COASTAL CHANGE SINCE 6000 B.P. AND THE PRESENCE OF MAN AT KENN MOOR, AVON

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INTRODUCTION

A carefully fashioned wooden stake of probable Early Bronze Age or Late Neolithic date has been described from Kenn Moor, Avon, by Gilbertson and Hawkins (1983). The peat deposit in which it was found suggested contemporary freshwater swamps, and the authors point to the similarities of the find and its environmental setting with those of the Somerset Levels Project, south of Mendip. Coles (1984) notes that although the find could indicate a wooden trackway or platform of the type found in the Somerset Levels, it may instead represent only a temporary encampment or could even have been washed into the swamp from a nearby settlement during flood times. Litho-stratigraphic investigations of the locality revealed complex sedimentary changes in Kenn Moor which pointed to the former existence, at different times in prehistory, of a variety of types of wetland environment. The aim of the present project has been to investigate the sedimentary sequence, using its microfossil (principally pollen) content, in order to discuss depositional environments and the presence of man in more detail.

THE STUDY AREA

Kenn Moor (ST 430680, Fig. 1) is situated *c.* 4 km inland of the present coastline at Clevedon, and is an area of low moorland with a present surface height of 4–5 metres above O.D. It can be regarded as one of the northernmost parts of the Somerset Levels, belonging to the extensive coastal lowland system which borders the Severn Estuary. The regional uplands are composed of Carboniferous limestone, while the lowlands have been eroded out of softer sandstones and mudstones. Subsequent lowland valley infilling by sedimentation has progressively levelled out the lowland relief and created the present moorland surfaces. Gilbertson and Hawkins (1978) have mapped the contours of the bedrock surface beneath the moorland, revealing the ancient river valley system now buried by up to 17 metres of postglacial sediments. The present day villages of Kenn and Yatton stand on a ridge of bedrock which is the remnant of an interfluve of this ancient valley system (Fig. 2).

Sir Harry Godwin (e.g. 1941, 1955) recognised that postglacial sediment build-up in the Somerset Levels had accompanied the general postglacial rise in sea-level and the formation of the Severn Estuary, with generally rising water levels creating

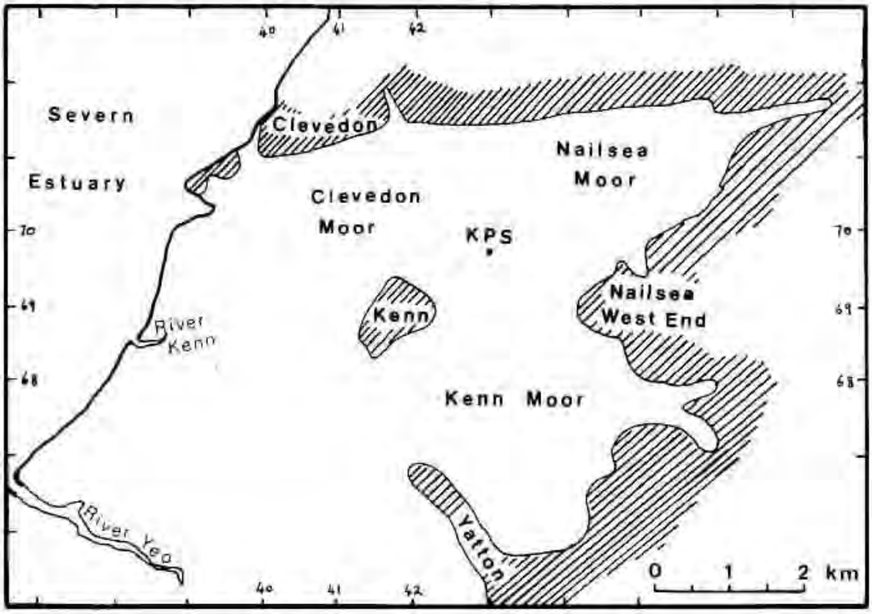

Fig. 1 The Kenn Moor area. Line follows edge of present alluvium (generally 7.6 m contour). KPS = Kennpier Pumping Station.

