

The origins of water meadows in England*

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Abstract

It is usually assumed that the 'floating' or artificial irrigation of water meadows was an innovation of the early modern period. Indeed, many authorities still attribute the technique to the late sixteenth-century improver Rowland Vaughan. There is, however, good evidence that irrigation was already understood and practised on at least a limited scale by the start of the sixteenth century. It is probable that early irrigation systems normally took the form of catchworks: the key development of the post-medieval centuries was the creation of more sophisticated bedwork systems, which allowed the widespread adoption of floating on the chalklands of southern England.

The artificial irrigation or 'floating' of water meadows was a major feature of post-medieval agriculture in many parts of England. In its fully-developed form, floating involved the inundation, during the winter months, of low-lying meadows so that a thin layer (ideally around an inch) of moving water passed through the lower stems of the grass sward. This encouraged the early growth of the grass in the spring, thus providing an early 'bite' for livestock. Watering usually began before Christmas and continued until March. Sheep, more rarely cattle, were then put on the meadows and remained there until May, when they were removed to other pastures. The meadows were then irrigated again, so that a large hay crop could be taken in June. In some cases, a further period of irrigation allowed a second or even third hay crop to be taken in late summer. Together, these benefits ensured that larger numbers of livestock could be kept through the winter months, and this in turn meant that more manure was available to fertilise the arable land on which the flocks were folded by night: water meadows were, for the most part, associated with primarily arable, 'sheep-corn' husbandry systems, especially in the Wessex chalklands.¹

Modern experiments suggest that irrigation water raises the temperature of the soil above 5°C, the point at which germination and growth commences, while oxygenation and protection from frost damage are also significant benefits. The effects of floating on summer hay production are more straightforward: irrigation simply stimulates grass growth by compensating for any soil water deficit. Other possible benefits to the quality of meadows include the control of

* The authors would like to thank Dr Joe Bettey, Dr Glyn Coppack, Dr Roger Cutting, Prof. C. Hugh Lawrence, and Dr Pauline Matarasso for advice and information.

¹ E. Kerridge, *The Agricultural Revolution* (1967), pp. 251–67; *id.*, 'The floating of the Wiltshire water meadows', *Wiltshire Arch. and Nat. Hist. Mag.* 55 (1953), pp. 105–18; *id.*, 'The sheepfold in Wiltshire and the floating of the water-meadows', *EcHR* 6 (1954), pp. 282–9; J. H. Bettey, 'The development of water meadows in Dorset during the seventeenth century', *AgHR* 25 (1977), pp. 37–43; G. G. S. Bowie, 'Water meadows in Wessex: a re-evaluation for the period 1640–1850', *AgHR* 35 (1987), pp. 151–8.

certain unpalatable species within the grass sward, and the dressing of the sward with nutrients, from solutes and from particles held in suspension – hence the preference expressed by various early writers for ‘dirty’ water in irrigation schemes.²

There were two main forms of floating. *Catchwork* systems involved the construction of leats, fed from a stream or from springs, which carried water sub-parallel to the contours: these then filled and overflowed. The water flowed down the slope, and was redistributed by arrangements of parallel ‘gutters’. Such systems were suitable for areas where there were abundant springs and/or hilly terrain with steep, narrow valleys. *Bedwork* systems in contrast were suited to more muted terrain, and in particular to wide alluvial valleys. Water was taken along a leat, leading off the stream or river higher up its course, and conducted to systems of parallel channels running along the tops of ridges (‘beds’ or ‘panes’), superficially resembling the ridge and furrow of former arable fields. The water flowed down the sides of the ridges and into drains, which returned the water – either directly or indirectly, via further ‘bedworks’ – to the river. Bedwork systems were more expensive to construct than catchworks but they were the only way to irrigate meadows where valleys had relatively wide, level floors: the majority of meadows in the chalklands of Wessex, the heartland of the practice, were of this type. Without ridges it would not have been possible to keep the water moving steadily across the surface, as the technique required: moving water dissolves oxygen but stagnant water creates anaerobic conditions, inimical to grass growth.³

