Sussex Archaeological Collections **121** (1983), 1–10.

FLOODPLAIN DEVELOPMENT IN AND THE VEGETATIONAL HISTORY OF THE SUSSEX HIGH WEALD AND SOME ARCHAEOLOGICAL IMPLICATIONS

by R. G. Scaife, B.Sc., Ph.D., F.R.G.S., and P. J. Burrin, B.Sc., A.K.C., F.R.G.S.

Geomorphological and palynological investigations have been undertaken of the floodplain and alluvial fill sediments of the rivers Ouse and Cuckmere, East Sussex. Results are presented from one of the sites studied, at Sharpsbridge near Newick, elucidating the nature and probable age of these deposits. It appears that valley alluviation in this area has been largely in response to anthropogenic valley side forest clearance dating back to the Mesolithic. It is of interest to note that the bulk of valley sedimentation in this part of the upper Sussex Ouse was completed by the close of the late Bronze--early Iron Age, despite later periods of forest clearance during Romano-British and Medieval times in association with the Wealden iron industry.

INTRODUCTION

From continued archaeological research in Sussex it has become evident that prehistoric man was present in this region in greater numbers and with a greater degree of organization than previously thought. Less clear, however, is the nature and impact of these people on the landscape. This results from our limited knowledge of the vegetational history of both South-East England (Smith and Pilcher 1973, Scaife 1982) and more specifically, the Wealden district (Sheldon 1978).

Consequently, it is of relevance to present some initial results of a continuing geomorphological (PJB) and palynological (RGS) research programme into the floodplain and alluvial fill deposits of the rivers Ouse and Cuckmere. These investigations build upon the earlier studies in the Vale of the Brooks, Lewes, by Jones (1971, 1981) and Thorley (1971, 1981). The three objectives of this paper are first, to discuss briefly the nature of the floodplain deposits; second, to provide some information concerning the vegetational history of the Sussex High Weald and the probable age of the floodplain sediments; and finally, to focus attention on the archaeological implications of these findings.

FLOODPLAIN ALLUVIUM

Detailed investigations of the alluvial fill sediments within the floodplain tracts of the Ouse and Cuckmere have been undertaken at twenty sites, utilising both Macintosh and Hiller augers. Litho-stratigraphic cross profiles have been constructed from interpolation of the data between adjacent boreholes across the floodplain. Attention is focused here on the results of subsurface investigations at Sharpsbridge (TQ 444 208), a site located on the southern margins of the High Weald, in the upper Ouse valley. Augering has revealed (Fig. 1) a complex, polycyclic, sub-alluvial surface cut into the Lower Cretaceous Tunbridge Wells Sand formation of the Hastings Beds. Two, small, bench-like features at approximately 8 m O.D. flank a deeper, channelised form, whose minimum surface elevation is 3.8 m O.D. The rockhead is partly mantled by a thin, residual clayey

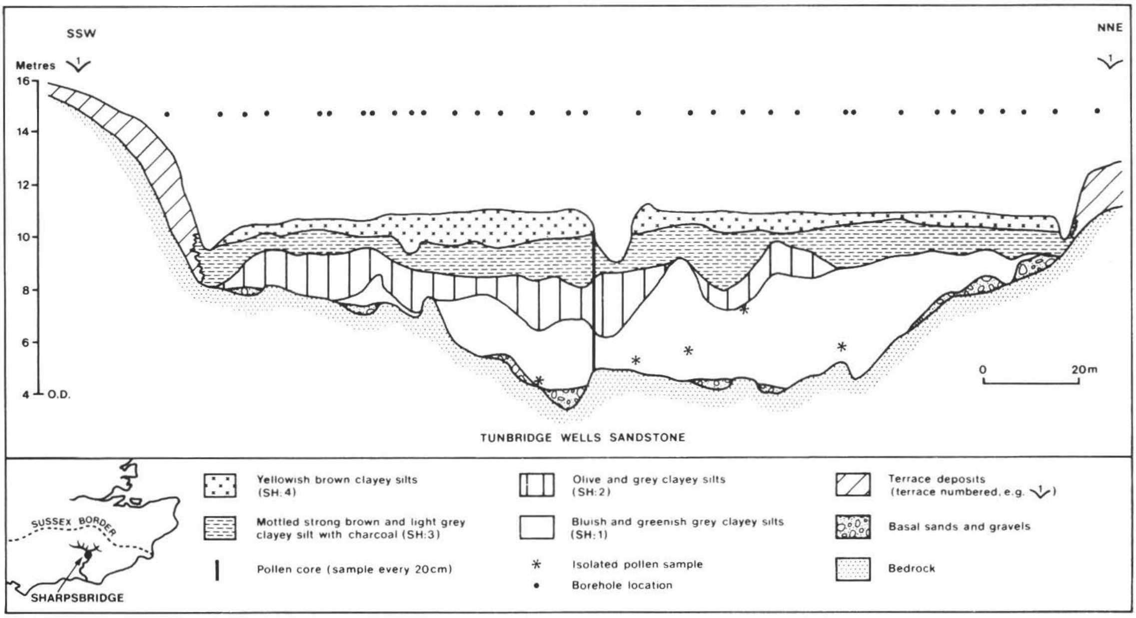

Fig. 1. The Sussex Ouse Valley Fill at Sharps Bridge.

