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Pollen Evidence for the Environment of Roman Britain

By PETRA DARK

INTRODUCTION

Pollen analysis has long been recognised as of key importance to archaeology for environmental reconstruction, but its application has concentrated on prehistory. This is, perhaps, due to a combination of two factors. First, there has been a greater interest by pollen analysts in questions relating to prehistoric than historic environments. Second, there are fewer suitable sequences available for later periods, especially from peat deposits where the upper layers have often been disturbed or removed by peat cutting. There is, however, an increasing amount of pollen-analytical data relevant to the first millennium A.D., and the purpose of this paper is to collate this information in order to illustrate the nature of the environment of Roman Britain.

Pollen evidence for the Roman period in Britain is available from several archaeological sites, especially those with waterlogged deposits or sealed anaerobic contexts.[1] Unfortunately, however, such information is often extremely local in the scale of vegetational reconstruction it permits, and when derived from soils may be severely affected by poor (and differential) pollen preservation. By contrast, lakes and mires not directly associated with occupation often contain long undisturbed sequences of well preserved pollen grains. Such sequences give a better picture of the nature of the surrounding vegetation, and usually provide a longer chronological context for the development of the Roman landscape. It is this type of 'off-site' pollen evidence that is considered here. Obviously there are problems with the use of this type of evidence also (discussed later), but where a large number of pollen sequences are examined together some of the shortcomings of individual sites may be overcome, enabling regional trends to be observed.

PREVIOUS SYNTHESES

The first specific attempt to use pollen evidence to reconstruct the Roman-period environment was Judith Turner's synthesis of radiocarbon-dated pollen diagrams from North-East England, published in 1979.[2] She argued that much of the area was cleared of woodland in the late Iron Age, and farmed throughout the Roman period and on until at least the sixth century A.D. The applicability, or otherwise, of this pattern to the rest of Roman Britain has long remained largely a matter for speculation, due to the small number of sequences covering this period. For instance, in her 1981

[1] For example, the town and amphitheatre at Silchester (Keith-Lucas 1984; Scheepen 1989) and the fort at Vindolanda, near Hadrian's Wall (Manning *et al.* 1997).

[2] Turner 1979.

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review of the evidence for the environment of Britain in the Iron Age to Anglo-Saxon periods, Turner was able to draw on few pollen sequences additional to those from the North-East, and the extra sequences that were available merely consolidated the existing distributional bias towards the northern half of Britain.[3]

Over the last decade many new radiocarbon-dated pollen sequences have been produced from most parts of Britain, but their potential for reconstructing the environment of the Roman period has largely been ignored. This paper presents a synthesis of all published radiocarbon-dated 'off-site' pollen evidence for the nature of the environment of Roman Britain.[4]

SITE SELECTION

The main way in which pollen sequences reflect the character of the landscape is in terms of the relative amounts of woodland (indicated by tree and shrub pollen) and open land (indicated by an abundance of pollen of herbaceous plants). Mapping the distribution of pollen sequences and indicating the frequency of tree and shrub pollen in the Roman-period deposits from each site can thus provide an indication of the overall extent of woodland present in the Roman period, and this is inversely proportional to the extent of open land.

To provide as accurate as possible a picture of the extent of woodland, it is necessary to adopt a rigorous approach to the selection of sites for inclusion in the database. One of the biggest problems is identification of the relevant part of the sequence. Most pollen sequences from lakes and mires span several thousand years, and a chronology is based on a series of radiocarbon dates from the deposits. Typically, there would only be around one radiocarbon date for every thousand years. Even where the sequence spans the Roman period, the dates might not necessarily fall within this period. Where accumulation rate has been demonstrably constant (as is often the case in lake sediments), it may still be possible to identify the Roman-period deposits by interpolation between the nearest dated levels. Peat deposits can show major fluctuations in accumulation rate, but fortunately these are often evident from the stratification, so sequences with such problems can be avoided.

Sites are included in the database here only if the Roman part of the sequence can be identified with a reasonable degree of certainty: that is, there must be at least one radiocarbon date where the two sigma range of the calibrated date lies at least partially in the Roman period, and this date must be part of a longer series of dates that support the Roman-period date (i.e. there is no evidence that this date is erroneous). Sites where the relevant dates have particularly large error terms ($>\pm 80$) are excluded.

Secondly, the temporal resolution of the sequence is important. Even when a sequence contains Roman-period deposits, there may be few or no pollen samples from the Roman period itself. For this study at least two pollen samples must be from the Roman-period deposits. Obviously, this is too few to show any change in vegetation during the period, but it does provide a general idea of the character of the vegetation for the purposes of mapping. The individual pollen sequences are discussed in regional groups, and the results of particularly detailed analyses are highlighted.

[3] Turner 1981.

[4] Roman Britain is here taken as the area up to the Antonine Wall, but some pollen sequences immediately to the north are also included where these are relevant to specific themes. A preliminary analysis of Roman-period pollen sequences by the author has previously been published (Dark and Dark 1997, 28–38). It should be noted that the range of sites discussed here differs slightly from that account, due to different criteria adopted for inclusion in the database.

