweathered 4th-century pottery in upper fill. *References*: GAT HER, PRN 28425; Hopewell 2016.

33. Sarn-y-bryn-caled, Welshpool (Powys), SJ 2202 0504

Location: group of up to nine kilns within prehistoric ritual and funerary complex in river valley. *Type and dating*: **33.1*** (61) pear-shaped, early medieval, dated on basis of similarity to other dated kilns at site. **33.2** (69) pear-shaped, early medieval, dated by radiocarbon date from upper fill cal. AD 420–570 (UB-4433, 1552±25 BP, unidentified charcoal). **33.3*** (58) pear-shaped, early medieval, dated on basis of similarity to other dated kilns at site. **33.4*** (122) pear-shaped, early medieval, dated on basis of similarity to other dated kilns at site. **33.5*** (55) pear-shaped, early medieval, dated on basis of similarity to other dated kilns at site. **33.6*** (66) sub-rectangular/sub-oval, early medieval, dated by radiocarbon date from lower fill: cal. AD 570–660 (UB-4432, 1434±25 BP, unidentified charcoal). **33.7** (116) possible sub-rectangular/sub-oval kiln; undated. **33.8** (127) possible sub-rectangular/sub-oval kiln; undated. **33.9*** (135) oval/circular, early medieval, dated on basis of similarity to other dated kilns at site. *References*: CPAT HER, PRN 43134; Blockley and Taverner 2002.

34. Buttington Cross, Welshpool (Powys), SJ 2430 0870 (nos 34.1–3), SJ 2430 0880 (no. 34.4), SJ 2452 0884 (no. 34.5)
Location: up to five kilns within prehistoric ritual and funerary complex in river valley. *Type and dating*: **34.1*** (47) oval/circular; early medieval, dated on basis of similarity of archaeobotanical assemblage with other dated examples at site. **34.2** (39) possible oval/circular kiln; undated. **34.3** (100) possible oval/circular kiln; undated. **34.4*** (566) pear-shaped-shaped; early medieval, dated by radiocarbon date from lower fill: cal. AD 380–540 (SUERC-24180, 1615±30 BP, wheat grain). **34.5*** (513) oval/circular, early medieval, dated by radiocarbon date from lower fill: cal. AD 430–650 (SUERC-24178, 1495±30 BP, *Hordeum vulgare* grain). *References*: CPAT HER, PRNs 84366, 164141, 164140; Mann and Hurst 2009.

35. Carmarthen Greyfriars (Carmarthenshire), SN 4102 1998
Location: on raised river terrace north of Franciscan Priory established in mid-13th century. *Type and dating*: **35.1*** keyhole-shaped; medieval, dated by radiocarbon dates from flue: cal. AD 990–1220 (Beta-113169, 950±60 BP, charred seeds and charcoal), and cal. AD 990–1220 (Beta-113170, 940±60 BP, charred seed and charcoal). *References*: DAT HER, PRN 125631; Manning 1998.

36. Llanddowror (Carmarthenshire), SN 2448 1445
Location: possible kiln found in area of prehistoric pits in farmland above valley. *Type and dating*: **36.1** uncertain form; possibly Middle Bronze Age, dated by radiocarbon date from basal fill: 1520–1410 cal. BC (SUERC-50314, 3194±29 BP, alder/hazel charcoal). *Reference*: DAT HER, PRN 125632; Barber *et al*. 2019, site 18.

37. Collfryn, Llansantffraid-ym-Mechain (Powys), SJ 2219 1737
Location: dug into rampart and ditch of Iron Age enclosure in valley farmland. *Type and dating*: **37.1*** keyhole-shaped; medieval/post-medieval, dated by radiocarbon date from stokehole: cal. AD 1310–1620 (CAR-565, 480±55 BP; unidentified charcoal). *References*: CPAT HER, PRN 50538; Britnell 1984.

38. Lan Ganol, Llanafanfawr (Powys), SN 9755 5695
Location: possible kiln on upland hillside in an area of medieval platform houses on edge of rough grazing. *Type and dating*: **38.1** unexcavated, possible keyhole-shaped kiln; undated. *References*: CPAT HER, PRN 88956.

39. Newtown (Powys), SO 1072 9169
Location: probably within burgage plot in medieval town. *Type and dating*: **39.1** keyhole-shaped; medieval, dated by 13th/14th-century pottery in stokehole. *References*: CPAT HER, PRN 128164; Dodd *et al.* 1999.

40. New Radnor (Powys), SO 2105 6075 (40.1), SO 2124 6084 (40.2)
Location: two kilns within burgage plots in 12th-century plantation town. *Type and dating*: **40.1*** (280 and 402) keyhole-shaped; medieval/post-medieval, dated by 15th-century pottery in chamber. **40.2** ('Hall Street') keyhole-shaped; medieval/post-medieval, dated by 14th–16th-century pottery in chamber. *References*: CPAT PRNs 17409, 17483; Jones 1998; Dorling 1988.

41. Pen-y-gaer, Cwmdu (Powys), SO 1686 2195
Location: in Roman military *vicus* beside a Roman fort, whose main period of activity was probably late 1st to late 2nd centuries AD. *Type and dating*: **41.1** uncertain form; Roman on basis of context and stratigraphical relationships. *References*: CPAT HER, PRN 658; Jones and Hankinson 2016.

42. Plas Goch (Wrexham), SJ 3259 5161
Location: next to Romano-British enclosure. *Type and dating*: **42.1*** T-shaped; Romano-British, dated by 2nd-century pottery in stokehole. *References*: CPAT HER, PRN 13092; Jones 2011.

43. Llanelwedd (Powys), SO 0497 5267
Location: within post-medieval upland farmstead complex. *Type and dating*: **43.1*** keyhole-shaped, post-medieval (included in gazetteer because noted in text), dated by 17th–18th-century pottery in stokehole. *References*: CPAT HER, PRN 122829; Britnell 2013.