sand and gravel deposit, which is buried by up to 7.0 m of relatively inorganic silts, clayey silts and silty clays, with some fine sandy inclusions and occasional very thin interbedded lenses of peat. These fine-grained sediments can be sub-divided into four litho-stratigraphical units (Fig. 1):

Unit	Description
1.	A bluish and greenish grey (5 Y 4/1, 5 GY 4/1, 5/1), mottled with grey (2.5 YN 7/0), dark grey (2.5 YN 4/0) and greyish brown (2.5 Y 3/2) clayey silt with occasional very thin laminations of interbedded peat. Maximum proven thickness 5.0 m.
2.	An olive (5 Y 5/4), olive grey (5 Y 4/2, 4/4) and olive brown (2.5 Y 5/4, 5/6) clayey silt, with occasional small charcoal fragments and a maximum thickness of 2.8 m.
3.	A mixed and variable deposit with a maximum proven thickness of 2.3 m. It is generally a strong brown (7.5 YR 5/6, 5/8) and light grey (2.5 YN 7/0) silt, often mottled with dark brown (10 YR 3/3) dark yellowish brown (10 YR 4/4, 5/6), pale yellow (2.5 Y 7/4) and reddish yellow (2.5 Y 6/8). It frequently contains a considerable amount of charcoal litter in its upper parts.
4.	Yellowish brown (10 YR 5/4, 5/6), dark yellowish brown (10 YR 4/3, 4/4), dark brown (10 YR 3/3) and brownish yellow (10 YR 6/6) fine sandy clayey silts with a maximum thickness of 1.8 m.

Normally these fine-grained alluvial deposits would be interpreted as reworked locally-derived sediments, the Wealden bedrocks having a high, though variable silt content (Gallois 1965). Detailed and extensive sedimentological analyses, however, have indicated that not only is it impossible to differentiate between these four litho-stratigraphic units, but also that there are significant differences between the relatively homogeneous, fine-grained, alluvium and the bedrock deposits. The repeated finding of sediments with loessal (i.e. aeolian, wind-blown), rather than the more variable locally-derived bedrock, characteristics suggest an origin external to these catchments (Burrin 1981). Such reworked loessal-derived sediments can be found within the alluvium of all Sussex rivers (Burrin, *in press*) thereby providing some indication as to the formerly, more widespread distribution of loess in Sussex.

PALYNOLOGICAL ANALYSIS

A palynological investigation was carried out in order to confirm the litho-stratigraphy of the alluvial fill deposits and to attempt to establish the age and evolution of the deposits. The predominantly inorganic nature of the alluvium precluded the possibility of obtaining an accurate chronology using radiocarbon dating.

Sequential samples of alluvium for pollen analysis were obtained (Fig. 1) using a standard Hiller auger in preference to a Russian/Jowsey corer, which was unable to penetrate the highly tenacious sediments. The valley fill was sampled at 20 cm intervals, 1–2 ml being taken for analysis. Isolated spot samples were also taken from a number of locations (Fig. 1) within the Sharpsbridge section. Standard techniques were used for extracting the sub-fossil pollen and spores (Faegri and Iversen 1974, Moore and Webb 1978). While the calculation of absolute pollen frequencies would have been desirable, facilities were not available to do so at the time of preparation. Proportional calculation was carried out, with pollen taxa being calculated as a percentage of the total pollen counted (TP) at each level. The pollen sum was largely dictated by the numbers of pollen grains present. Wherever possible a minimum sum of 150 arboreal pollen grains per level was recorded, together with all extant taxa. Pollen of *Alnus* was included in the arboreal pollen sum because it was regarded as being part of the total plant community and, therefore, relevant to any interpretation of the development of the floodplain. Overrepresentation of this taxon in the pollen spectrum is likely because of its high pollen productivity, anemophily and autochthony.

Spores of Filicales and Bryophytes were calculated as a percentage of total pollen plus spores. Attempts to quantify the numbers of pollen grains having exine degradation were made in order to assess those pollen grains of secondary derived origin. Unfortunately, pollen degradation was apparent in many levels, perhaps due to fluctuating water tables or the occasional drying out of the floodplain and alluvial fill during parts of the Flandrian. Consequently, such efforts proved unsuccessful. Pollen sampling was not undertaken in the upper 80 cm of valley fill because the alluvium had been appreciably disturbed by anthropogenic activity.