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DATA ANALYSIS

The Roman-period deposits were first identified on the basis of the radiocarbon dates for each sequence. The dates were calibrated using CALIB version 3.0.3 (intercepts method)[5] with the data of Stuiver and Pearson.[6] The relevant dates are given in Appendix 1, where calibrated ranges at both one and two sigma are given. Note that these results may differ from the calibration (if any) given by the original analysts, due to use of earlier calibration curves. In the text, all dates are discussed as two sigma ranges, rounded outwards to ten years. While it has often been considered acceptable to use one sigma ranges, there is only a 68 per cent chance that the actual date lies inside this range. For greater reliability it is necessary to use the two sigma range, which has a 95 per cent chance of containing the true age.

Inspection of the calibrated ranges at two sigma highlights the fact that many of the 'dates' have age ranges in excess of two centuries. This means that there is considerable uncertainty in assigning dated events to particular parts of the Roman period, and sometimes it may be unclear whether they are Roman at all. There is little that can be done to avoid this problem, and this will continue to be the case so long as chronologies for pollen sequences are reliant on radiocarbon dates.

One approach whereby the precision of radiocarbon chronologies can be improved is by Bayesian analysis of series of dates that are sufficiently closely spaced in a sequence for their age ranges to overlap.[7] The method takes account of the stratigraphic sequence of the dates to reduce the span of their calibrated age ranges. Unfortunately, the large number of dates required means that this approach has little prospect of becoming widely applicable, given that funding for radiocarbon dating is often limited.

For the purposes of this paper it has been necessary to attempt to identify the total span of the Roman-period deposits in each sequence. This has been achieved by interpolation between the Roman-period date(s) and the dates for the rest of the sequence, assuming a constant accumulation rate where the nature of the stratification seemed to warrant this. This obviously introduces a further source of error, and one that is less easily quantifiable.[8]

These problems of chronology mean that the mapped distribution of tree and shrub pollen frequencies must be considered an approximation of the amount of woodland at particular sites over a time-span centred on the Roman period, and not a detailed representation of the Roman-period vegetation. The extent of woodland during the course of the Roman period is unlikely to have been static, as consideration of the more detailed pollen sequences covering the period demonstrates.

Turning to representation of the pollen data, for each site frequencies of tree and shrub pollen have been calculated from published pollen diagrams as an average figure for the whole of the Roman period (in so far as this could be defined in the deposits). Determination of these frequencies was not straightforward, as different workers have based their calculations on different pollen sums. Analysts of peat sequences often exclude from the sum plants that may have grown on the bog surface, especially ferns and members of the heather family (Ericaceae). These plants may, however, also have grown in the vegetation on dry land. The approach adopted here has been to use a standard basis for calculation of tree and shrub pollen frequencies, as a percentage of a sum including all identified pollen and spores, apart from those of obligate aquatic

5 Stuiver and Reimer 1993.
6 Stuiver and Pearson 1993.
7 For discussion and examples of Bayesian analysis see Buck *et al.* (1991, 1992).
8 See K.D. Bennett 1994.

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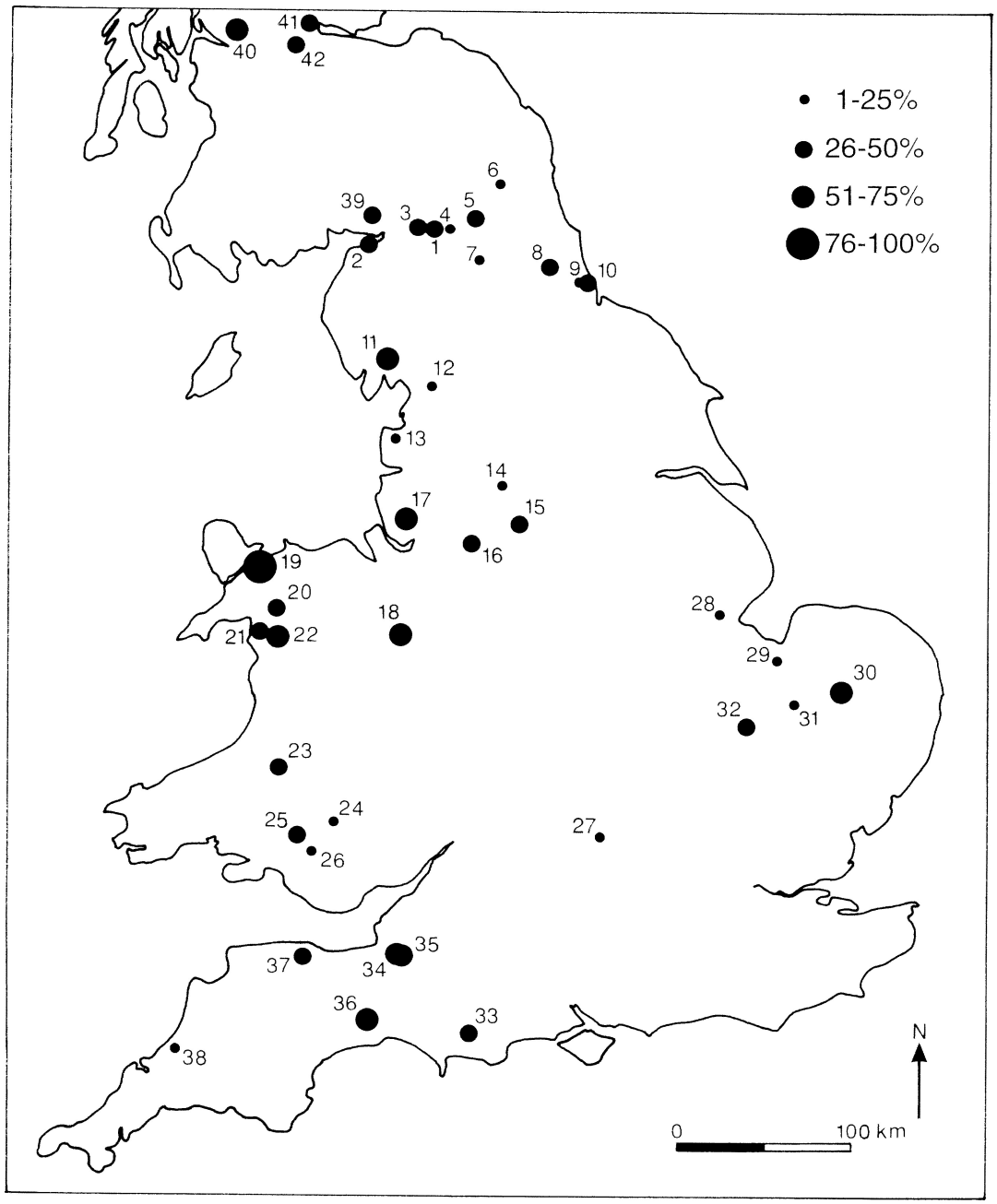