44. Aberyscir Court, Yscir (Powys), SN 9955 2955
Location: four certain and four probable kilns in proximity of Roman auxiliary fort in river valley. *Type and dating*: **44.1*** (064) dumb-bell/figure of eight-shaped; Romano-British, dated on basis of similarity to 44.3. Radiocarbon date from upper fill of flue assumed to be from residual material: 8710–8350 cal. BC (SUERC-56070, 9311±40 BP, charred hazelnut shell). **44.2*** (009) dumb-bell/ figure of eight-shaped; Romano-British, dated on basis of similarity to 44.3. **44.3*** (011) dumb-bell/ figure of eight-shaped; Romano-British, dated by radiocarbon date from upper fill: cal. AD 80–330 (SUERC-56071, 1821±40 BP, charred hazelnut shell). **44.4*** (13/38) dumb-bell/ figure of eight-shaped; Romano-British, dated on basis of similarity to 44.3. **44.5** (018) possible oval/circular kiln; undated. **44.6*** (006) possible oval/circular kiln; undated. **44.7*** (021) possible oval/circular kiln; undated. **44.8***

(29) possible oval/circular kiln; undated. *References*: CPAT HER, PRN 131220; Leonard 2014; Darvill *et al.* forthcoming, site 50.05.

45. Old Village Road, Barry (Vale of Glamorgan), ST 1039 6719
Location: in proximity of medieval houses in shrunken medieval village. *Type and dating:* **45.1** keyhole-shaped; medieval, dated on basis of sherd of late 13th-century pottery in chamber wall. *References*: GGAT HER, PRN E000890; Thomas and Dowdell 1987.

46. Llanelen, Llanrhidian Lower (Swansea), SS 5112 9337
Location: possible kiln found beside cemetery related to a pre-13th-century chapel later replaced by farm buildings. *Type and dating*: **46.1** possible L/comma-shaped; undated. *References*: GGAT HER, PRN 00234w; Schlesinger and Walls 1996.

47. Atlantic Trading estate, Barry (Vale of Glamorgan), ST 132 673
Location: in coastal location in vicinity of an early medieval cemetery. *Type and dating*: **47.1*** rectangular; medieval, dated by radiocarbon date from unspecified context: cal. AD 990–1210 (CAR-1498, 950±50 BP, unspecified sample). *References*: Caseldine 1995; Newman 1987.

48. Cefn Drum, Pontardulais (Swansea), SN 6136 0453
Location: one, possibly two, kilns probably associated with nearby platform houses of 12th–14th-century date. *Type and dating:* **48.1** keyhole-shaped; medieval, dated by radiocarbon date from kiln entrance: cal. AD 1040–1260 (OxA-10056, 859±34 BP, unidentified charcoal). **48.2** unexcavated possible kiln of uncertain form; undated. *References*: GGAT HER, PRN 00367w; Kissock and Johnston 2007; Kissock and Phillips 2000.

49. St Brynach's Churchyard, Llanfrynach (Vale of Glamorgan), SS 9797 7461
Location: possible kiln within medieval churchyard in deserted medieval hamlet, built against wall of a building. *Type and dating*: **49.1** possible kiln of uncertain form; medieval dating assumed from general context of site, associated with 13th–14th-century finds. *References*: GGAT HER, PRN 03609s.

50. Llampha (Vale of Glamorgan), SS 9242 7486
Location: possible kiln within a deserted medieval settlement. *Type and dating*: **50.1** unexcavated stone-built structure of uncertain form; undated. *References*: NMR, NPRN 15338; RCAHMW 1982.

51. Merthyr Dyfan, Barry (Vale of Glamorgan), ST 1134 6948
Location: possible kiln identified near shrunken medieval village. *Type and dating*: **51.1** possible keyhole-shaped kiln; medieval, dated on basis of 13th–14th-century pottery in flue. *References*: GGAT HER, PRN 03562s; NMR, NPRN 15358; Havard 2002.

52. St Fagans (Cardiff), ST 1181 7621

Location: in shrunken medieval village. *Type and dating*: **52.1** pear-shaped; medieval, dated by sherd of 13th–14th-century pottery in flue. *References*: GGAT HER, PRNs E002407, 05093s; Yates 2001.

53. Whitton Lodge, Wenvoe (Vale of Glamorgan), ST 0811 7133
Location: two kilns associated with Romano-British farm/villa. *Type and dating*: **53.1** ('External kiln') T-shaped; Romano-British dated by sherds of 3rd and 4th-century pottery in fill. **53.2** ('East range kiln') T-shaped; Romano-British, dated by context within and contemporary with a large late 3rd-century building. *References*: GGAT HER, PRN 00382s; Jarrett and Wrathmell 1981.

54. Biglis, Barry (Vale of Glamorgan), ST 1420 6940
Location: up to five kilns found within multiphase Late Iron Age/Romano-British agricultural settlement. *Type and dating*: **54.1** (424) T-shaped, Romano-British, pre-dating radiocarbon date for later inhumation burial: cal. AD 400–650 (CAR-270, 1520±70 BP, human bone). **54.2** (146) possible oval/circular kiln; Iron Age/Romano-British, dated by Late Iron Age/early Romano-British pottery in fill. **54.3** (314) possible oval/circular kiln; Iron Age/Romano-British, dated by sherd of Late Iron Age pottery in fill. **54.4** (430) possible oval/circular kiln; Romano-British, dated by sherd of 3rd–4th-century pottery in fill. **54.5** (020) possible sub-rectangular/sub-oval kiln; Romano-British, dated by sherd of 3rd–4th-century pottery in fill. *References*: GGAT HER, PRN 00578s; Parkhouse 1988.

55. Cowbridge (Vale of Glamorgan), SS 9937 7483
Location: up to twelve kilns in area of Romano-British occupation associated with a possible auxiliary fort. *Type and dating*: **55.1** (882) possible rectangular kiln; Romano-British, dated on stratigraphic evidence to 4th-century AD. **55.2** (895) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. **55.3** (1140) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. **55.4** (1416) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. **55.5** (1518) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. **55.6** (1549) possible rectangular kiln; Romano-British, dated by 4th-century coins in fill. **55.7** (012) T-shaped; Romano-British, dated by 3rd–4th-century pottery in fill. **55.8** (1005) T-shaped; Romano-British, dated by 2nd-century coin and 4th-century-pottery and in fill. **55.9** (229) T-shaped; Romano-British, dated by 3rd–4th-century pottery in fill. **55.10** (520) possible rectangular kiln; Romano-British, dated by 2nd–3rd finds in fill; **55.11** (886) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. **55.12** (966) possible rectangular kiln; Romano-British, dated by morphological similarity to others dated to this period. *References*: GGAT HER, PRN 00893s; Parkhouse and Evans 1996.