I

According to some authorities, the technique of floating may have developed from the more primitive technique of ‘floating upwards’ – that is, simply flooding a meadow by controlling water at the point of exit.⁴ This practice continued sporadically into the eighteenth century in the Vale of Pewsey and certain Cotswold valleys. Marshall in 1796 thus condemned the ‘antient method’ by which water was simply ponded back behind some barrier, believing (correctly) that such a practice was potentially toxic to grass.⁵ Either way, most historians believe that true irrigation – with a moving film of water – was first developed in the post-medieval period, some attributing it specifically to the Herefordshire landowner Rowland Vaughan, whose book *Most approved and long experienced water workes* was published in 1610. Eric Kerridge, for example, while acknowledging that ‘previous efforts from about 1560 had made some progress’, firmly stated that ‘real floating was invented by Rowland Vaughan ... in or about 1589’.⁶ Others place less emphasis on Vaughan, but nevertheless stress that the practice is first recorded in the valleys of Wessex in the early seventeenth century, where it was employed largely in the form of valley-floor bedworks.⁷ The spread of water meadows continued in the Wessex chalklands

² R. Cutting and I. Cummings, ‘Water meadows: their form, operation and plant ecology’, in H. Cook and T. Williamson (eds) *Water Management in the English landscape: field, marsh and meadow* (1999), pp. 157–178.

³ R. Cutting, H. Cook and I. Cummings, ‘Hydrologic conditions, oxygenation, temperatures and sediment relations of bedwork water meadows’, *Hydrological*

Processes (in press).

⁴ Kerridge, *Agricultural Revolution*, p. 254.

⁵ W. Marshall, *The rural economy of the Midland Counties* (1796), pp. 277–8.

⁶ E. Kerridge, *The Farmers of Old England* (1973), p. 110.

⁷ Bettey, ‘Water meadows in Dorset’, p. 37; S. Wade Martins, *Fields and Farms* (1995), pp. 67–8.

through the seventeenth and into the eighteenth centuries, and from the late seventeenth century the practice spread into the neighbouring areas of Devon, Gloucestershire and Somerset. Here – because of the more hilly topography and the abundance of relatively narrow, steep-sided valleys – ‘catchworks’ were the most usual method of irrigation.⁸ Outside these southern and western heartlands floating was only ever sparingly adopted, and in some cases at least it was used primarily, or even solely, as a way of enhancing the summer hay crop, rather than for producing an early ‘bite’. In south-east England and East Anglia the construction of meadows, usually of bedwork form, peaked in the decades around 1800, when farming was particularly profitable; while in the early and middle nineteenth century catchworks were widely adopted in many upland areas of Britain, often as part of flamboyant schemes of ‘improvement’.⁹

Although most modern authorities seem happy to ascribe the invention of ‘true’ floating to the post-medieval period, and often to Rowland Vaughan, earlier generations were less certain. Marshall in 1796 thus speculated on the origins of the practice in the west of England and asserted that these ‘cannot be reached by memory’.¹⁰ Vaughan himself nowhere claims that the practice of irrigation was actually invented by him, and the real character of his method is debated. His text is unclear on the precise techniques involved, and indeed on practical matters generally, the author being more interested in advocating the general *principle* of grassland irrigation. Eric Kerridge asserted that the system created by Vaughan in the Golden Valley, which had been perfected by 1589, was of the catchwork variety but the remains of that part of the system which still survive around Turnstone indicate something rather different.¹¹ They suggest that his method involved running water from a ‘Trench Royal’ (the main carrier, fed from the river Dore) into a series of basins separated by low ridges. The flow of water through these was controlled by placing turfs in notches, and the water was caused to pause ‘long enough to feed the ground’.¹² Although Vaughan emphasised the importance of keeping the water moving, impounding it in this way (with its attendant risks) was clearly more akin to ‘floating upwards’ than it was to either catchworks or bedworks.

More importantly, it is evident that irrigation – apparently in its ‘normal’ forms – was being practised in the Wessex chalklands some years before the publication of Vaughan’s text in 1610. It is possible that this was due to the early spread of Vaughan’s ideas (in Wessex), before the publication of his book: Vaughan’s family had connections with the Herberts, Earls of Pembroke, who held many estates in the chalkland areas of Wiltshire. But there is no direct evidence that Vaughan’s ideas were transferred to Wessex in this way and the earliest generally agreed references to floating in the southern chalklands come not in fact from Pembroke manors but from Affpuddle in Dorset, where the manorial lord was the agricultural improver Sir Edward

⁸ J. H. Bettey, ‘The development of water meadows in the southern counties’, in Cook and Williamson (eds), *Water Management*, pp. 179–95; Kerridge, *Agricultural Revolution*, pp. 251–67.