FIG. 1. Locations of pollen sequences used in this study. Size of circle indicates the percentage of tree and shrub pollen in the Roman-period deposits. 1.Midgeholme Moss. 2. Glasson Moss. 3. Walton Moss. 4. Fellend Moss. 5. Fozy Moss. 6. Steng Moss. 7. Quick Moss. 8. Hallowell Moss. 9. Hutton Henry. 10. Thorpe Bulmer. 11. Rusland Moss. 12. Fairsnape Fell. 13. Fenton Cottage. 14. Rishworth Moor. 15. Featherbed Moss. 16. Lindow Moss. 17. Knowsley Park. 18. Crose Mere. 19. Llyn Cororion. 20. Bryn y Castell. 21. Moel y Gerddi. 22. Crawcwellt. 23. Cefn Gwernffrwd. 24. Brecon Beacons. 25. Nant Helen. 26. Cefn Glas. 27. Sidlings Copse. 28. Swineshead. 29. Wiggenhall St Germans. 30. Hockham Mere. 31. Redmere. 32. Willingham Mere. 33. Rimsmoor. 34. Abbot's Way. 35. Meare Heath. 36. Aller Farm. 37. Hoar Moor. 38. Rough Tor. 39. Burnfoothill Moss. 40. Blairbech Bog. 41. Letham Moss. 42. Fannyside Muir.

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plants and *Sphagnum* moss. It should be noted that in this calculation heathers are excluded from the shrub category (some analysts include them as shrubs). The results are plotted in one of four percentage ranges (FIG. 1).

Frequencies of tree and shrub pollen provide an indication of the amount of woodland, but land that was not wooded may, of course, have been occupied by a variety of vegetation types, including grassland, arable land, heath, and moor. The nature of these open land communities is not easily reconstructed from the pollen evidence. This is especially the case where grasses were dominant, because different species of grasses from a wide variety of vegetation types have similar pollen grains. Even plants often taken to be indicative of certain habitat types, such as the classic 'pastoral indicator', ribwort plantain (*Plantago lanceolata*), may occur in other situations.[9]

Obviously, pollen of crops provides clues to the presence of arable land, although few crops have pollen sufficiently distinctive to be separable from non-cultivated members of the same family. The only types that occur in the Roman-period sequences are cereals and possibly hemp (*Cannabis sativa*), which was used in the past as a source of fibre. Pollen grains of the different types of cereals are not easily separable from each other, with the exception of rye (*Secale cereale*), and some may resemble pollen of wild grasses.[10] In many early pollen diagrams cereals are not identified at all, and even in sequences analysed over the last decade the different types may not be distinguished. Here, cereals are treated together, but where rye has been separately identified this is indicated. Cereals are under-represented in the pollen record due to a combination of low pollen production and poor dispersal, so they have been mapped only by presence (FIG. 2).

Hemp pollen closely resembles that of the hop (*Humulus lupulus*), which grows naturally in fen environments. Pollen analysts sometimes use the category '*Cannabis* type' for pollen resembling hemp to allow for this uncertainty.[11] Occasionally a specific identification is made, and in cases where *Cannabis* type pollen is absent from prehistoric deposits and only occurs consistently later, it is likely that hemp is indeed present. Because of the uncertainties attached to the identification of hemp pollen, possible records for its presence in Roman-period deposits are discussed in the text but not mapped.

RESULTS AND INTERPRETATION

There are forty-two pollen sequences fitting the criteria adopted here as reflecting the vegetation of the Roman period. Their distribution is biased strongly to parts of the North and West, largely because peat deposits and lakes are more abundant in these areas than in the South and East.

Of these sites, only ten have tree and shrub pollen frequencies greater than 50 per cent, and fourteen have tree and shrub pollen frequencies of 25 per cent or less. These frequencies cannot be interpreted as a direct reflection of the amount of woodland in the surrounding landscape because of differences in pollen output between tree species, different sampling properties of different types of deposit, and so on.[12] However, studies involving comparison of modern pollen samples with the surrounding vegetation suggest that frequencies of tree and shrub pollen greater than 50 per cent are likely to reflect a substantially wooded landscape, while frequencies less than 20 per cent reflect an open environment.[13] Applied to the data in FIG. 1 this suggests that much of the landscape probably

9 Behre 1981.
10 Andersen 1979.
11 Moore *et al.* 1991, 103.
12 For a discussion of these problems see Moore *et al.* 1991, chs 2 and 8.
13 For example, Tinsley and Smith 1974.