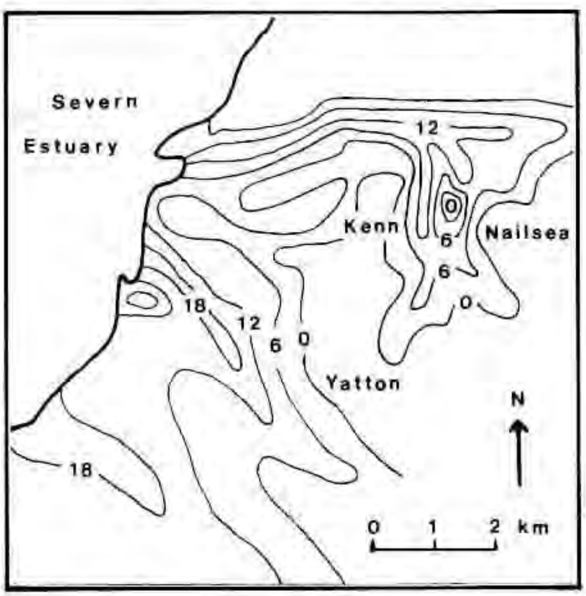

Fig. 2 Sub-drift bedrock morphology (after Gilbertson and Hawkins, 1978). Contours in metres below O.D.

the vertical space necessary for the accumulation of coastal and floodplain deposits. Applying palaeo-ecological and radio-carbon dating techniques to the region, Godwin investigated the relationships between sedimentation, vegetational history and relative changes in sea-level. More recently, Hawkins (1971a,b), Kidson and Heyworth (1973, 1976) and Heyworth and Kidson (1982) have developed this field of enquiry, while the Somerset Levels Project (e.g. Coles, 1978) has yielded a wealth of archaeological information which attests prehistoric human settlement in the region at least from the early Neolithic (*c.* 5500 b.p.) onwards.

METHODS AND RESULTS

The existing record of a section exposed during the construction of Kennpier pumping station (Gilbertson and Hawkins, 1983) provided a starting point from which to extend a stratigraphic survey southwards across Kenn Moor (Fig. 3). A maximum coring penetration of 7.5 metres was achieved by manual use of the Dutch Gouge Auger, but the actual Holocene (postglacial) sediment thicknesses are much greater than this. The stratigraphy as revealed by the nine boreholes is complex, with considerable local variation from core to core. This seems to be due both to local variation in the original environments of deposition (e.g. with the existence of stream channels that have since become filled in) and to post-depositional effects such as differential compaction. However, some correlations with the radio-carbon dated section at Kennpier have been attempted, and these are shown by dashed lines in Figure 4.

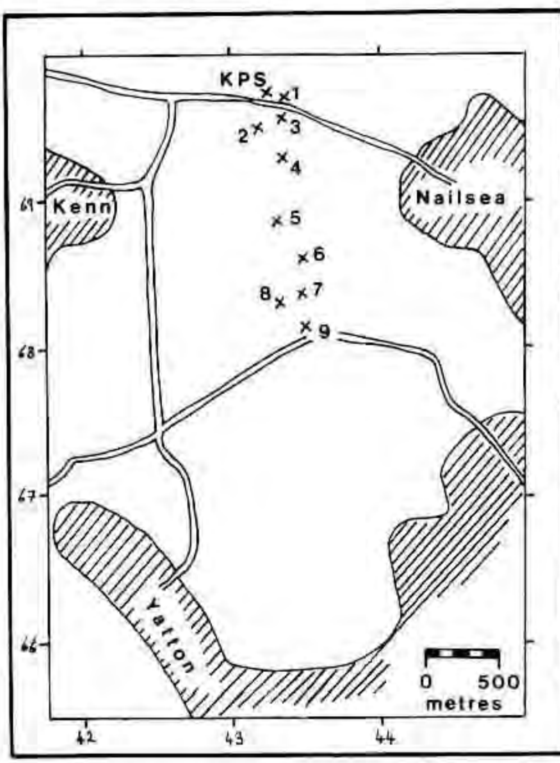

Fig. 3 Location of boreholes. Line follows edge of present alluvium.