⁹ S. Wade Martins and T. Williamson, ‘Inappropriate technology? The history of ‘floating’ in the north and east of England’, in Cook and Williamson (eds) *Water Management*, pp. 196–209; *id.*, ‘Floated water meadows in Norfolk: a misplaced innovation’, *AgHR* 42 (1994),

pp. 20–37.

¹⁰ W. Marshall, *The rural economy of the West of England* (1796), p. 206.

¹¹ Kerridge, *Agricultural Revolution*, p. 255; M. De-lorme, ‘A watery paradise: Rowland Vaughan and Herefordshire’s Golden Vale’, *History Today* 39 (July 1989), pp. 38–43.

¹² E. L. Wood (ed.) *Rowland Vaughan’s most approved and long-experienced waterworks ...* (1897), p. 83.

Lawrence. The manorial court book for 1605 refers to the construction of ditches and channels in the meadows beside the river Piddle, while in 1607 and 1608 there are references to disputes concerning the use of the water and its diversion from its old course. The court book entries for 1610 record the appointment of three men to oversee the watering of the meadows and the charges to be paid by the tenants benefiting from the operation.¹³

Yet by this time floating was perhaps already a technique familiar to some farmers in England. Folkingham in 1610 advocated the practice of running 'water participating of a slimie and muddy substance' from 'land floods and fatte rivers' across meadow land in the spring.¹⁴ But a much clearer description, and one more closely approximating to 'true' floating, was provided by John Fitzherbert in *The Boke of Surveying and Improvements*, published as early as 1523:

... yf there be any rynnng water or lande flode that may be sette or brought to ronne ouer the medowes from the tyme that they be mowen vnto the begynning of May / and they will be moche bettr and it shall kylle / drowne / and driue awaye the moldywarpes / and fyll vp the lowe places with sande & make the grounde euyn and good to mowe. All maner of waters be good / so that they stande nat styll vpon the grounde. But especially that water that cometh out of a towne from eury mannes mydding or donghyll is best / and will make the medowes moost rankest. And fro the begynning of May tyll ye medowes be mowen and the hay gotten in / the waters wolde be set by and ron another way.¹⁵

Fitzherbert appears to be describing an established, rather than an innovatory practice, and various references in local documents suggest that, by the start of the sixteenth century, some form of irrigation was common practice in certain districts of England. At Clent in Worcestershire, for example, in 1522 one Richard Sparry, a tenant of the abbot of Hales, was presented in the manorial court for building a dam in an area called Kings Meadow, which had led to the inundation of neighbouring land; he committed exactly the same offence in 1530. In both cases he was ordered to rectify matters, the court ruling that tenants could, by custom, divert water onto their own land for six days at a time between Pentecost (i.e., Whit Sunday, usually in May) and Michaelmas (29 September).¹⁶ As C. K. Currie has perceptively pointed out, this sounds remarkably like the later practice of meadow irrigation, albeit restricted to the improvement of the summer hay crop.¹⁷ Harry Thorpe noted in 1962 the evidence for a probable catchwork system constructed in the early sixteenth century near Wormleighton in Warwickshire as part of the agricultural improvements carried out by Sir John Spencer, who died in 1522. The catchwork was spring-fed, and formed part of a complex system of water management which included fishponds and ponds for watering livestock.¹⁸ We should also note that a number of field names which, by the later seventeenth century certainly, were used for irrigated meadows are recorded in documents predating the publication of Vaughan's text, such as *le Flote* at Kimbolton, Herefordshire, in 1610; and several names featuring the term 'floodgate' in Warwickshire, including *Fludgatedmedow* (1490) and *le Floudyeat* (1544) although some of these may

¹³ Bettye, 'Development of water meadows', p. 180.

¹⁴ W. Folkingham, *Feudographica* (1610), p. 24.

¹⁵ J. Fitzherbert, *The boke of surveying and improvements* (1523), pp. 42–3.

¹⁶ J. Amphlett, *A short history of Clent* (1807), pp. 77–8.

¹⁷ C. K. Currie, 'Clent Hills, Worcestershire: an archaeological and historical survey', *Trans. Worcestershire Arch. Soc.*, third ser. 16 (1998), pp. 183–206.