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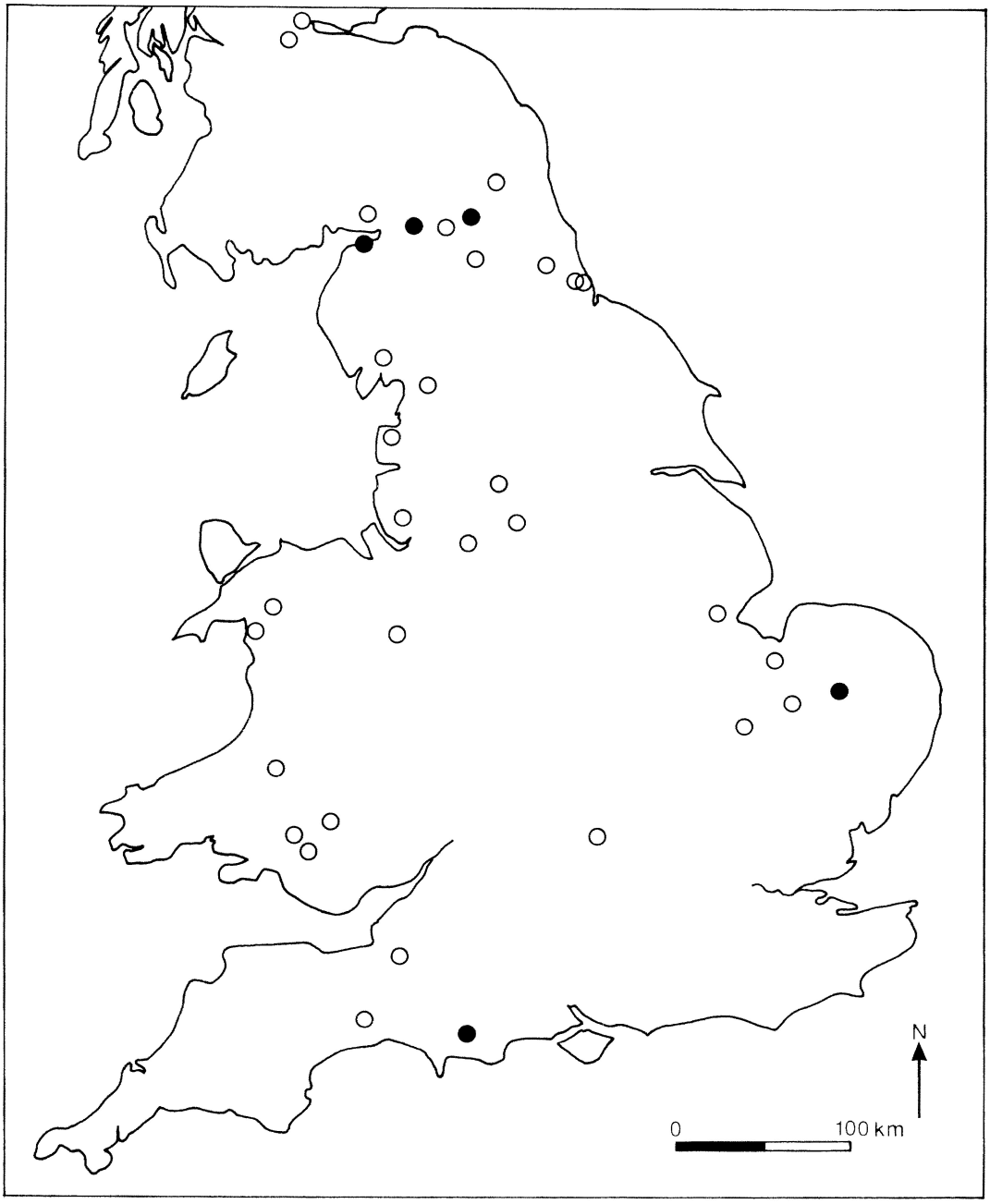


FIG. 2. Distribution of pollen sequences with cereal pollen in the Roman-period deposits. Sites where the cereal pollen assemblage includes rye are indicated as filled circles. For key to sites see FIG. 1.

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consisted of a mixture of woodland and open land in the Roman period, but in some areas woodland was scarce.

Turning to the pollen evidence for agriculture, cereal pollen is recorded in Roman-period deposits from all but seven of the sequences, stretching from Dorset to southern Scotland and from west Wales to East Anglia. Rye is specifically identified from five of these: Rimsmoor in Dorset, Hockham Mere in Norfolk, and three sites in Northumberland: Fozy Moss, Glasson Moss, and Walton Moss (although an early post-Roman date for some of these records is possible, as discussed later).[14] Because cereal pollen is under-represented in the pollen record, this distribution is likely to provide a major underestimate of the true extent of cereal cultivation.

Having established this general picture of the extent of woodland in the Roman period, and the distribution of cereal cultivation, we will now look in more detail at regional groups of sites. In the following, it should be noted that the interpretation of the sequences is my own, and may not necessarily correspond with that of the original authors.