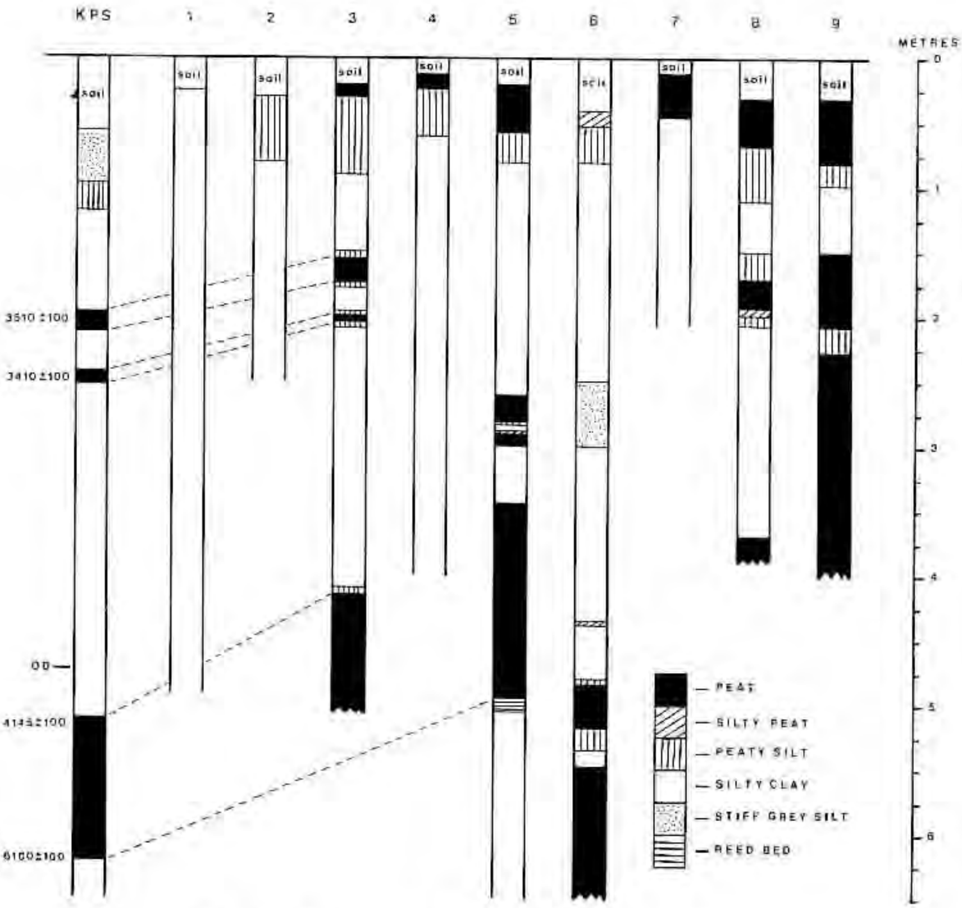

Fig. 4 Borehole stratigraphy. Depths in metres below surface.

Samples for microfossil analysis were taken from core 3 and core 5, and were processed using the technique of microfiltration to concentrate the microfossils for mounting on microscope slides (Hunt 1985). Figure 5 shows the results as a percentage frequency diagram and has been divided on the basis of microfossil content into local assemblage zones (KM1 – KM11). The microfossil characteristics of each assemblage zone are summarized in Tables 1 and 2.

PALAEO-ENVIRONMENTS

All the water-laid silt units were found to contain the remains of a mixture of both marine and freshwater organisms, which indicate an environment of deposition in which the mingling of water from sea and fresh sources was taking place. The zone KM1 silts occur at some 5 metres depth in the stratigraphy, so that during this zone the bedrock ridge to the west (upon which the village of Kenn is now located) would have been more pronounced. It perhaps rose some 10 metres above the general level of the silt surface and thereby afforded protection against direct marine influence from the west. It thus appears that freshwater run-off from the

FIGURE 5: KENN MOOR PERCENTAGE POLLEN DIAGRAM (major taxa)