¹⁸ H. Thorpe, 'The lord and the landscape', *Trans. Birmingham Arch. Soc.* 80 (1965), pp. 38–77.

have associations with mills or fishponds.¹⁹ The name ‘Water Meadow’ is itself frequently recorded in sixteenth-century documents. By the seventeenth century this term was usually used in the strict and correct sense, for a meadow intentionally irrigated with channels, sluices etc., rather than in the wider modern sense, of any area periodically overflowed by an adjacent watercourse without human assistance. When the term was used to name a specific piece of land – highlighting, as it were, something different or distinctive about it – it seems likely that it was being used in the narrow, technical sense.²⁰

II

There are thus good grounds for believing that the artificial irrigation of meadow land, with moving water at critical times of the year, was already a familiar practice in certain districts by the start of the sixteenth century, some time before Vaughan’s Herefordshire experiments. But it may have a much longer history. Meadow irrigation was certainly known in medieval France. The ‘Description of Clairvaux’, written in the twelfth century by a monk of that abbey, includes an account of how water was extracted from the River Aube in order to supply the monastic complex and its fish ponds, and to irrigate both vegetable plots and grass – a typically complex example of monastic water management.²¹ An artificial channel carried half of the extracted water to the monastery, where sluice gates controlled the flow to a grain mill. After this the same water was used for the preparation of beverages, and was then conducted to the workshops and kitchens. Finally, according to the account, it ‘carries the waste products away’ (presumably flushing the reredorter latrines) before returning to the river.

But it is the other channel that is of particular interest in the present context:

Now that we have returned the stream to its bed, let us go back to those rills [or trenches] we left behind. They too are diverted from the river and meander placidly through the meadows, saturating the soil that it may germinate. And when, with the coming of the mild spring weather, the pregnant earth gives birth, they keep it watered too lest the springing grasses should wither for lack of moisture.²²

Irrigation also encouraged a bumper hay crop:

This meadow is refreshed by the floodwaters of the Aube, which runs through it, so that the grass, thanks to the moisture at its roots, can stand the summer heat. Its extent is great enough to tire the community for the space of twenty days when the sun has baked to hay its shorn grassy fleece. Nor is the haymaking left to the monks alone: alongside them a countless multitude of lay-brothers and voluntary and hired helpers gather the mown grass and comb the shorn ground with wide-toothed rakes.²³

No such clear documentary evidence has yet come to light in England, but given the close-knit nature of Cistercian houses, and the exchange of people and information between them, it would be surprising if something similar had not been attempted here. No claim is made here

¹⁹ J. Field, *A History of English Field Names* (1993), pp. 90–1. *writings of the twelfth century* (1993), pp. 288–91.

²⁰ *Ibid.*, p. 91.

²² *Ibid.*, pp. 289–90.

²¹ P. Matarasso, *The Cistercian World: monastic*

²³ *Ibid.*, p. 290.