THE NORTH

This region is taken to include the counties of Cumbria, Northumberland, and Durham, and the area northwards up to, and immediately beyond, the Antonine Wall. Since Turner's survey of the pollen sequences from parts of this area,[15] much new research has been undertaken. There is a concentration of pollen sequences within a 20 km zone around Hadrian's Wall, most of which indicate that major woodland clearance began in the late Iron Age or Roman period. Recent debate has focused on the reason for the clearance: was it part of a general agricultural expansion by native farmers, or undertaken by the Roman military who arrived in the area in the A.D. 70s–80s and built Hadrian's Wall in the A.D. 120s–130s?[16]

Here the problems of a radiocarbon chronology are highlighted by attempts to correlate the pollen record with the relatively closely dated historical and archaeological data for construction of the Roman frontier. For sequences dated solely by radiocarbon, we must face the fact that it is simply not possible to establish a certain link between construction of the Wall and local vegetational change, although in some cases it seems that such a link is at least probable.[17]

The sequences closest to the Wall are from Fellend Moss, Fozy Moss, Glasson Moss, and Midgeholme Moss. Fellend Moss lies adjacent to the Vallum, and here the first significant woodland clearance began just above a level with a date range of 40 cal B.C.–cal A.D.150.[18] There are substantial increases of grasses, ribwort plantain (*Plantago lanceolata*), and heather (*Calluna vulgaris*), and cereal pollen is recorded from a single sample from the probable Roman-period deposits. This sequence of events might reflect clearance of the military zone before construction of the Vallum and Wall, although earlier clearance is also a possibility, given the age range of the radiocarbon determination.

Fozy Moss lies just 200 m north of the central sector of the Wall, and the pollen sequence indicates a major, and apparently rapid, reduction in the extent of woodland at a level with a date range of cal A.D. 80–340.[19] This clearance resulted in an almost totally treeless landscape, and has been argued to be linked with construction of the Wall. Obviously the range of the radiocarbon

[14] For Rimsmoor see Waton 1982; 1983; for Hockham Mere see K.D. Bennett 1983, and for the Northumberland sites see Dumayne and Barber 1994.
[15] Turner 1979.
[16] Dumayne 1993; 1994; Dumayne and Barber 1994; Hanson 1996; Tipping 1997.
[17] Dumayne *et al.* 1995.
[18] Davies and Turner 1979.
[19] Dumayne and Barber 1994.

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SOUTH-WEST ENGLAND

Probably the best-known pollen sequences from this region are from the Somerset Levels, associated with the prehistoric Abbot's Way (late Neolithic) and Meare Heath (Bronze Age) trackways. The Meare Heath sequence indicates an increase of clearance on dry land at a level dated 190 cal B.C.–cal A.D. 60, following disturbance from the Bronze Age.[80] Clearance continued into the Roman period, with evidence for local cereal cultivation, but much woodland remained.

The Abbot's Way sequence, 3 km to the south-east, unfortunately ends just after a level with a date range of 40 cal B.C.–cal A.D. 140, so reflects the vegetation of the early Roman period only, if at all.[81] The sequence suggests woodland clearance began in approximately the mid-Iron Age, and was probably accompanied by cereal cultivation. The extent of clearance did not increase appreciably later, so that woodland remained a significant feature of the landscape in the late Iron Age/early Roman period.

Moving west to the uplands of Exmoor, at Hoar Moor major clearance apparently did not begin until at least the Roman period, at a level dated cal A.D. 80–440.[82] Other pollen sequences from Exmoor show earlier clearance, however, from the Bronze Age or Iron Age,[83] so the apparently late survival of woodland at Hoar Moor may be exceptional.

Further south, peat discovered during excavations at Aller Farm in Devon began to form in the late Iron Age or early Roman period, at a level with a date range of 40 cal B.C.–cal A.D. 140.[84] The sequence reflects mainly the local woodland dominated by alder, but there was some local pasture and arable. Pollen analysis has also been undertaken on peat deposits from Dartmoor,[85] but these sequences have acceptable radiocarbon dates only for the prehistoric period.

On Bodwin Moor, pollen sequences have been produced from several sites around Rough Tor, an area of extensive field-systems and hut circles of probable Bronze Age date.[86] The timing of woodland clearance is uncertain due to problems with some of the radiocarbon dates, but much of the area seems to have been open by the Bronze Age—as one might expect, given the archaeological evidence for settlement! At Rough Tor north (Site C) some local woodland was present in the early Iron Age, possibly resulting from an earlier regeneration phase. Most of this was cleared in approximately the mid-Iron Age, and an open landscape then persisted throughout the Roman period.

DISCUSSION

Discussion of the significance of the pollen data in relation to the Roman occupation is, of course, limited by the bias in its distribution away from what may be seen as those areas with the most intensive Romanization. Despite this, regional trends are apparent where there is a denser coverage of sites. Perhaps the clearest point to emerge is that most of England and Wales had experienced major woodland clearance long before the Roman period, sometimes from as early as the first half of the Bronze Age. Furthermore, cereal cultivation was already widespread in the Iron Age.[87] The Roman period saw an infilling of the distribution of sites with evidence for local cereal cultivation, rather than an extension of its range.

80 Beckett and Hibbert 1979.
81 Beckett and Hibbert 1979.
82 Francis and Slater 1990.
83 Francis and Slater 1992; Moore *et al.* 1984.
84 Hatton and Caseldine 1992.
85 K. Smith *et al.* 1981.
86 Gearey and Charman 1996.
87 For a review of pollen evidence for cereal cultivation in the Iron Age see Dark and Dark (1997, 107).