56. RAF St Athan (Vale of Glamorgan), ST 0042 6892 (no. 56.1), ST 0039 6894 (no. 56.2)
Location: up to two kilns within Romano-British field system overlying Late Iron Age enclosure and settlement. *Type and dating*: **56.1*** ('Drying oven 2') possible kiln of uncertain

form: undated. **56.2*** ('Drying oven 1') T-shaped; Romano-British, dated on basis of morphology. *References*: GGAT HER, PRN E005345; Barber *et al.* 2006.

57. Great Bulmore, Caerleon (Newport), ST 3590 9151
Location: possible kiln within Romano-British roadside settlement. *Type and dating:* **57.1** possible sub-rectangular/sub-oval kiln; possibly Romano-British on basis of context. *References*: GGAT HER, PRN 04908g; Tuck 2006.

58. Cae Summerhouse, Merthyr Mawr (Bridgend), SS 8639 7798
Location: two kilns in Iron Age/Romano-British agricultural settlement, ?abandoned in 2nd century. *Type and dating*: **58.1** ('North terminal dryer') T-shaped; Romano-British, dated by form. **58.2** ('D-shaped enclosure dryer') form uncertain; Romano-British, dated on basis of context. *References*: GGAT HER, PRN 00246m; Arnold and Davies 2000; Davies 1973; Robinson 1988.

59. Dan-y-Graig, Porthcawl (Bridgend), SS 8407 7805
Location: within Romano-British agricultural estate. *Type and dating*: **59.1*** T-shaped; Romano-British, dated by late 3rd-century finds in primary fill. *References*: GGAT 04734m; Newman 1990.

60. Newhouse Park, Chepstow (Monmouthshire), ST 5287 9111
Location: associated with Romano-British farmstead. *Type and dating*: **60.1*** dumb-bell/figure of eight-shaped; Romano-British, dated by 1st–2nd-century finds from lower fill and 2nd–4th-century finds from upper fill. *Reference*: Robic and Ponsford 2008.

61. Hay-on-Wye (Powys), SO 2309 4253
Location: group of up to five kilns probably on periphery of medieval town. *Type and dating*: **61.1*** (135) keyhole-shaped; medieval, dated by 13th/14th-century pottery in demolition layer. **61.2*** (608 and 631) keyhole-shaped; medieval, dated by 13th/14th-century pottery in demolition layer. **61.3*** (120) keyhole-shaped, medieval, dated by 13th/14th-century pottery in primary fill. **61.4*** (174 and 185) keyhole-shaped; medieval, dated by late 12th/13th-century pottery in demolition layer. **61.5** (625) possible sub-rectangular/sub-oval kiln; medieval, dated by 12th/13th-century pottery in fill. *References*: CPAT HER, PRN 122856; Border Archaeology 2005.

62. Four Crosses, Llandysilio (Powys), SJ 26837 19164
Location: in angle between field boundaries thought to be medieval. *Type and dating*: **62.1*** pear-shaped, medieval/post-medieval, dated by radiocarbon dates from upper and secondary fill: respectively cal. AD 1450–1640 (SUERC-34227, 355±30 BP, oat grain), and cal. AD 1450–1640 (SUERC-34229, 355±30 BP, rye grain). *References*: CPAT HER, PRN 122857; Jones and Grant 2011.

63. Caer Alyn, Llay (Wrexham), SJ 33326 54007

Location: dug into hillslope in area of medieval settlement. *Type and dating*: **63.1** keyhole-shaped; medieval, dated by associated 14th/15th-century pottery. *References*: CPAT HER, PRN 128511; Hanna 2008.

64. Cryn Fryn, Llanwrthwl (Powys), SN 9750 6190
Location: possible kiln built in upland river valley in area of possibly post-medieval field enclosures. *Type and dating*: **64.1** possible keyhole-shaped kiln; undated. *Reference*: CPAT HER, PRN 4016.

65. Byllfa-uchaf, Merthyr Cynog (Powys), SN 97219 42962
Location: two possible kilns near remote post-medieval upland farmstead, in river valley. *Type and dating*: **65.1** unexcavated, possible kilns of uncertain form (represented by circular sunken areas); dating uncertain. *References*: CPAT HER, PRNs 122858, 15613; Silvester and Hankinson 2013.

66. Cefn Trum yr Hwch, Merthyr Cynog (Powys), SN 99384 40617
Location: unexcavated, possible kiln or root vegetable clamp near medieval/post-medieval upland farmstead, in river valley near edge of enclosed land. *Type and dating*: **66.1** possible kiln of uncertain form; undated. *References*: CPAT HER, PRN 122885; Silvester and Hankinson 2013.

67. Llidiart Yspytty, Porthmadog (Gwynedd), SH 55649 40326
Location: within corner of stone-walled building or wind-break in Romano-British settlement, including a bath-house, on hillside above a river valley. *Type and dating*: **67.1*** T-shaped; Romano-British, dated by radiocarbon dates from upper layers: cal. AD 70–320 (Beta-205125, 1840±40 BP, emmer/spelt grains) and cal. AD 80–330 (Beta-205126, 1820±40 BP, barley grains). *References*: GAT HER, PRN 19661; Kenney 2006.

68. Caerau Hillfort, Caerau (Cardiff), ST 1337 7489
Location: within Iron Age hillfort on inland promontory above a river valley. *Type and dating*: **68.1*** pear-shaped; early medieval, dated on basis of radiocarbon date from primary fill: cal. AD 420–640 (UBA-38185, 1509±40 BP, wheat grain). *Reference*: Davis and Sharples 2014.

69. Cosmeston (Vale of Glamorgan), ST 1774 6889
Location: in shrunken medieval village. *Type and dating*: **69.1** keyhole-shaped; medieval, 12th/4th-century on basis of associated features in settlement. *References*: GGAT HER, PRN 00948s; Forward and Hines 2016.

70. Rhuddlan (Denbighshire), SJ 0273 7776 (no. 70.1), SJ 0263 7788 (nos 70.2, 70.3)
Location: three kilns in area of medieval town. *Type and dating*: **70.1*** (C3) pear-shaped; medieval, dated by 13th-century pottery and residual Saxo-Norman pottery in associated features. **70.2*** (T50) oval/circular; medieval, 13th/14th-century, on basis of stratigraphic

relationships. **70.3*** (T61) pear-shaped; medieval, 13th/14th-century on basis of stratigraphic relationships. *References*: CPAT HER, PRN 167040, 167041, 167042; Quinnell *et al.* 1994.