The palynological results are presented in Fig. 2, 3 and 4. Four biostratigraphical assemblage zones have been recognised and designated Sharpsbridge (SH:) 1–4. These are characterised as follows:

SH:1 6.4–5.3 m	Dominated by *Pinus* (60–80%), *Corylus* type (31%), Gramineae (up to 9%) and *Dryopteris* type (23–40%). *Betula*, *Quercus* and *Fraxinus* are also present, whilst herbaceous pollen other than that of Gramineae are few and consist largely of marginal aquatic and fen taxa.
SH:2 5.3–2.7 m	Aboreal taxa are dominated by *Quercus* (18–32%), *Tilia (10–30%)* and *Alnus* (17-33%). Highest values of *Ulmus* (5%) and *Fraxinus* (8%) are also present, the latter declining above 3.4 m whilst *Betula* (2–9%) increases significantly from the previous zone. Pollen from shrubs is dominated by *Corylus* type which declines throughout the zone. A significant increase in pollen of herbaceous taxa (3–15% TP) also occurs and includes *Plantago lanceolata*, *Rumex*, Liguliflorae and Gramineae. The presence of pollen of cereal and Cruciferae is also significant.
SH:3 2.7–1.3 m	This zone has been delimited by a marked decline (Fig. 2) in the pollen of *Tilia*, *Ulmus*, *Alnus*, *Quercus*, *Fraxinus* and *Corylus* type. In contrast to this reduction is the notable expansion of herbaceous pollen (averaging 66% TP). Of particular significance are Gramineae (25–50%), cereal (2–3%), Liguliflorae (33.5%) and *Plantago lanceolata* (2.5%). Cruciferae and *Centaurea cyanus* can be regarded as possible indicators of arable agriculture.
SH:4 1.3–0.8 m	This zone is characterised by an increase of arboreal pollen to 42% of total pollen, with an increase in the numbers of *Alnus* and *Tilia* pollen; expansion of *Corylus* type pollen is also evident. Conversely, pollen of herbaceous taxa are less well represented.

A good correlation appears to exist between the litho-stratigraphy as described above and the bio-stratigraphy. The lowest pollen assemblage zone (SH:1) is characterised by its dominant *Pinus*