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In most areas the Roman occupation seems to have provided a further impetus to clearance, presumably to increase the area available for cultivation of crops. This is especially clearly seen in the vicinity of Hadrian's Wall. This contrasts with the situation in eastern Scotland, north of the Antonine Wall, where pollen evidence indicates a marked phase of woodland regeneration in the Roman period.[88] This has been argued to result from agricultural decline linked with Roman incursions, suggesting perhaps that the nature of the relationship between Roman and native north of the Antonine Wall differed from that south of the border.

The pollen data must also be viewed in the light of the contemporary climate, for which a variety of sources exist.[89] These suggest that relatively cool/wet conditions in the Iron Age were followed by a shift to a climate similar to that of today by the beginning of the Roman period. Temperatures then rose until the late third and fourth centuries (by perhaps up to 1 degree C), before falling at the end of the Roman period. Some upland areas that are today marginal for agriculture may, therefore, have been more suitable for cultivation in the Roman period, and this may have facilitated the expansion of agriculture evident at many sites.

CROPS IN ROMAN BRITAIN

It has already been mentioned that pollen analysis is limited in the extent to which it can illustrate the history of crop cultivation due to problems of identification. Macroscopic remains of crops are required to enable specific identification in most cases, but these are virtually never found in the type of 'off-site' contexts that provide the best pollen sequences. There are, however, two aspects of the pollen data that mean it provides a valuable complement to the record of macroscopic remains of crops (principally cereals) from archaeological sites.

Most assemblages of macroscopic plant remains have come from sites in southern England (although van der Veen has recently analysed a range of sites in northern England[90]), whereas the pollen record is biased to the North and West. A combination of the two sources might provide a better indication of the extent of cereal cultivation in the Roman period than either source could alone.

Second, cereal pollen in 'off-site' deposits is very likely to represent local cultivation of cereals, whereas remains of cereal grains from archaeological sites may represent either crops grown locally or imported from elsewhere. So, pollen evidence, where available, may provide better evidence than 'on-site' assemblages of macroscopic remains for the local cultivation of a crop.

Finds of macroscopic plant remains suggest that the main cereals grown in Roman Britain were spelt wheat (*Triticum spelta*) and barley (*Hordeum vulgare*), accompanied at some sites by bread wheat (*Triticum aestivum*), rye (*Secale cereale*), and oats (*Avena sativa*).[91] Until recently, the bias in the distribution of this evidence to the South, combined with consideration of the modern distribution of arable and pastoral farming in Britain, has led to the perception that arable agriculture in the Roman period was limited to the lowland areas of the South and East. However, the pollen evidence makes it clear that this was not the case. Cereal cultivation was widespread in Roman Britain. In relation to rye (the only cereal that can be identified with confidence from its pollen), while macroscopic remains have been found only in southern England, the pollen evidence suggests that its use extended at least as far north as Hadrian's Wall.

There is also possible evidence from Hadrian's Wall and sites further south for the cultivation of hemp, although in several cases the site chronologies are insufficiently precise to exclude a

88 Whittington and Edwards 1993.
89 Reviewed in Dark and Dark 1997, 18–21.
90 van der Veen 1992.
91 M. Jones 1981; Greig 1991.

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post-Roman date for this activity. Hemp was used in pre-modern times in fibre production, and its pollen is especially likely to occur in lake sediments due to the practice of 'retting': soaking the hemp in water to soften it during processing.[92] It is, however, possible that many of the early records for '*Cannabis* type' pollen actually come from hops. Macroscopic remains of hemp in Roman contexts are rarely recorded. They are known from Roman York,[93] but need not reflect local cultivation.

INDUSTRY

A question of particular interest is whether or not the major industries of Roman Britain (such as those producing iron and pottery) had a significant impact on the environment. Unfortunately, however, detailed pollen evidence from relevant areas is minimal. There is only one pollen sequence from a major pottery producing area, and this is the site at Sidlings Copse, in the area of production of Oxfordshire ware. As discussed earlier, this site shows that woodland was already sparse by the end of the Iron Age.[94] The remaining alder woodland was completely cleared during the Roman period, leaving a limited amount of oak and hazel woodland on dry land and willow on the damper soils. It is, perhaps, unlikely that the final disappearance of alder was due to removal as a source of fuel: this would have been a rather short-sighted policy in an area with so little woodland. In fact, it is possible that there was a deliberate attempt to improve fuel supplies by encouraging the growth of willow. Pollen frequencies of willow increase in the Roman period, and it is not impossible that this was due to planting or encouragement of the shrub. Willow coppice would have provided an excellent renewable source of fuel, as it regrows rapidly after cutting. The small amount of oak/hazel woodland that remained on well-drained soils may also have been managed by coppicing.

The major iron industries of Roman Britain, such as the Weald and the Forest of Dean, would also be expected to have produced environmental changes. Unfortunately, however, their impact on woodland resources is currently uncertain, as there are no detailed pollen sequences from any of these areas.

Finally, we may consider the contribution that the pollen record can make to our understanding of the end of Roman Britain.

POLLEN EVIDENCE FOR THE END OF ROMAN BRITAIN

The end of Roman Britain in environmental terms has often been seen as having been accompanied by widespread woodland regeneration following abandonment of agricultural land. This view was based on changes apparent in a handful of pollen sequences, mostly from northern England and Scotland,[95] but has often been assumed to be more widely applicable.[96] For example, Michael Jones has recently placed great emphasis on the role of the environment, especially climatic deterioration, at the end of the Roman period.[97] Yet his use of pollen data is minimal, and he continues to rely only on a small selection of pollen sequences produced at least twenty years ago.