71. Highlight, Barry (Vale of Glamorgan), ST 0981 6998
Location: built over gable end of abandoned buiding in lowland deserted medieval village. *Type and dating*: **71.1*** possible kiln of uncertain form; medieval, allocated to 15th-century phase of occupation. *References*: GGAT HER, PRN 00536s; Thomas 1967; Thomas 1970.

72. Llanbadarn Castle, Aberystwyth (Ceredigion), SN579 58153
Location: associated with medieval castle. *Type and dating*: **72.1** unexcavated and unlocated, uncertain form; medieval, on basis of historical record in 1298–1300, 1300, and 1301/2. *References*: DAT HER, PRN 125633; Rhys 1936, 177, 151, 468.

73. Dinevor Castle, Llandeilo (Carmarthenshire), SN 6114 2173
Location: associated with medieval castle. *Type and dating*: **73.1** unexcavated and unlocated, uncertain form; medieval, on basis of historical record in 1300. *References*: DAT HER, PRN 125634; Rhys 1936, 167.

74. Dryslwyn Castle, Llangathen (Carmarthenshire) SN 5540 2035
Location: associated with medieval castle. *Type and dating*: **74.1** unexcavated and unlocated, uncertain form; medieval, on basis of historical record in 1300. *References*: DAT HER, PRN 125635; Rhys 1936, 167.

75. Cardigan Castle (Ceredigion), SN 1779 4590
Location: associated with medieval castle. *Type and dating*: **75.1** unexcavated and unlocated, uncertain form; medieval, on basis of historical record in 1300. *References*: DAT HER, PRN 125636; Rhys 1936, 167.

76. Emlyn Castle, Newcastle Emlyn (Carmarthenshire), SN 3113 4072
Location: associated with medieval castle. *Type and dating*: **76.1** unexcavated and unlocated, uncertain form; medieval, on basis of historical record in 1300. *References*: DAT HER, PRN 125637; Rhys 1936, 167.

77. Pentre Farm, Pontardulais (Swansea), SN 5913 0263
Location: on edge of Bronze Age mound near river fording point. *Type and dating*: **77.1** dumb-bell/figure of eight-shaped; early medieval, dated by radiocarbon date from ?primary fill: cal. AD 416–655 (HAR-959, 1500±70 BP, *Quercus* sp. charcoal). *References*: GGAT HER, PRN 00195w; Edwards and Lane 1978; Ward 1978.

NOTES

1. Rhiannon Comeau and Steve Burrow, ‘Corn-drying kilns in Wales’ (2021), available on the ADS website.

2. National Library of Wales, ‘Welsh tithe maps’, available at <https://places.library.wales>.
3. Available online at <www.archwilio.org.uk>.
4. Available online at <www.coflein.gov.uk>.

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Table 1. Recorded Welsh corn-drying kilns by type and period

Type	Total	Middle Bronze Age?	Iron Age?	Romano-British	Early medieval	Medieval	Medieval/post-medieval	Undated
dumb-bell/figure of eight	14	–	–	5	8	–	–	1
oval/circular	30	–	2	3	12	4	–	9
T-shaped	11	–	–	11	–	–	–	–
rectangular	11	–	–	10	–	1	–	–
pear-shaped	22	–	–	–	12	3	1	6
keyhole-shaped	21	–	–	–	–	13	5	3
L/comma-shaped	6	–	–	–	1	4	–	1
sub-rectangular/sub-oval	12	–	–	2	7	1	–	2
uncertain type	16	1	–	2	2	4	–	7
Total	143	1	2	33	42	30	6	29

Table 2. Dimensions of the main types of corn-drying kiln, ordered chronologically

Type	Total no.	length (m)	width (m)	depth (m)
Dumb-bell/figure of eight	14	1.0–3.4	0.85–1.7	0.15–1.0
Oval/circular	30	0.4–4.4	0.25–3.0	0.1–1.4
T-shaped	11			
drying chamber		1.5–3.2	0.55–1.6	0.4–1.1
flue		1.9–3.5	0.4–0.88	0.4–0.7
Pear-shaped	22	0.8–6.7	0.65–3.6	0.12–2.0
Keyhole-shaped	21	2.0–9.0	0.8–2.9	0.3–1.4
drying chamber		0.7–2.9	0.7–2.9	0.05–0.99
flue		0.8–3.5	0.3–1.0	0.3–0.8
L/comma-shaped	6	2.29–7.9	0.7–1.9	0.25–0.28
drying chamber		0.7–2.1	0.48–1.6	0.5 (2 examples)
flue		1.0–4.5	0.34 (1 example)	0.1 (1 example)