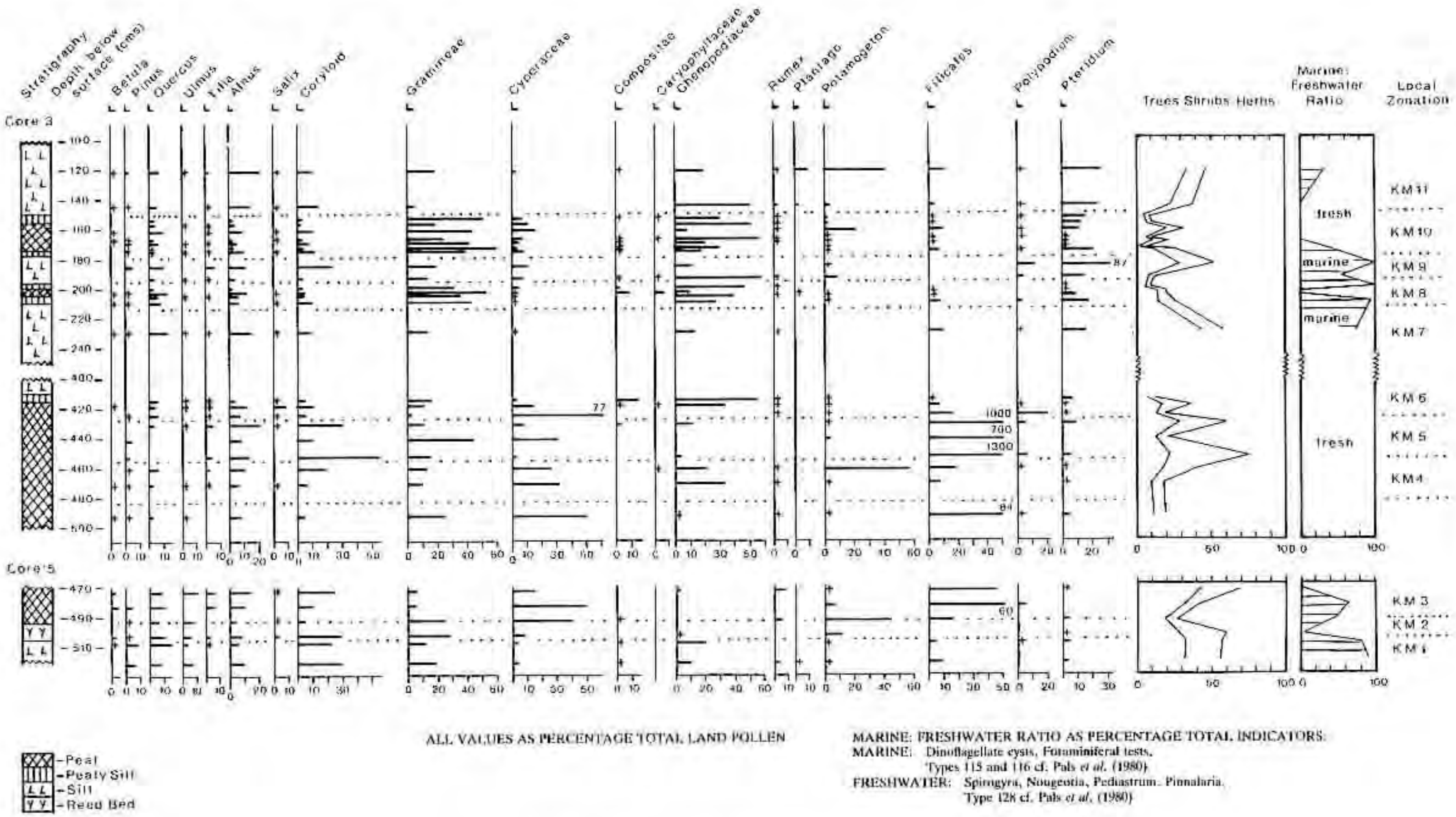

Fig. 5 Kenn Moor percentage pollen diagram (major taxa).

surrounding higher ground was entering a sheltered tidal inlet or embayment, open to the sea only beyond the northern end of the Kenn ridge (i.e. in the region of Clevedon Moor). The Kenn ridge probably stood as a low coastal promontory, and the high proportions of Chenopodiaceae (goosefoot family) and Gramineae (grass) pollen in the silts were probably derived from local salt marsh and mudflat vegetation. This may have been lagoonal, if the degree of protection of such an estuarine embayment was enhanced by a coastal barrier across its entrance.