The recent increase in the number of radiocarbon-dated pollen sequences spanning the end of the Roman period has prompted a reassessment of this issue by the present author.[98] Examination of all

92 Bradshaw *et al.* 1981.
93 Hall *et al.* 1980, 143.
94 Day 1991; 1993.
95 Turner 1981.
96 See Bell 1989 for the first serious challenge to this view.
97 M.E. Jones 1996.
98 Dark 1996.

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pollen sequences spanning the period A.D. 400–800 in Britain shows that approximately half indicate reduced intensity of land use, and half of these are in the extreme north of England. Clearly, woodland regeneration was not a universal consequence of Roman withdrawal from Britain.

The consistent pattern of land abandonment in the extreme north of England is in direct opposition to previous interpretations of the pollen evidence from part of this area. Turner argued for continuity of farming until at least the sixth century A.D. in North-East England, followed by woodland regeneration only after that date.[99] This suggestion was based on radiocarbon dates apparently associated with woodland regeneration phases in the pollen sequences, but at some of the sites, including Fellend Moss and Steng Moss,[100] regeneration actually began *before* the radiocarbon-dated level.

Examination of the pollen sequences discussed by Turner, and others that have subsequently been published, provides no supporting evidence for her hypothesis of initial continuity.[101] Almost all sites near Hadrian's Wall show evidence for woodland regeneration at approximately the end of the Roman period (in so far as it is possible to tell on the basis of radiocarbon chronologies). It is interesting that this is the area which showed the greatest response to the Roman occupation in terms of increased woodland clearance,[102] and it seems likely that the regeneration reflects the collapse of the agricultural systems that had previously expanded to supply the Roman forces at the frontier.

CONCLUSION

The pollen evidence indicates that much of Britain was already a predominantly agricultural landscape prior to the Roman Conquest. In the southern half of England and Wales much woodland was removed in the Bronze Age, followed by an episode of woodland regeneration in the early Iron Age, and then renewed clearance in the late Iron Age or Roman period. In North Wales major clearance occurred in the late Bronze Age and early Iron Age. The Iron Age seems to have seen the most significant increases in pre-Roman woodland clearance in the northern half of England.

In many areas there was apparently further clearance in the Roman period, and in the extreme north of England this may have accompanied establishment of the Hadrianic frontier. Cereal cultivation was widespread in the Roman period, in both upland and lowland areas.

Most of Roman Britain probably remained more wooded than today, but some areas, notably the extreme North and perhaps parts of southern England, may already have been as open as the modern landscape. In such areas there would have been little potential for further expansion of farmland during the Roman occupation, because most suitable land was already exploited. Greater productivity may have been achieved by draining land previously unsuitable for agriculture, as in the Severn Estuary Levels,[103] or increasing the output of existing arable land by changes in types of crops grown, use of crop rotation, and application of manure.

There is much more pollen evidence for the nature of the Roman environment than is, perhaps, generally appreciated by archaeologists. This is unsurprising, in view of the fact that discussion of most long 'off site' pollen sequences has, until recently, tended to focus on the long-term, and

[99] Turner 1979.
[100] Davies and Turner 1979.
[101] For a fuller discussion of the pollen sequences from this area see: Dark and Dark 1996.
[102] Dark and Dark 1997, 30–3.
[103] Allen and Fulford 1986; 1992; Fulford *et al.* 1994.

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often prehistoric, aspects of vegetational change. The primary purpose of this paper has been to increase awareness of the existence and utility of this information, in the hope that future discussions of the environment of Roman Britain, and its end, may be enriched by this wealth of palynological information.

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APPENDIX 1

Details of radiocarbon dates for Roman-period deposits from sites discussed in the text. Results of calibration using the programme CALIB rev. 3.0.3, intercepts method,[104] using the data of Stuiver and Pearson.[105] Calibrated results are given as: minimum of range (cal age) maximum of range. Site references are given in the footnotes to the text.