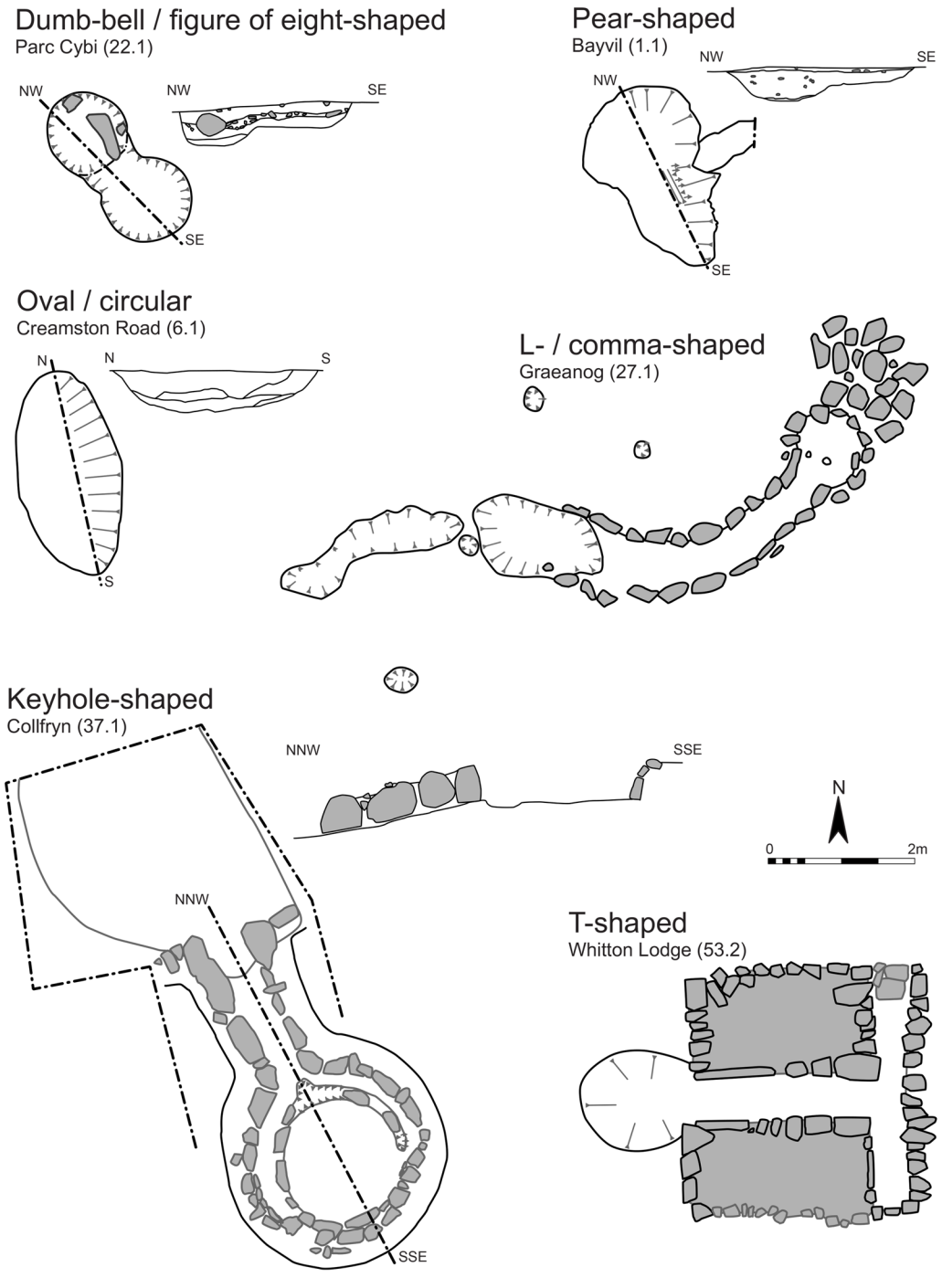


Fig. 1. Plans and sections of different types of later prehistoric to sixteenth-century corn-drying kiln in Wales.

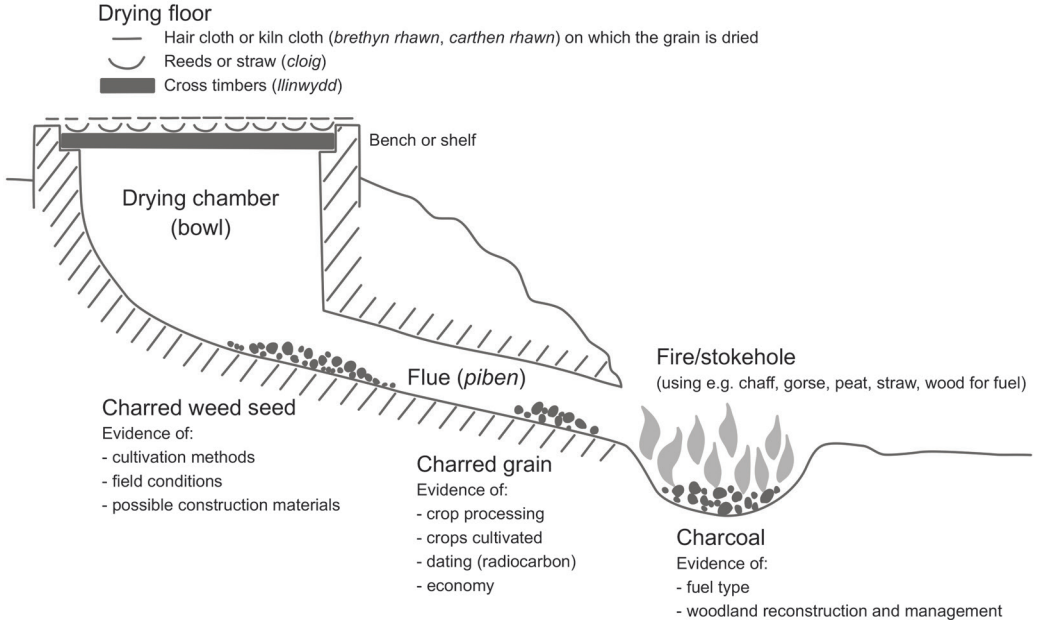


Fig. 2. Schematic representation of an open keyhole-shaped corn-drying kiln or field kiln (*odyn faes*), with some of the Welsh terms used in nineteenth-century accounts (cf. Monk 2014).