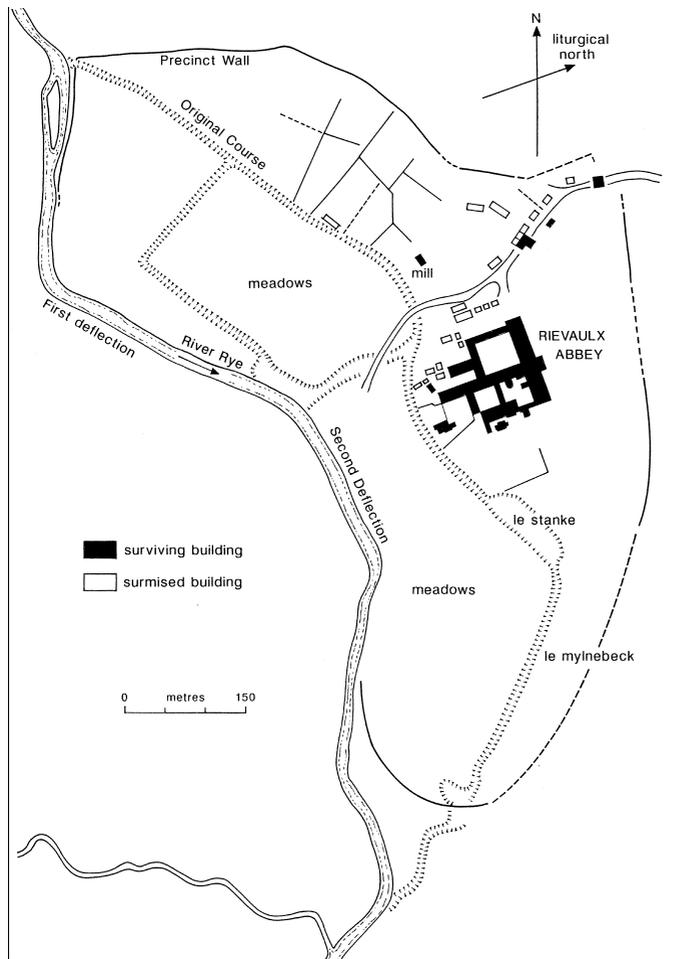


FIGURE 1. The precinct of Rievaulx Abbey in 1583, showing buildings, closes, meadows and river deflections. *Source:* adapted from Coppack, 'Some descriptions of Rievaulx Abbey'.

for the Cistercians as major agricultural innovators – and other monastic orders were noted for their schemes of integrated water management – but it is noteworthy that Marshall, speculating on the origins of floating in the west country, noted the juxtaposition of one major leat 'of winding direction and regular descent' with 'a hedge in appearance some centuries old' on a farm in west Devon formerly belonging to Buckland Abbey, a Cistercian house.²⁴ At Rievaulx in Yorkshire possible evidence of meadow irrigation exists on the ground. Some time before 1150 an agreement was reached with Byland Abbey (another Cistercian house) allowing the monks of Rievaulx to divert the river Rye to the west side of its valley leaving the original course as a mill leat (Figure 1).²⁵ By 1160 a second diversion had been effected, incorporating areas of land received from Byland and from Hugh de Malbis, a local benefactor, which added some 80 acres (32 hectares) of potential meadow land to the abbey precinct. Drains, still visible on

²⁴ Marshall, *Rural economy of the West of England*, p. 206.

²⁵ G. Coppack, 'Some Descriptions of Rievaulx Abbey in 1538–9: the disposition of a major Cistercian precinct

in the early sixteenth century', *J. British Archaeological Association* 139 (1990), p. 118; id., *Abbeys and Priors* (1990), p. 85.

the ground, returned water from the mill channels to the deflected channel of the river, and the arrangement certainly had the potential to operate as an irrigation system. A third deflection made at a subsequent date permitted control of the river as it left the precinct to the south.

The records of other monastic houses, especially in the north of England, suggest elements of water management consistent with meadow irrigation. At Bolton Priory in Yorkshire in 1311 payments were made for 'diverting the water of the Aire in the field of Kildwick'.²⁶ Particularly interesting are the 'water meadows' of Fountains Abbey in the same county, beside the rivers Wiske, Swale and Ouse, for these were partly destroyed by a flood in 1456–7, leading to a reduction in the tenants' rent. The fact that the meadows could be 'destroyed' clearly suggests that they consisted of something more than areas of low-lying grassland, and it is tempting to believe that a system of sluices and leats was washed away by the inundation.²⁷ Donkin found references to 'water meadows', perhaps referring to pasture that was improved by the use of water control structures, in the twelfth- and thirteenth-century records of other Cistercian properties in Yorkshire and elsewhere: at Beaulieu, Byland, Jervaulx, Warden, St Mary Graces, Combermere, Furness, Quarr, Holm Cultram, Stanley, Bruern, Rufford, Kingswood, Bordesley and Thame.²⁸ While it is possible that the term was being used in its late, loose sense, a measure of water control, perhaps involving controlled flooding, may be implied.

But such references do not only occur in connection with monastic houses. Fragments of evidence suggest that irrigation may have been a normal part of demesne and perhaps of peasant agriculture in certain districts of England by the fourteenth century. The field name *Le Flodgatedewe* is recorded as early as 1339 at Minshull Vernon in Cheshire. In his 1993 volume on field names John Field commented that this was 'much earlier than the recognised starting date for managed water-meadows, and may relate to a precursor of the more elaborate technique ...'.²⁹ More explicit are fourteenth-century references from the valley of the river Wey in Surrey, a major centre of floating in post-medieval times.³⁰ A list of the labour services due from the tenants of the abbot of Westminster, described in a custumal from Pyrford in Surrey, includes 'damming the water, to overflow the Lord's Meadow, ½d.; Mowing the meadows for three days, 3d.'.³¹ Steward's accounts for Allerton Bywater in Yorkshire from 1420/1 similarly record the payment of wages to one man for 'making several weirs (*gurgites*) in the flood banks (*ripe aquae*)', while payments were also made for 'flooding and raising the ditch near the king's highway for safe-keeping of the king's meadow there'.³²