At about 6000 b.p., in zone KM2, succession to fresher-water marsh appears to have taken place. Estuarine reedswamp with sedges (Cyperaceae) and tracts of calm, fresh-to-brackish water colonized by pondweeds (*Potamogeton*) developed. If developing from a lagoon, the environment of zone KM2 may have been 'fluvio-lagoonal' (Van Der Woude, 1984) in which, as the tidal influence diminished, river channels replaced former tidal creeks while successive flooding episodes built up channel levees and left stretches of permanent open water between them, trapped behind the coastal barrier. Reedswamp spread along the levees and across shallower water areas, and passed landward into alder (*Alnus*) woods and mixed deciduous forest.

Organic sedimentation and hydroseral development then gained pace, and by zone KM3 advancing reedswamp reduced the extent of open water areas, while alder carr advanced onto former reedswamp. Eventually the expanding peat surfaces, with their swamp forest vegetation took over large areas of the former embayment or lagoon, broken only by the river channels and perhaps also small lakes or marshes in former deeper water areas. The deltaic swamp forest was composed dominantly of alder and willow (*Salix*). Birch (*Betula*) is surprisingly poorly represented. However, high numbers of fern spores (Filicales) and corroded pollen grains suggest relatively dry fen peat surfaces, so that other trees such as oak (*Quercus*) and elm (*Ulmus*) with a rich fern undergrowth were also able to take hold. It is not known how far to seaward the coastline had moved during this period, but occasionally severe flood episodes may still have involved seawater brought unusually far inland by tidal flow and surges up the rivers. The influx of Chenopodiaceae pollen in zone KM4 could represent coastal salt marsh pollen brought inland by such an event, or it could represent a temporary period of marked coastline recession.

Deltaic swamp forest generally persisted for some 2000 years, after which marked hydrological, depositional and vegetational changes took place from about 4000 b.p. The transition to zone KM7 seems to have been a gradual one, marked by the occurrence of rhythmites and by a pollen stratigraphy showing a period of high Cyperaceae frequencies followed by high Chenopodiaceae. Thus it would appear that rising relative water levels drowned the fen and carr woods and favoured initially the expansion of sedge reedswamp. But seawater input was also increasing and a tidal influence began to return to the locality, giving rise to the laminated organic and mineral deposition and leading to the eventual establishment of salt marsh and mudflat at *c*. 4000 b.p.

There is a problem with the radio-carbon dates, but at around 3500 b.p. (zone KM8–KM10) the sediment and pollen record points to expansion of peatland areas between the tidal creeks and gullies. In both peat growth phases KM8 and KM10 the pollen is dominated by that of salt marsh plants, with a period of higher, slightly fresher-water marsh in the centre of each peat band. In zone KM8 this higher marsh phase is characterised by increased Compositae (daisy family), Caryophyllaceae (pink family) and Gramineae (grass family) and by reduced Chenopodiaceae. In zone KM10 reduced Chenopodiaceae is met by higher Gramineae, Cyperaceae and *Potamogeton* values. In both phases rising estuarine water levels