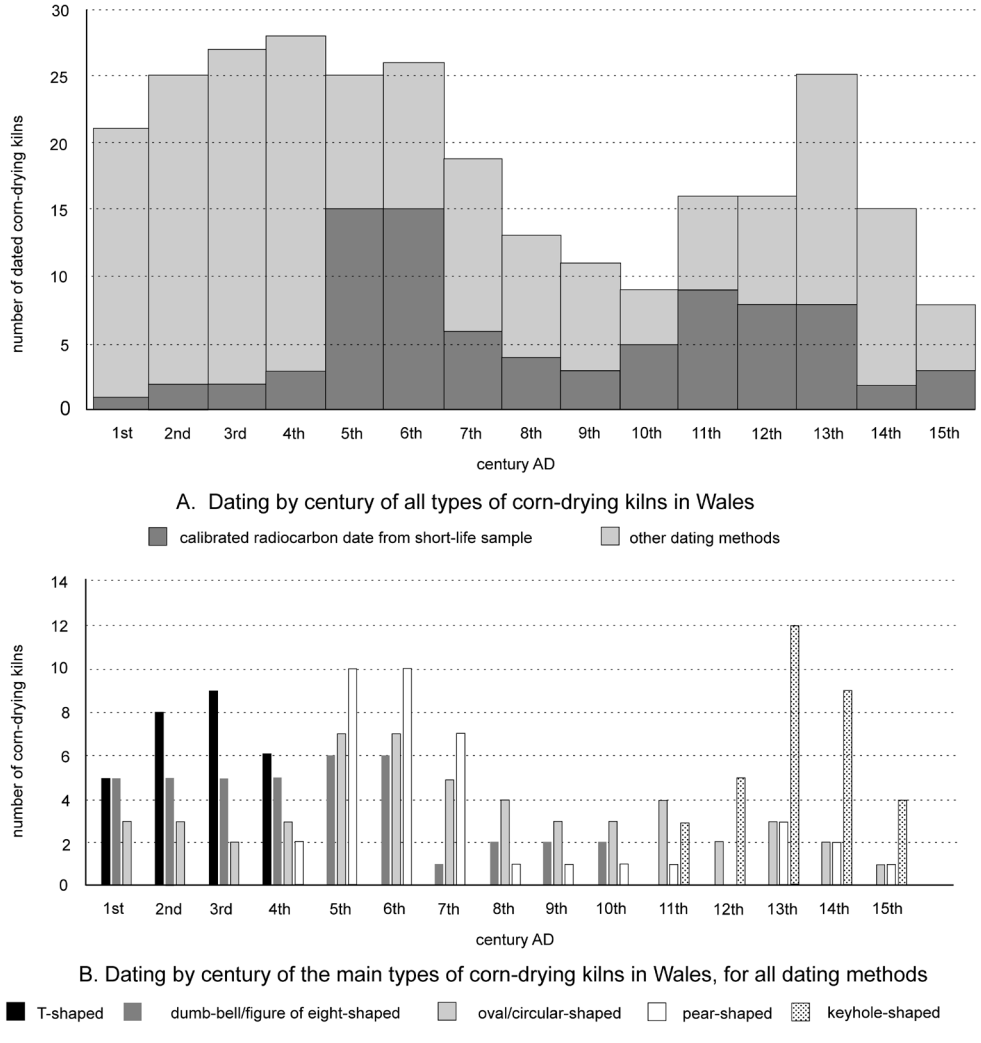


Fig. 3. Dating of later prehistoric to sixteenth-century corn-drying kilns in Wales. (A version of Fig. 3B showing kilns with radiocarbon dates from short-life samples is available on the ADS website.)

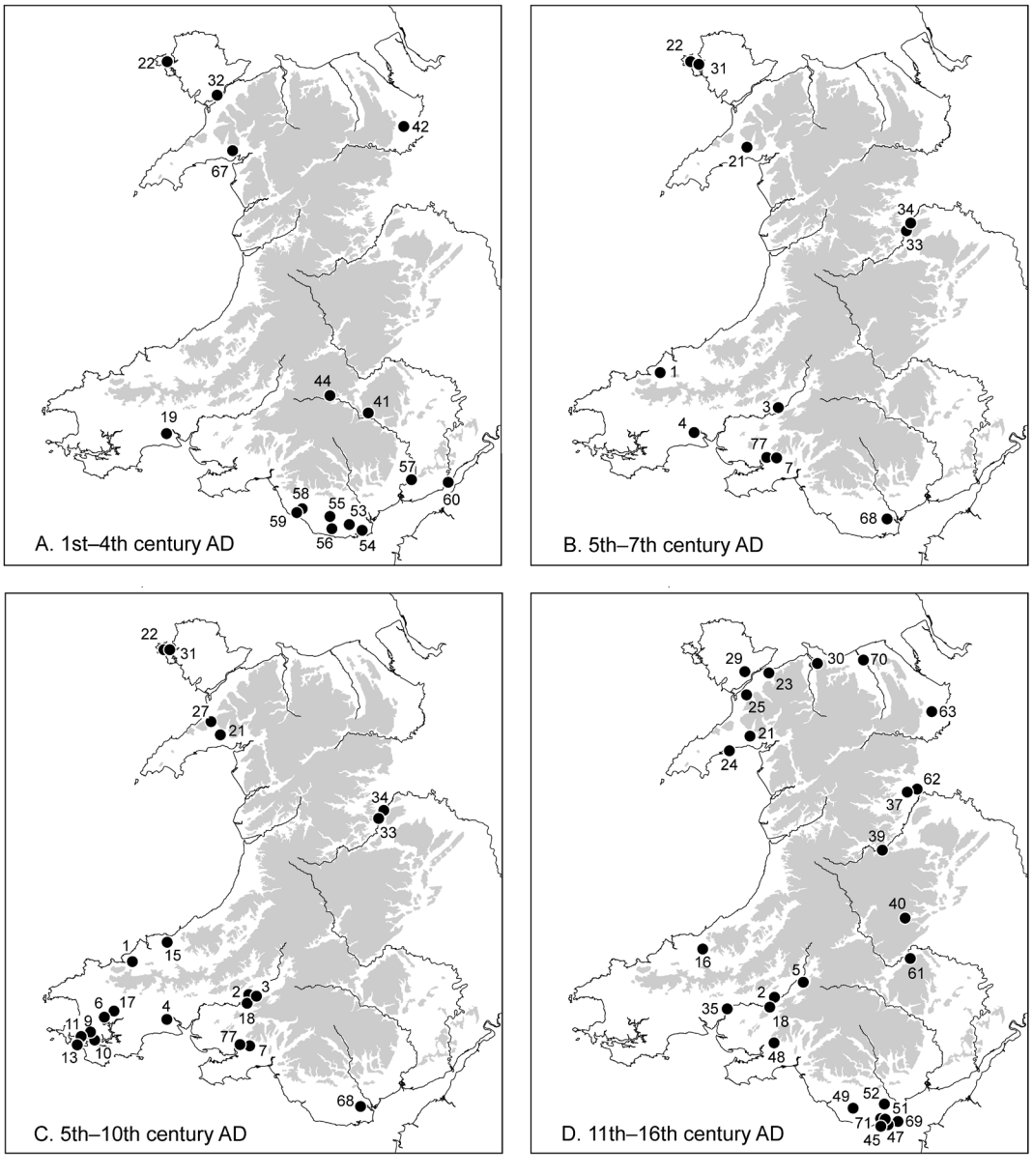


Fig. 4. Distribution of dated later prehistoric to sixteenth-century corn-drying kilns in Wales. Land above 200m shaded.