It is noteworthy that at Rievaulx the possible irrigation system was associated with a water mill, the mill leat itself acting, perhaps, as a main carrier in a catchwork system. In the 1590s Vaughan's attention was drawn to the potential of irrigation by the way in which water leaking from a leat leading to an overshot mill had enhanced the growth of grass.³³ The possible relationship between mills and early irrigation was noted in the 1960s by Atwood, who suggested

²⁶ S. A. Moorhouse, 'Water supply' in M. L. Faull and S. A. Moorhouse (eds), *West Yorkshire: an Archaeological Survey to AD 1500* (3 vols, 1981), III, pp. 697–8.

²⁷ R. A. Donkin, *The Cistercians: studies in the geography of medieval England and Wales* (1978), p. 120.

²⁸ *Ibid.*, p. 120.

²⁹ Field, *English Field Names*, p. 91.

³⁰ N. Bowles, *The Southern Wey: a guide* (1988), p. 8.

³¹ O. Manning and W. Bray, *The history and antiquities of the county of Surrey* (3 vols, 1804–14), I, p. 154.

³² Moorhouse, 'Water supply', pp. 697–8.

³³ Wood (ed.) *Vaughan's most approved ... water-works*, p. 83.

that the origins of floating lay in the juxtaposition of mill streams (taking water to mills at a high level) and mill tails (removing water at a lower level).³⁴ The early examples of this association which he quotes carry little conviction, but the possible cases presented above suggest that he may well have been thinking on the right lines. Of course, by their very nature many of the references cited are ambiguous in character and, in particular, might refer to 'floating upwards' rather than to irrigation in its fully-developed sense. Nevertheless, coupled with Fitzherbert's description of the technique as early as 1523, they strongly suggest that 'floating' was a medieval rather than post-medieval innovation.

III

It is thus probable that the principles of watermeadow irrigation were quite widely understood several centuries before the experiments of Rowland Vaughan in the 1590s. It is possible that observation of the growth of grass in the vicinity of overshot mills, whose elevated leats were prone to leakage, may have first stimulated experiments in irrigation; and that the earliest irrigation schemes were associated with mills and their leats. If irrigation was indeed practised in the middle ages it was probably always in restricted areas, especially those with narrow valleys and undulating terrain where 'catchworks' could be created with relative ease – the examples quoted above are generally in locations which appear to fit this description. The association of many of the possible examples of medieval meadow irrigation with monastic houses may simply reflect the fact that their activities are generally better-documented than those of lay estates. But the well-established interest of monasteries in water management schemes, and their expertise in hydraulic engineering, may suggest that meadow irrigation was a particular feature of monastic land management. It may be a coincidence, but an interesting one, that Vaughan's Golden Valley was an area in which the Cistercian abbey of Dore held very extensive estates prior to the Dissolution: well-developed systems of leats, associated with a mill but also with areas of meadow land, existed within the monastic precinct.³⁵

Either way, the widespread adoption of irrigation in the course of the seventeenth century was not, in all probability, the consequence of the arrival of an entirely new concept. What may have been new was the development of a particular technique which allowed its widespread adoption in areas in which it could bring the greatest economic benefits – that is, the sheep-corn, arable areas of the southern chalklands. Earlier instances of floating appear to have been of simple catchwork type: but the wide valleys of the main chalkland rivers could only be effectively floated through the construction of bedworks. The stimulus for this innovation did not come from any sudden realisation that floating increased grass production, but arose instead from particular economic circumstances: an expansion in the market, rising prices, and the development of large capitalised farms whose owners and tenants were keen to invest in a range of 'improvements'.³⁶

³⁴ G. Atwood, 'A study of the Wiltshire water meadows', *Wilts Arch. and Nat. Hist. Mag.* 58 (1964), pp. 403–13.

³⁵ R. Shoesmith and R. Richardson, *A definitive history of Dore Abbey* (1997), p. 132.

³⁶ This article is intended as a call for information, and

a description of 'work in progress', rather than as a definitive statement on the subject of the medieval origins of water meadows. The authors would welcome any further evidence, documentary or archaeological, for the early practice of meadow irrigation in Britain.