TABLE 1

SUMMARY OF EVIDENCE

Deposit	Years B.P.	Assemblage Zone	Microfossil Content
	2000		
Silt		KM 11	Increased representation of tree and shrub pollen. *Pteridium* well represented and *Plantago* also high. *Potamogeton* and freshwater indicators abundant.
Peat		KM 10	Chenopodiaceae and Gramineae dominate at start and end of peat band. Central peat characterised by more Cyperaceae and *Potamogeton* and greater woodland representation. Freshwater indicators dominate.
Silt		KM 9	Increased representation of tree and shrub pollen. *Pteridium* well represented. Marine microplankton dominant.
Peat		KM 8	High Chenopodiaceae at start and end of peat band, giving way to Gramineae, Compositae and Caryophyllaceae in centre. Increase in freshwater indicators.
Silt		KM 7	Increased representation of tree and shrub pollen. *Pteridium* well represented. Marine microplankton dominant.
	4000		
		KM 6	Declining Filicales. Initially Cyperaceae dominates but is later replaced by Chenopodiaceae, Compositae and Gramineae.
Peat		KM 5	Decline in Chenopodiaceae and swamping of assemblage by Filicales spores. Decline and temporary disappearance of *Ulmus* and *Quercus*, while *Corylus* shows temporary abundance.
		KM 4	Filicales values drop markedly. Chenopodiaceae returns in large amounts and co-dominates the assemblage with Cyperaceae and Gramineae. At the top of the zone *Potamogeton* becomes abundant.
		KM 3	Decreasing herbs and aquatics. Increasing tree and shrub pollen. Filicales spores abundant and Cyperaceae still well represented.
	6000		
Reed Bed		KM 2	Chenopodiaceae pollen disappears. Increases in Gramineae, Cyperaceae and *Potamogeton*. Mainly freshwater indicators.
Silt		KM 1	Tree and shrub pollen well represented. Herb pollen mainly Gramineae and Chenopodiaceae. Other microfossils include both marine and freshwater types.

TABLE 2

INTERPRETATION AND COMPARISONS

Age	Local Zone	Basin Environment	Regional Environment	Vale of Avalon Beckett & Hibbert 1979 Regional Assemblage Zones		Godwin Pollen Zone	Climatic Period	Archaeological Period
2000								
	KM 11	Fluvio-lagoonal?	Agricultural expansion			VIII	Sub-Atlantic	Roman and Iron Age
	KM 10	Marine/Perimarine Lagoonal		D	Selective clearance			
3000(?)	KM 9 KM 8 KM 7	Salt marsh and mud flat, with occasional spread of reed-swamp and carr	Renewed clearance and woodland management (?)	to F	Occasional regeneration	VII b	Sub-Boreal	Bronze Age
4000								
	KM 6	Freshwater perimarine	Possible regeneration	C	Forest regeneration			
	KM 5	swamp forest with *Alnus* carr reed-	Forest clearance and woodland management	B	Forest clearance and woodland management			Neolithic
5000	KM 4	swamp and small lakes. Occasional tidal	Elm decline					
	KM 3	flooding	Mixed oak forest	A	Mixed oak forest	VIIa	Atlantic	
6000								
	KM 2	Fluvio-lagoonal						
	KM 1	Marine lagoonal salt marsh and mud flat						Mesolithic

evidently initiated subsequent retrogression to low marsh and mudflat. The persistence of *Potamogeton* in these silts, expecially in KM11, contrasts with previous silt units and may indicate somewhat calmer and fresher, permanent open water such as may be found in fluvio-lagoonal rather than true mudflat environments.

Godwin (1943) suggested, on the basis of artefactual dating, that deposition of the uppermost silt unit in the Somerset Levels (the coastal clay belt or Roman clay) began and ended within the Romano-British period. However, radio-carbon dating did not bear this out, and Hawkins (1971b) envisaged a longer time period in which slowly accreting mudflats during the third and fourth millennium b.p. had, by Romano-British times, largely developed into pioneer salt marsh. The foraminiferal study of Murray and Hawkins (1976) supports this idea, but also indicates local variations in timing of the development of salt marsh from mudflat according to local shoreline conditions. At Kenn Moor it seems that marshland peats were able to develop across the fourth millennium mudflats at *c*. 3500 b.p. but that mudflat/low marsh conditions (perhaps somewhat fluvio-lagoonal) again prevailed during the third millennium and well into the Romano-British period. The transition from the upper silt unit into the peaty soils of the topmost metre at Kenn Moor has not been analysed in the present study.

During prehistory, then, coastal and wetland sedimentation linked to generally rising water levels progressively reduced the height difference between the sediment surface of the moor and the dry land surface of the Kenn promontory. This levelling out of the landscape eventually allowed flooding of the promontory itself to occur, so that a 1.0–1.5 metre-thick layer of silts was deposited over the ridge (Gilbertson and Hawkins, 1978). The relationship of these to the sequence in Kenn Moor has not been established in the present study, but they seem unlikely to be earlier than *c*. 3500 b.p.