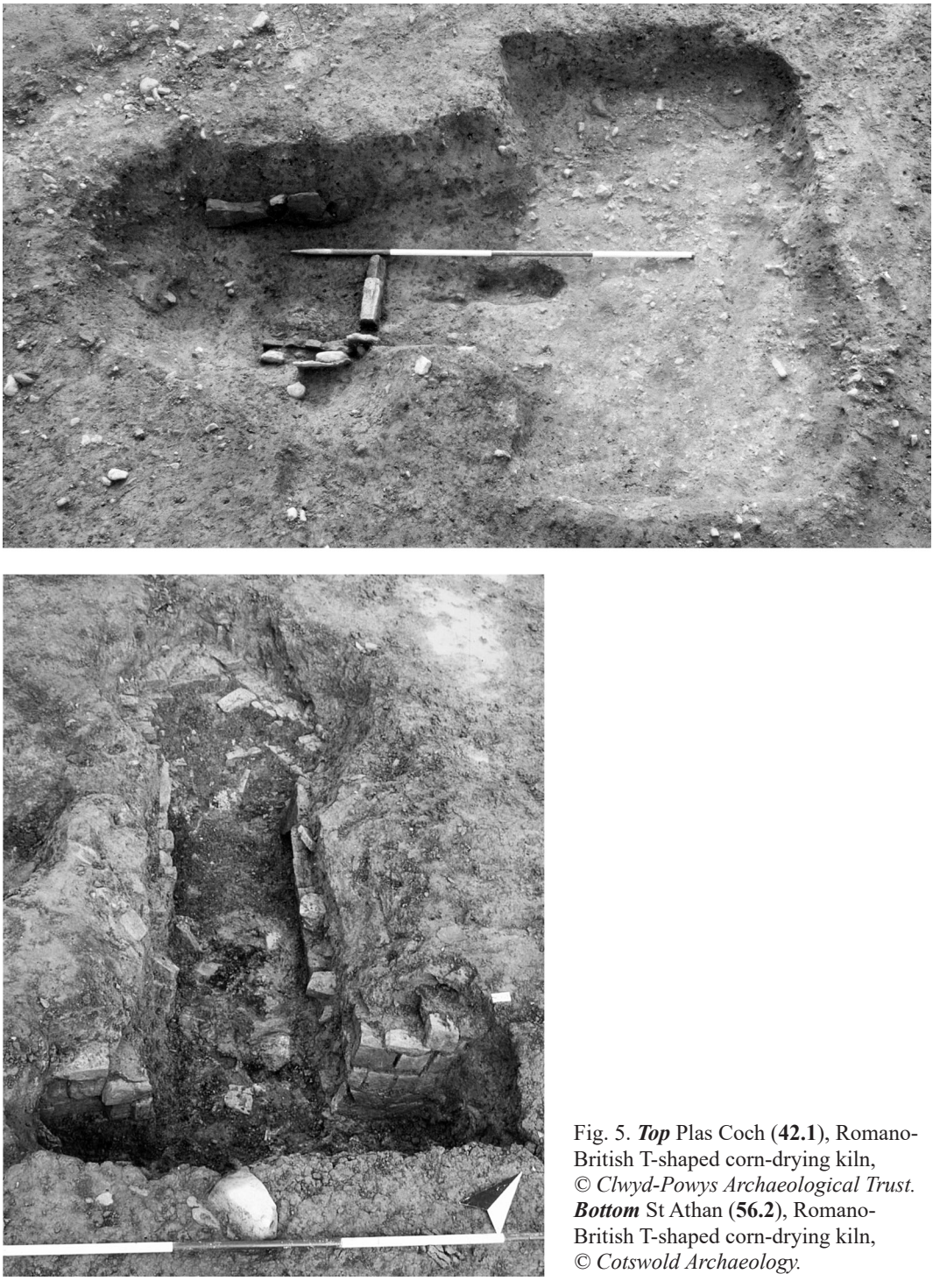


Fig. 5. ***Top*** Plas Coch (**42.1**), Romano-British T-shaped corn-drying kiln, © *Clwyd-Powys Archaeological Trust.* ***Bottom*** St Athan (**56.2**), Romano-British T-shaped corn-drying kiln, © *Cotswold Archaeology.*

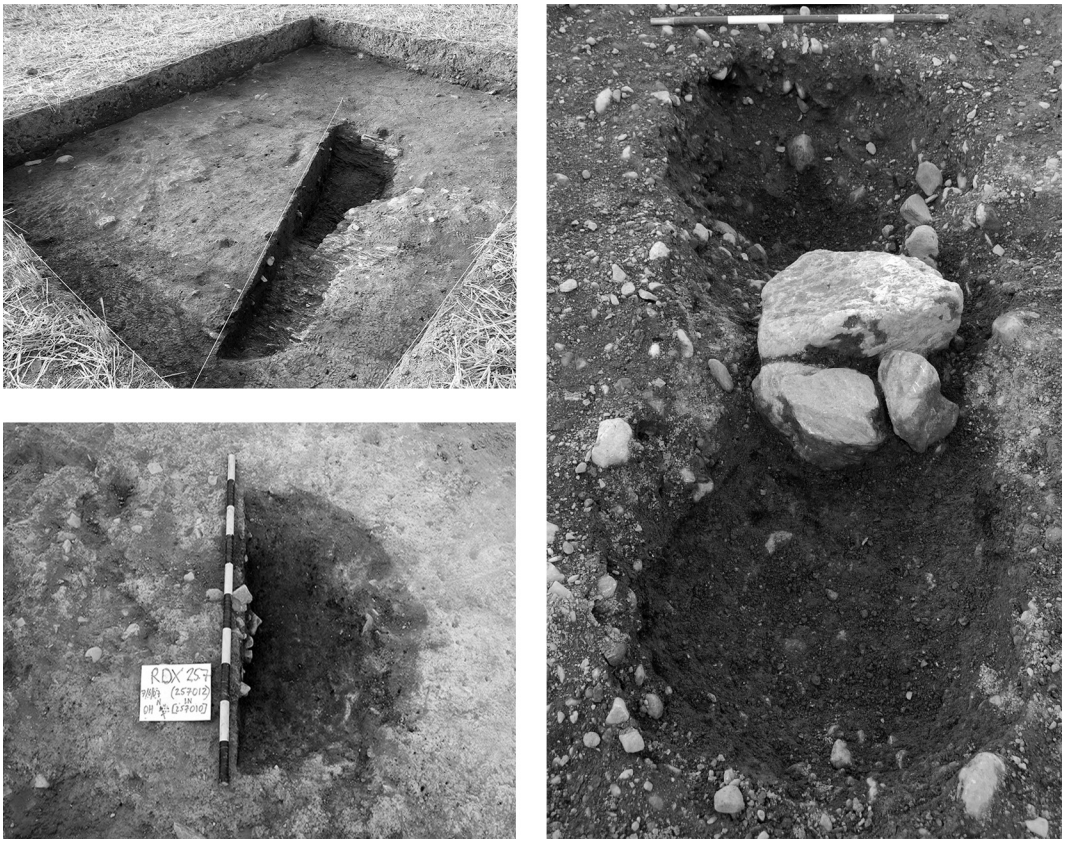
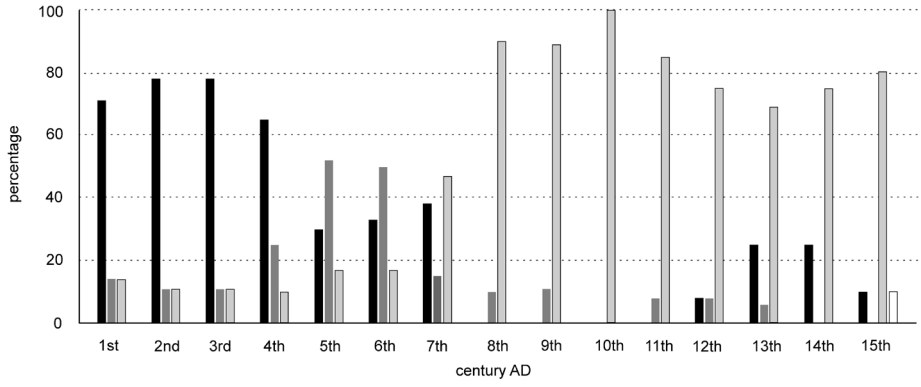