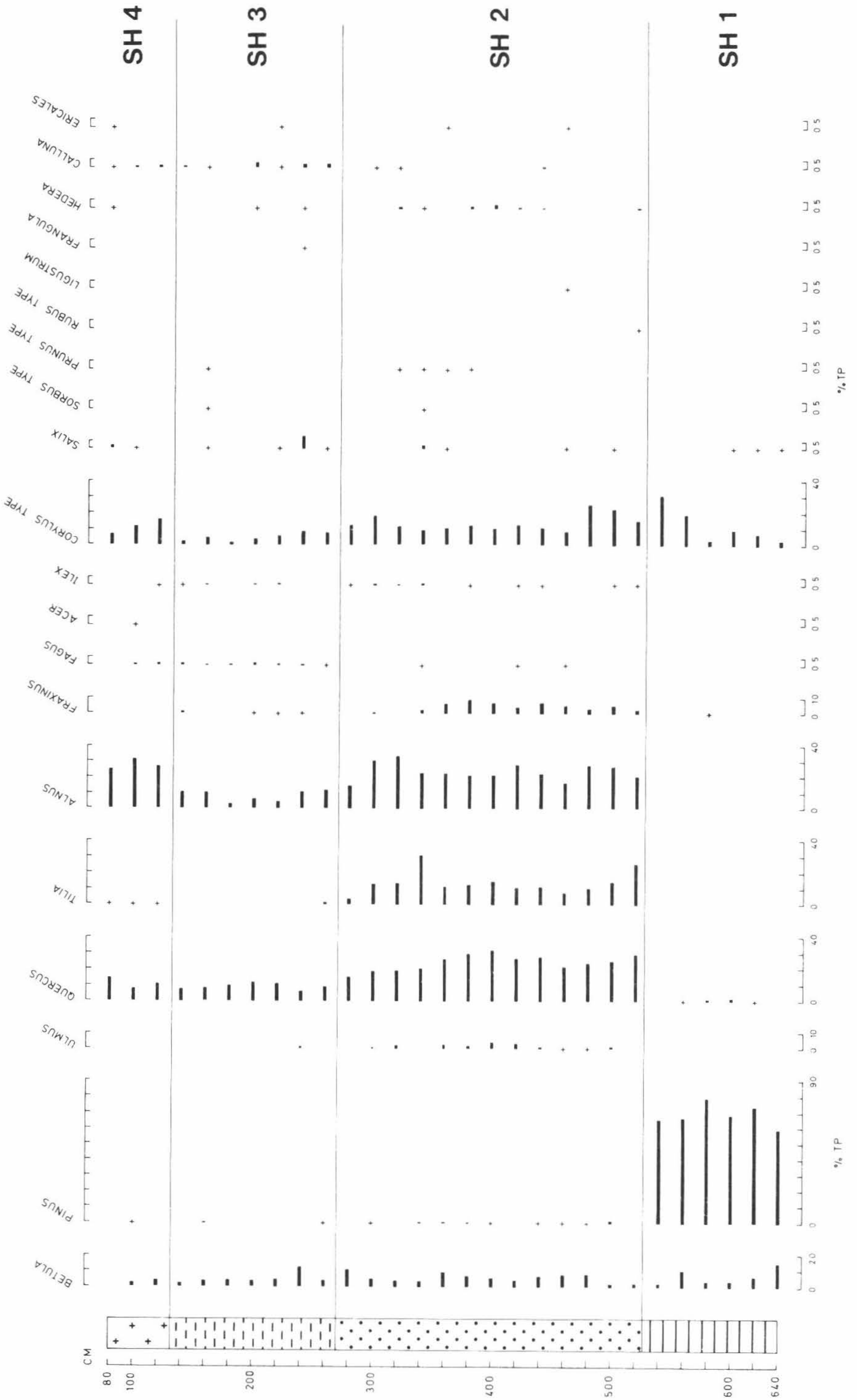

Fig. 2. Sharpsbridge biostratigraphy (arboreal and shrubs).

and *Corylus* type and by its well defined bio-stratigraphical discontinuity with the succeeding zone SH:2 (Fig. 2). From the floristic contents of this zone, it is suggested that the sediments were deposited during the early Flandrian. High values of *Pinus* pollen have been noted in sediments of this age in England for some years. Erdtman (1928) discussed the early expansion of this taxon during the Flandrian in this region, which has subsequently been verified by other researchers (Seagrief 1959, 1960, Seagrief and Godwin 1960, Haskins 1978, Scaife 1980, 1982, Kerney *et al.* 1981). The dating of this zone is dependent on the suggested time of entry of *Pinus* into southern England in the Late-Devensian or early Flandrian periods. The domination of arboreal pollen by *Pinus* (Fig. 2) and the relatively low numbers of pollen of herbaceous taxa (Fig. 3), especially those often indicative of Late-Devensian conditions (Scaife 1982), suggest that an early Flandrian age is most likely. The vegetation represented by zone SH:1 was apparently dominated by stands of *Pinus* and/or *Corylus*, this being the predominant vegetation growing during the Boreal period (Godwin 1975a, 1975b).

A sharply defined bio-stratigraphical discontinuity occurs between 5.2 and 5.4 m (Fig. 2), separating pollen zones SH:1 and SH:2. Within the 20 cm sampling interval, an hiatus of some thousands of years is present in the palynological profile and there is a notable absence of pollen of late Boreal or Atlantic age (Godwin's pollen zones VI and VIIa). On the basis of the arboreal pollen found in SH:2, it is evident that *Quercus*, *Tilia*, *Ulmus* and *Fraxinus* were the dominant taxa during this episode of sedimentation, whilst *Alnus* may have formed a substantial carr community, possibly on the floodplain itself. From the relatively high *Tilia* percentages (Fig. 2), it is suggested that this species was a dominant element in the woodland within the vicinity of the floodplain, the relatively well-drained soils overlying the adjacent sandstone lithology probably providing habitats suited to its growth. Elsewhere within the area of pollen catchment, *Quercus* and *Ulmus* might have been preferentially suited to growth on slightly heavier soils. Herbaceous pollen in this zone, including those of cereal crops and associated weeds of cultivation, is evidence that a degree of anthropogenic deforestation and subsequent agriculture took place. This, together with the absence of a 'Primary *Ulmus* Decline' which was broadly synchronous across Britain at *c.* 5000 b.p. (Smith and Pilcher 1973), suggest that these sediments were deposited in the post-Neolithic. By analogy with the *Ulmus* pollen changes seen in more complete Flandrian palynological sequences (Girling and Greig 1977, Haskins 1978, Scaife 1980, 1982, Tomalin and Scaife 1980), it is probable that the *Ulmus* profile in SH:2 represents secondary regeneration during the Neolithic period, which is also found in other pollen diagrams from southern England (Scaife 1982). It is suggested, therefore, that the sedimentation represented by pollen zone SH:2 was initiated during the immediate post *Ulmus* decline shortly after *c.* 5000 b.p. At a depth of between 2.6 and 2.8 m, a marked decline in pollen of *Tilia* is found (Fig. 2). This phenomenon, although not a synchronous occurence (Smith and Pilcher 1973), is nevertheless an important and significant feature in pollen diagrams constructed from sites analysed elsewhere in southern England (Baker *et al.* 1978, Thorley 1981, Scaife 1980, 1982, Greig 1982). Various explanations have been advanced as to its cause, including climatic change (Godwin 1956) and anthropogenic forest clearance (Turner 1962). The latter appears more plausible because of the asynchroneity noted at sites analysed across the region and from the significant associated increase of herbaceous pollen, including cultigens, in the period immediately following the *Tilia* decline. Radiocarbon dating of this phenomenon has provided a range of dates from Neolithic at Borthwood Bog, I.O.W. (Scaife 1980) to Saxon in Epping Forest (Baker *et al.* 1978), but the majority of dates fall between 1500 and 500 B.C., within the late Bronze Age or early Iron Age. Immediately after the decline in *Tilia* pollen at Sharpsbridge an increase in herbaceous pollen occurs, including taxa which are again indicative of forest clearance and subsequent agriculture.