Site	C14 date (BP)	Lab. code	Calibration at 1 sigma	2 sigma
Abbot's Way	1954±40	SRR-1011	AD 15 (70) 114	BC 34 (AD 70) AD 134
Aller Farm	1790±50	GU-2710	AD 213 (244) 329	AD 123 (244) 391
Blairbech Bog	1750±45	SRR-4619	AD 241 (260, 289, 324) 379	AD 149 (260, 289, 324) 413
Brecon Beacons	1855±80	CAR-58	AD 77 (143) 312	AD 1 (143) 387
	2065±70	CAR-57	BC 170 (47) AD 16	BC 344 (47) AD 82
Bryn y Castell (BYC 2)	1655±50	GrN-17582	AD 349 (414) 436	AD 258 (414) 541
Burnfoothill Moss	2015±45	SRR-3752	BC 45 (AD 2) AD 60	BC 110 (AD 2) AD 83
Cefn Glas	1700±70	CAR-415	AD 252 (382) 424	AD 213 (382) 539
Cefn Gwernffrwd	1900±45	CAR-74	AD 73 (120) 144	AD 18 (120) 236
	2030±45	CAR-73	BC 54 (31, 18, 9) AD 23	BC 159 (31, 18, 9) AD 77
Crawcwellt	1780±35	GrN-18405	AD 231 (249) 327	AD 144 (249) 376
Crose Mere	1610±75	Q-1231	AD 393 (432) 546	AD 256 (432) 621
	2086±75	Q-1232	BC 190 (64) AD 5	BC 360 (64) AD 78
Fannyside Muir	1925±45	SRR-4617	AD 59 (82) 130	AD 0 (82) 221
Fairsnape Fell	1595±45	SRR-4504	AD 419 (442) 542	AD 391 (442) 595
	1735±45	SRR-4505	AD 248 (266, 278, 331) 390	AD 223 (266, 278, 331) 419
	2025±40	SRR-4506	BC 48 (5) AD 23	BC 110 (5) AD 75
Featherbed Moss	2028±50	Q-853	BC 57 (30, 26, 7) AD 55	BC 165 (30, 26, 7) AD 81
Fellend Moss	1948±45	SRR-876	AD 16 (72) 119	BC 36 (AD 72) 144
Fenton Cottage	1590±50	GU-5144	AD 419 (445) 545	AD 387 (445) 602
	1810±90	GU-5157	AD 119 (235) 341	AD 18 (235) 424
	1940±110	GU-5158	BC 41 (AD 76) AD 223	BC 190 (AD 76) AD 342
	2080±90	GU-5159	BC 193 (58) AD 19	BC 369 (58) AD 120
Fozy Moss	1820±45	SRR-4539	AD 137 (230) 313	AD 86 (230) 337
Glasson Moss	1860±40	SRR-4533	AD 118 (141) 231	AD 74 (141) 311

[104] Stuiver and Reimer 1993.
[105] Stuiver and Pearson 1993.

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Site	C14 date (BP)	Lab. code	Calibration at 1 sigma	2 sigma
Hallowell Moss	1782±60	SRR-414	AD 150 (248) 340	AD 90 (248) 412
	1956±70	SRR-415	BC 6 (AD 69) AD 127	BC 99 (AD 69) AD 233
Hoar Moor	1760±80	I-15,548	AD 214 (256, 296, 319) 440	AD 83 (256, 296, 319) 440
Hockham Mere	1625±45	Q-2225	AD 404 (425) 532	AD 341 (425) 547
	1980±50	Q-2224	BC 32 (AD 26, 42, 53) 80	BC 60 (AD 26, 42, 53) AD 131
Hutton Henry	1842±70	SRR-600	AD 86 (213) 314	AD 23 (213) 381
Knowsley Park	1680±50	Birm-1177	AD 267 (397) 424	AD 248 (397) 532
Letham Moss	1715±40	SRR-4542	AD 258 (344, 370) 403	AD 240 (344, 370) 423
Lindow Moss	1764±48	UB-3238	AD 233 (255, 299, 317) 370	AD 139 (255, 299, 317) 410
Llyn Cororion	1585±65	SRR-3468	AD 415 (449, 488, 493) 554	AD 342 (449, 488, 493) 626
Meare Heath	1746±45	SRR-911	AD 243 (262, 286, 326) 382	AD 215 (262, 286, 326) 415
	2062±45	SRR-912	BC 111 (46) AD 1	BC 185 (46) AD 59
Midgeholme Moss	1740±90	GU-5179	AD 222 (264, 281, 329) 416	AD 83 (264, 281, 329) 538
	1970±60	GU-5081	BC 32 (AD 59) 115	BC 92 (AD 59) 205
Moel y Gerddi	1665±60	CAR-660	AD 269 (409) 436	AD 246 (409) 544
Nant Helen	1820±70	CAR-1150	AD 124 (230) 324	AD 65 (230) 399
Quick Moss	2035±50	not given	BC 64 (34) AD 23	BC 171 (34) AD 79
Redmere	1850±50	Q-2593	AD 119 (146, 190) 240	AD 71 (146, 190) 326
Rimsmoor	2080±80	HAR-3923	BC 190 (58) AD 12	BC 361 (58) AD 111
Rishworth Moor	1920±80	GaK-2825	AD 12 (84) 215	BC 59 (AD 84) AD 320
Rough Tor (north C)	1840±70	Beta-78541	AD 87 (215) 315	AD 25 (215) 383
Rusland Moss	1963±50	SRR-126	AD 3 (64) 114	BC 47 (AD 64) 141
Sidlings Copse	1820±80	OxA-2047	AD 119 (230) 329	AD 25 (230) 413
Steng Moss	1970±60	Q-1520	BC 32 (AD 59) AD 115	BC 92 (AD 59) AD 205
Swineshead	1590±60	Q-2558	AD 415 (445) 548	AD 345 (445) 612
	1740±60	Q-2557	AD 239 (264, 281, 329) 398	AD 139 (264, 281, 329) 428
Thorpe Bulmer	1730±120	GaK-3713	AD 146 (268, 274, 334) 432	AD 59 (268, 274, 334) 601
	2064±60	SRR-404	BC 161 (47) AD 10	BC 197 (47) AD 75
Walton Moss	1925±40	SRR-4530	AD 62 (82) 128	AD 7 (82) 214
	2000±40	SRR-4531	BC 36 (AD 12) AD 67	BC 60 (AD 12) AD 112
Wiggenhall St Germans	1820±50	Q-2587	AD 134 (230) 315	AD 83 (230) 343
Willingham Mere	1910±60	Q-2582	AD 59 (88, 98, 115) 198	BC 32 (AD 88, 98, 115) 245

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