THE PRESENCE OF MAN

Building on the reconstruction of local wetland palaeo-environments, the likely regional pollen elements, derived from dry land vegetation, can now be suggested. In zone KM1 the open nature of the Kenn embayment, with its mudflats and salt marsh, suggests that the tree pollen was derived from marginal areas above the level of MHWST and from higher ground vegetation surrounding the embayment (although some long distance transport of pollen by sea cannot be ruled out). Thus, alder (*Alnus*) was probably prevalent in the wetter marginal areas and streamsides but passed landward into a deciduous woodland of oak (*Quercus*), elm (*Ulmus*), lime (*Tilia*) and hazel (Coryloid). (N.B. Within the Coryloid group it was not possible to distinguish hazel (*Corylus*) from bog myrtle (*Myrica gale*)).

Subsequently, in zone KM3, the suggested spread of alder carr essentially expanded the woodland area. With the development of fern scrub and possibly also fen woodland by zone KM5, tree pollen may be of more local origin and screening by local fern scrub and corrosion of pollen on drier surfaces may have created large biases. However, the temporary disappearance of oak and marked rise in coryloid pollen at the opening of KM5 do resemble pollen diagrams from the Vale of Avalon to the south (Beckett and Hibbert, 1979), where regional woodland management and clearance for agriculture is indicated. This initial impact has been dated to *c*. 5000 b.p., with a second phase of activity between *c*. 4000 and 3500 b.p. The wooden stake from Kenn Moor (perhaps correlating with zones KM7–10) may be contemporary with this second phase of activity, while the zone KM5 pollen may indicate man's presence here in the earlier phase also.

In view of the fact that clearance and agriculture can have a powerful impact on local geo-morphological processes, it is interesting that a changeover from stabilized peat surfaces to increased waterlogging and silt deposition in the Kenn Moor stratigraphy (KM6/7) coincides with possible evidence for Late Neolithic or Early Bronze Age human activity in the region. Thus, woodland clearance on the local hillsides, causing accelerated soil erosion and increased surface run-off, could have led to downstream siltation of river channels within the swamp forest by increasingly mineral material; and to changes in the hydrological régime, with more frequent and dramatic flooding and a generally rising water table, resulting in widespread silt deposition. In an explanation of the Kenn Moor sequence the possibility of such human impact on the environmental system should perhaps be considered and assessed in conjunction with natural processes of coastal change.

From zone KM7, the Bronze Age period, *Pteridium* (bracken) spore values are noticeably high, becoming an important feature of the pollen record up until Roman times. Was this spread of bracken accompanying agricultural and land use progress and change (cf. Taylor, 1985), and to what extent does this indicate continued presence of man in the Kenn Moor region? Towards the closing stages of prehistory the nearby Cadbury-Congresbury hillfort provides evidence for pre-Roman Iron Age settlement (Burrow, 1981), while Lilly and Usher (1972) record Romano-British artefacts from Kenn Moor itself. The high *Plantago* (plantain sp.) values in zone KM11 may correspond to the agriculture of this later prehistoric period.

CONCLUSION

Although mostly concerned with local wetland and perimarine environments at Kenn Moor, this paper has suggested that surrounding woodland changes are also detectable in the pollen record. These changes can be quite favourably compared to the regional pollen assemblage zones for the Vale of Avalon (Beckett and Hibbert, 1979) and may similarly indicate the presence of man since Neolithic times, so widening the known region of prehistoric human settlement. The local sediment sequence in Kenn Moor appears to be in good general agreement with Kidson and Heyworth's (1976) borehole sequences from Bridgwater Bay and the Somerset Levels. In explaining these at the regional level, the authors drew attention to the interactions between sea level bound water table fluctuations, local coastline geo-morphology and hydrology, and rates of coastal sedimentation. In particular, the rates of sea level rise relative to rates of sedimentation were stressed, with peatland development seen as a response in part to relatively slower rates of sea level rise. However, with prehistoric settlement, land clearance and agriculture taking place over a wide region, there may well have been human influence on local hydrology and sedimentation.

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