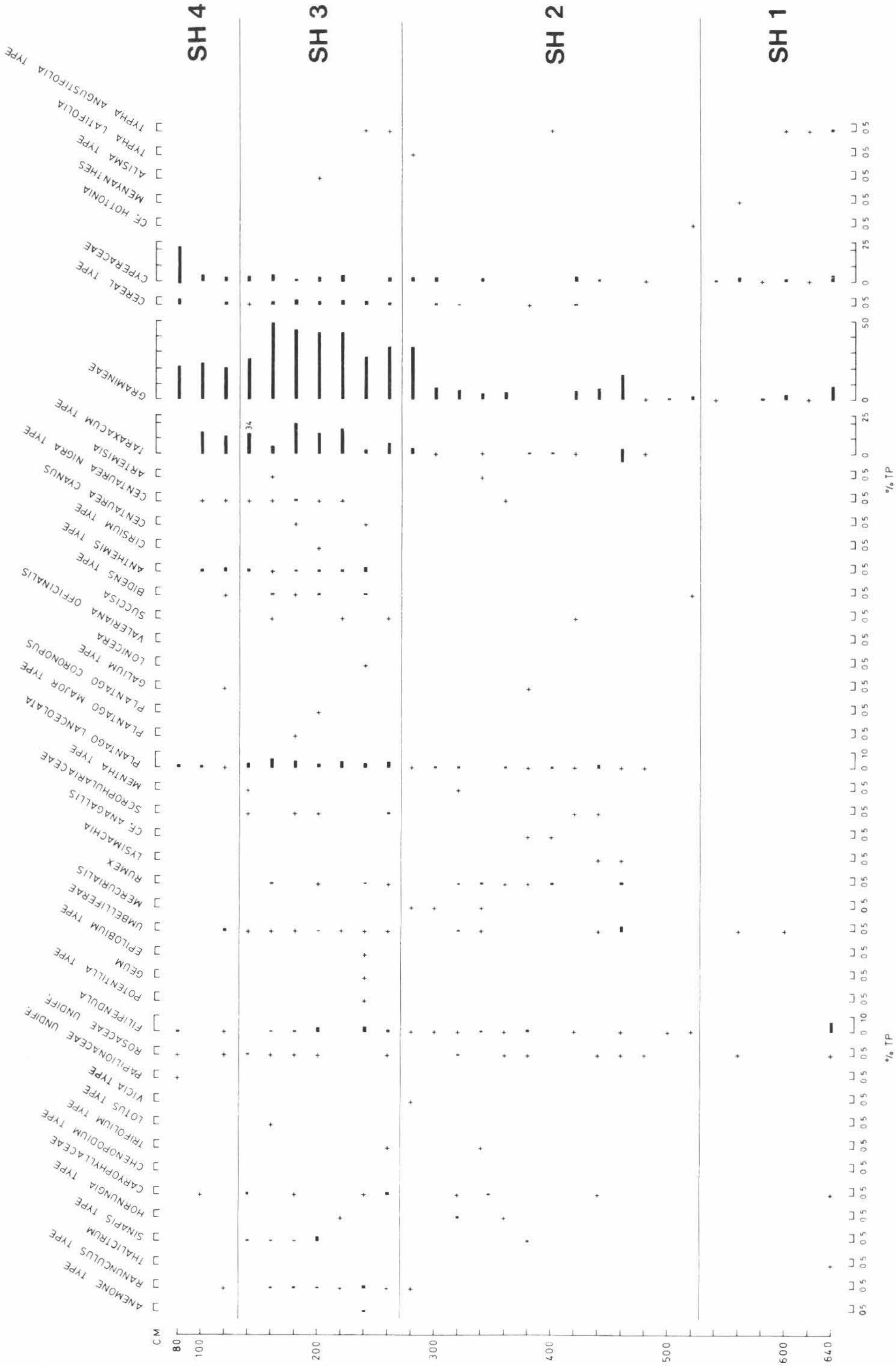

Fig. 3. Sharpsbridge biostratigraphy (herbs).

These pollen types include Gramineae, Cerealia type, *Plantago lanceolata*, Cruciferae and Compositae species including *Centaurea cyanus*. Without absolute dating evidence from this site, it can only be postulated that anthropogenic deforestation caused the *Tilia* decline, probably during the late Bronze age—early Iron Age. Such an interpretation offers tentative support for the work of Ellison and Harriss (1972) in that major land apportionment and agricultural activity took place in Sussex during this period. The presence of *Calluna* pollen in this zone may be indicative of a degree of soil deterioration, with small areas of heathland being initiated as a result of forest clearance on areas of poorer soils. Such deterioration in parts of the western Sussex Weald has been shown by Dimbleby (1962) to have resulted from Bronze Age activity.