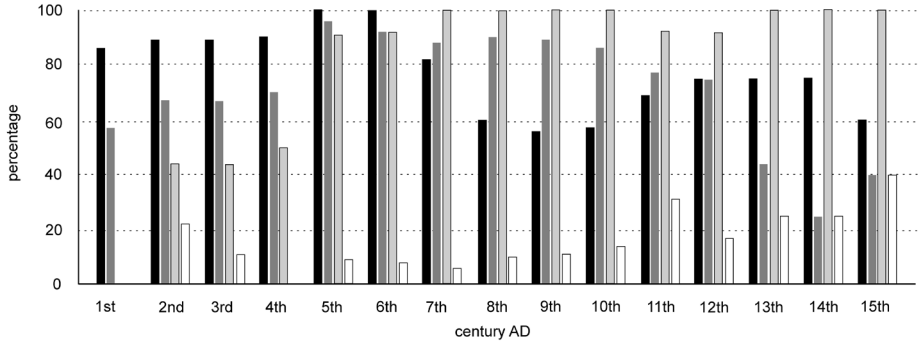
Fig. 6. ***Top left*** Bayvil (**1.1**), early medieval pear-shaped corn-drying kiln (2.85 × 1.67m across), © *Mike Parker Pearson*. ***Bottom left*** Brynwgan (**2.2**), medieval oval/circular corn-drying kiln, © *Cotswold Archaeology*. ***Right*** Parc Cybi (**22.3**), early medieval dumb-bell/figure of eight-shaped corn drying kiln, © *Gwynedd Archaeological Trust*.

Fig. 7. ***Left*** Caerau Hillfort (**68.1**), pear-shaped corn-drying kiln with heat-reddened stone in the base, *Oliver Davis and Neil Sharples © CAER Heritage.* ***Bottom*** Glan Morfa (**24.1**), medieval L/comma-shaped corn-drying kiln, © *Gwynedd Archaeological Trust*.

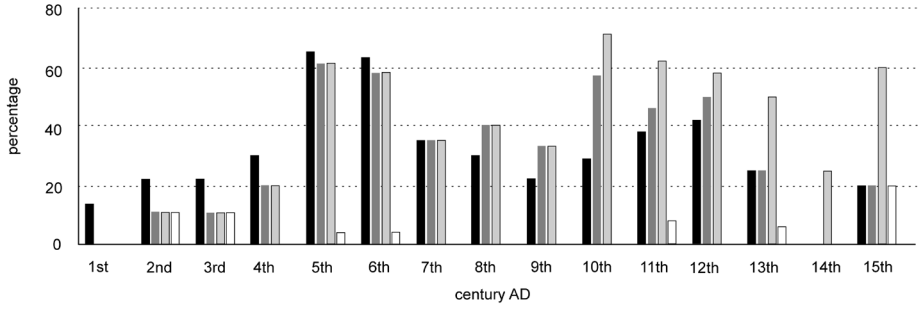
Fig. 8. ***Top*** New Radnor (**40.1**), medieval/post-medieval keyhole-shaped corn-drying kiln. ***Bottom left*** Collfryn (**37.1**), medieval/post-medieval keyhole-shaped corn-drying kiln. ***Bottom right*** Newtown (**39.1**), medieval keyhole-shaped corn-drying kiln. *All © Clwyd-Powys Archaeological Trust.*



A. Dominant grain at all dated corn-drying kilns in Wales with archaeobotanical assemblages



B. Grain presence at all dated corn-drying kilns in Wales with archaeobotanical assemblages, expressed as percentages of all corn-drying kilns with date ranges in that century



C. Grain presence in archaeobotanical assemblages at corn-drying kilns in Wales, where dating derives from radiocarbon dates from short-life samples, expressed as percentages of all corn-drying kilns with date ranges in that century

Fig. 9. Grain types recorded at later prehistoric to sixteenth-century corn-drying kilns in Wales.

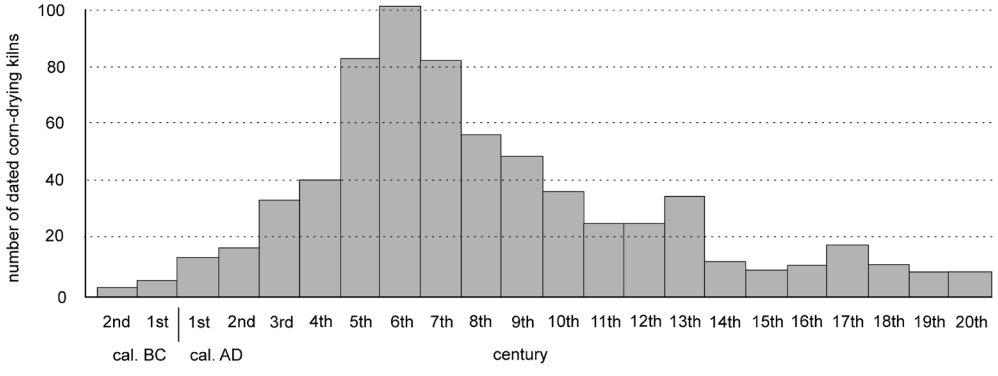


Fig. 10. Dating evidence for Irish corn-drying kilns (based on 288 calibrated radiocarbon dates at 95% probability from 250 sites). After Monk and Power 2012, fig. 1.