The recognition of the uppermost zone SH:4 is based on the expansion of arboreal taxa, with the re-establishment of *Tilia* and *Alnus*, the latter possibly colonizing the floodplain. Whether or not this zone is a distinct unit with an hiatus between SH:3 and SH:4, or a continuously deposited sedimentary sequence is not clear. However, the irregular boundary between the two units (Fig. 1), the more variable litho-stratigraphic nature of SH:2 and the sharp discontinuity in the *Alnus* pollen profile (Fig. 2) indicate that the existence of two distinct units is more probable. As pollen sampling was not carried out in the uppermost parts of the alluvial fill, possible increases in the pollen of *Ulmus* or *Pinus* caused by local afforestation during the last 200 years have not been found. It seems probable, therefore, that the older sediments of zone SH:4 pre-date *c.* 1700 and may date from the late Iron Age or Romano-British times. It is also possible that alluviation of SH:4 was partly in response to forest clearance and charcoal production for the furnaces and forges associated with the Wealden iron industry, during both Roman times and the Middle Ages (Straker 1931, Sweeting 1944, Tebbutt 1981).

DISCUSSION

There are important limitations in the palynological analyses of mineral sediments of similar character to those described here. These are well known and have been discussed elsewhere (Faegri and Iversen 1964, Burrin and Scaife, *in press*). It seems clear from the palynological analysis that units SH:2, SH:3 and SH:4 have accumulated largely in response to the increase in sediment supply within parts of the Ouse catchment, as a result of episodes of anthropogenic deforestation since at least Neolithic times. It is of interest to contrast Thorley's (1971) inference that the South Downs in the Lewes area were still wooded in the Neolithic, with primary clearance not beginning until the Middle Bronze Age. Conversely, Drewett (1978a) provides evidence of extensive, but local, clearance from three Neolithic sites at Alfriston (Cuckmere), Offham and Bishopstone (Ouse). It is suggested that the Sharpsbridge alluvial fill is indicative of a more widespread Neolithic impact within Sussex. This is tentatively supported by the common occurrence of similar alluvial deposits to those comprising unit SH:2 elsewhere within the upper Ouse and Cuckmere valleys.

The causal mechanisms responsible for the alluviation of unit SH:1 are more difficult to account for, given the apparent lack of anthropogenic indicators in the pollen record (Figs. 2, 3 and 4). Changing environmental conditions from the more rigorous conditions of the Late-Glacial to the temperate early Flandrian would, almost inevitably, have induced a natural change within fluvial regimes (e.g. from braided to meandering channels) and a new sedimentary equilibrium would probably have been established as a direct result. When considered in isolation from other environmental factors, this argument would appear to explain satisfactorily this early Flandrian aggradation. Yet, when a more complete environmental reconstruction is considered, the situation becomes more complex. During the pre-Boreal *c.* 10250-9450 b.p. (Goudie 1977) tree migration

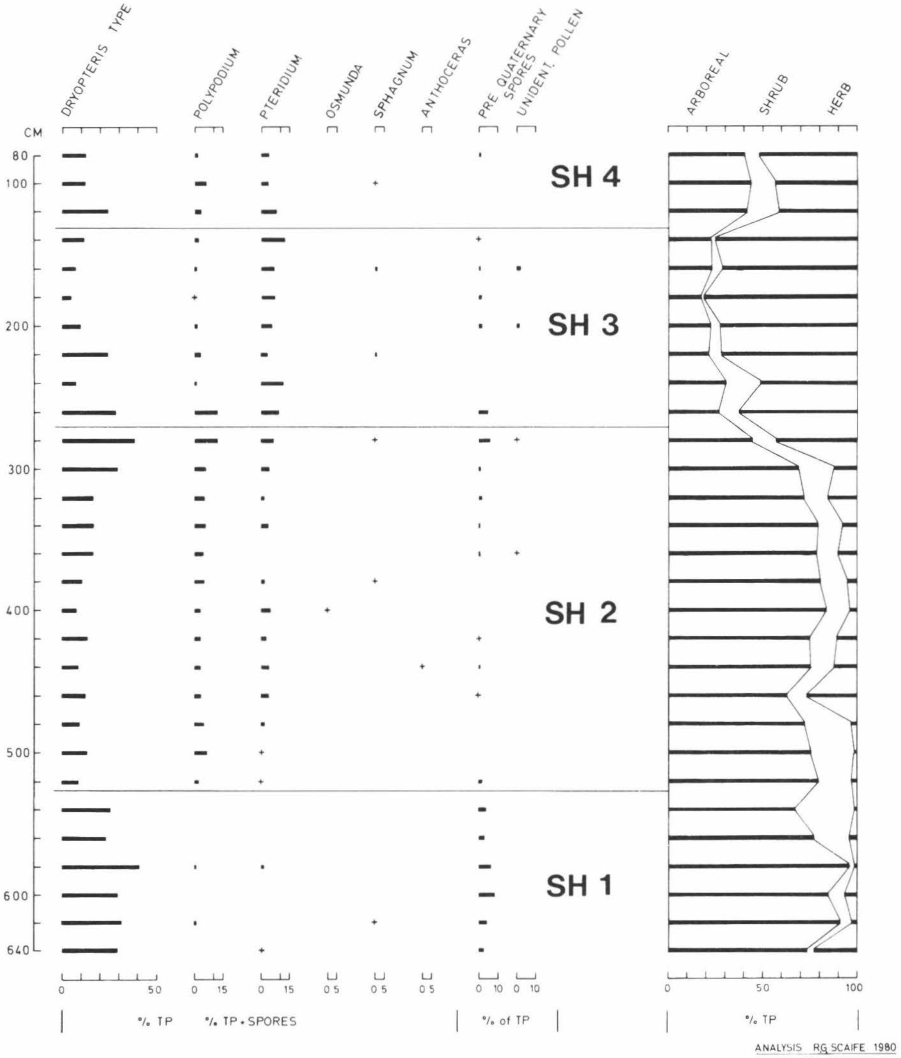

Fig. 4. Sharpsbridge biostratigraphy (spores and summary diagram).

was proceeding rapidly, so that by the beginning of the Boreal (*c.* 9450 b.p.) there was considerable vegetation cover in southern England (Scaife 1982). However, just as the valley sides become established by *Betula*, *Pinus* and *Corylus*, there occurred substantial alluviation within the Ouse valley at Sharpsbridge. This appears to be illogical, for the forest cover should have minimized surface run-off by promoting higher interception, infiltration and evapotranspiration rates. These factors, together with the binding of regoliths by root systems would consequently reduce valley side erosion and sediment supply to the valley bottoms. The early Flandrian sediment at Sharpsbridge must, therefore, have been derived from the erosion, transportation and deposition of older sediments previously deposited upstream. Unfortunately, there is no evidence in the pollen record of this having taken place. The question arises, therefore, as to why the vegetation cover was unable to restrict the sediment supply to the valley bottom during the early Flandrian and yet was apparently able to do so during the late Boreal and Atlantic (middle Flandrian). Two possible hypotheses can be ventured:

(a) The early Flandrian alluviation took place at Sharpsbridge prior to valley side stabilization by the Boreal forest, i.e. during the pre-Boreal or possibly very early Boreal. The difficulty with this interpretation is that it is refuted by pollen evidence from across southern England and by general palaeoecological argument (Scaife 1982).

(b) It is possible that the vegetation cover may have been locally removed or significantly disturbed by Mesolithic man. Although Thorley (1971) noted *Pteridium* inclusions in the Atlantic-age sediments in the Vale of the Brooks, which suggested possible local influence of Mesolithic man, no evidence of similar anthropogenic activity can be found in the Sharpsbridge pollen record (SH:1, Fig. 2, 3 and 4). However, if the view is accepted that the evidence for Mesolithic activity represents the movements of essentially mobile hunting and gathering peoples, then these archaeological records may represent only transitory settlement sites. In consequence, little if any record of their activities might be expected in the pollen record.

As localised forest clearance has been demonstrated elsewhere in Sussex during this period (Keef *et. al.* 1965, Scaife—West Heath study, *in press*), it would appear reasonable to argue for a similar occurrence within the vicinity of Sharpsbridge.

From these geomorphological and palynological results, it can be suggested that prehistoric man was able to make a significant impact on his environment to the extent that it caused local floodplain sedimentation and alluviation within the upper Ouse valley. Initial results from other sites within the Ouse and Cuckmere floodplain valley tracts provide further evidence for these findings and will be discussed more fully at a subsequent date. It would appear increasingly probable that Sussex prehistoric cultures were not necessarily as constrained by their environment as was once believed (Curwen 1954), but rather, they were able to make a considerable environmental impact, a view supported to some extent by more recent Sussex archaeological studies (Drewett 1978b).

CONCLUSIONS

Research into the nature and age of the floodplain sediments of the Sussex Ouse has indicated that episodes of sedimentation and floodplain construction therein appear to have resulted largely from anthopogenic forest clearance at intervals dating back to the Mesolithic. This provides support for a more widespread and significant impact by man on his environment than previously envisaged, particularly during the early and middle Flandrian. It is suggested that cultivation of interdisciplinary studies, involving archaeologists, geomorphologists, palynologists and other related interests, may prove to be of increasing value in helping to identify evidence of anthropogenic-environmental inter-relationships.

ACKNOWLEDGEMENTS

Research was undertaken whilst one of the authors (PJB) was in receipt of a N.E.R.C. research studentship, which is gratefully acknowledged. The authors would also like to thank David Lawes and Nicola Pope for their assistance in the preparation of this manuscript.

Authors: P. J. Burrin, Department of Geography, University of London, Goldsmiths' College, New Cross, London SE14 6NW

R. G. Scaife, Institute of Archaeology, University of London, 31 Gordon Square, London W.C.1.

References

Baker, C. A., Moxey, P. A. and Oxford, P. M. 1978 'Woodland continuity and change in Epping Forest' *Field Studies 4*, 645–69.

Burrin, P. J. 1981 'Loess in the Weald', *Proc. Geol. Ass.* **92**, 87–92.

Curwen, E. C. 1954 *The archaeology of Sussex* Methuen, London.

Dimbleby, G. W. 1962 *The development of British heathlands and their soils* Oxford.

Drewett, P. L. 1978a 'Neolithic Sussex', in Drewett, P. L. (ed.) Archaeology in Sussex to A.D. 1500, *CBA Res. Rep.* **29**, 23–9

—— 1978b 'Archaeology in Sussex to A.D. 1500' *CBA Res. Rep.* **29.**

Ellison, A. and Harriss, J. 1972 'Settlement and land use in the prehistory and early history of southern England: a study based on locational models', in D. L. Clarke (ed.) *Models in Archaeology*, 911–62, Methuen.

Erdtman, G. 1928 'Studies in the post-arctic history of the forests of north-west Europe. 1. Investigation in the British Isles.', *Geol. Foreningen: Stockholm Forhandlingar* **50**, 123–92.

Faegri, K. and Iversen, J. 1974 *Textbook of pollen analysis* Blackwell, Oxford.

Gallois, G. W. 1965 *The Wealden District* H.M.S.O.

Girling, M. A. and Greig, J. R. A. 1977 'Palaeoecological investigation of a site at Hampstead Heath, London', *Nature* **268**, 45–7.

Godwin, H. 1975a History of the natural forests of Britain: establishment, dominance and destruction. *Phil. Trans. Roy. Soc.* **B271**, 47–67

—— 1975b *The history of the British flora* Cambridge University Press.

Goudie, A. 1977 *Environmental Change* Clarendon Press, Oxford.

Greig, J. R. A. 1982 'Past and present lime woods of Europe', in Limbrey, S. and Bell, M. (eds) *Archaeological aspects of woodland ecology*, 23–46, BAR Int. Ser. **146**.

Haskins, L. E. 1978 'The vegetational history of south-east Dorset', Univ. of Southampton, unpubl. PhD. thesis.

Jones, D. K. C. 1971 'The Vale of the Brooks', in Williams, R. B. G. (ed.) *Guide to Sussex Excursions*, Inst. Brit. Geog., 43–6.

—— 1981 *Southeast and Southern England* Methuen, London.

Keef, P. A. M., Wymer, J. J. and Dimbleby, G. W. 1965 'A Mesolithic site on Iping Common, Sussex, England'. *Proc. Prehist. Soc.* **31**, 85–92.

Kerney, M. P., Preece, R. C. and Turner, C. 1981 'Molluscan and plant biostratigraphy from some Late-Devensian and Flandrian deposits in Kent', *Phil. Trans. Roy. Soc. London* **B291**, 1–43.

Moore, P. D. and Webb, J. A. 1978 *An illustrated guide to pollen analysis* Hodder and Stoughton.

Scaife, R. G. 1980 'Late Devensian and Flandrian Palaeoecological studies in the Isle of Wight' Univ. of London unpub. Ph.D. thesis.

—— 1982 'Late Devensian and early Flandrian vegetation changes in southern England', in Limbrey, S. and Bell, M. (eds.) *Archaeological aspects of woodland ecology*, 57–74, BAR Int. Ser. **146.**

Seagrief, S. C. 1959 'Pollen diagrams from southern England: Wareham, Dorset and Nursling, Hampshire', *New Phytol.* **58**, 316–25.

—— 1960 'Pollen diagrams from southern England: Cranes Moor, Hampshire', *New Phytol.* **59**, 73–83.

—— and Godwin, H. 1960 'Pollen diagrams from southern England: Elstead, Surrey', *New Phytol.* **59**, 84–91.

Sheldon, J. 1978 'The environmental background', in Drewett, P. L. (ed.) Archaeology in Sussex to A.D. 1500, *CBA Res. Rep.* **29**, 3–7.

Smith, A. G. and Pilcher, J. R. 1973 'Radiocarbon dates and the vegetational history of the British Isles', *New Phytol.* **72**, 903–14.

Straker, E. 1931 *Wealden Iron* Bell, London.

Sweeting, G. S. 1944 'Wealden Iron Ore and the history of its industry', *Proc. Geol. Ass.* **55**, 1–20.

Tebbutt, C. F. 1981 'Wealden Bloomery Iron Smelting Furnaces', *Sussex Arch. Coll.* **119**, 57–64.

Thorley, A. 1971 'Vegetational history in the Vale of the Brooks', in Williams, R. B. G. (ed.) *Guide to Sussex Excursions*, 47–50, Inst. Brit. Geog.

—— 1981 'Pollen analytical evidence relating to the vegetation history of the Chalk', *J. Biogeog.* **8**, 93–106.

Tomalin, D. and Scaife, R. G. 1980 'A Neolithic flint assemblage and associated palynological sequence at Gatcombe, Isle of Wight', *Proc. Hants. F.C. Arch. Soc.* **36**, 25–33.

Turner J. 1962 'The *Tilia* decline: an anthropogenic interpretation', *New Phytol.* **61**, 328–41.