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LATE HOLOCENE VEGETATIONAL DEVELOPMENT AT CHYANDOUR, NEAR PENZANCE, WEST CORNWALL

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The submerged forest in Mount's Bay was first described by John Leland in the mid-sixteenth century. More recent observers have noted the presence of oak, hazel and willow, and in 1966 a radiocarbon date of 3656 ± 150 BP was obtained. A temporary exposure of a section near Chyandour was described by James in 1990; samples for pollen analysis were taken at this time, and local pollen assemblage zones (LPAZ) have been defined. The initial phase in the sequence is characterized by alder carr with some oak and birch present. A drier and more open environment succeeds the carr, with a number of diverse herb species appearing. *Typha* and *Scheuchzeria* occur in low numbers in LPAZ3, and the alder carr expands again slightly in the final stage of the succession. A radiocarbon date of 1770 ± 40 BP was obtained from a depth of 50 cm from the peat surface, placing this part of the sequence in Godwin's pollen zone VIII. The Chyandour peat bed shows local changes which occurred when the drainage of Ponsandane stream was impeded by a coastal barrier, probably formed by the now fossilized sand dunes which lie seaward of the peat. The pollen content shows that the deposit was formed under freshwater conditions. Although the peat bed has hitherto been described as a drowned forest, this study suggests that it was formed in an open regional environment for most of its history, and that the `forest', at least at Chyandour, never developed beyond the fen carr/fenwood stage.

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THE STUDY AREA

James (1990) reported extensive Holocene peat beds at Ponsandane, near Penzance (Figure 1). Submerged forests and/or peat beds have been noted at a number of localities around the coast of Cornwall following the earliest report of the Mount's Bay submerged forest by Leland in the mid-sixteenth century. Boase (1825) produced a detailed paper incorporating a cross-section of the `Ligneous stratum' from Ponsandane to the west of the Chyandour site. Macrofossils of hazel, alder, elm and oak were extracted from this organic unit. Apparently, the Chyandour site was inaccessible at that time, although in the previous century Borlase (1758) reported the presence of a submerged forest in that area. However, Carne (1846) confirmed the existence of the submerged forest along the Eastern Green, describing large sections of oak, birch and hazel embedded in the organic unit.

The construction of a flyover into the Treneere Valley necessitated the excavation of the southern end of Ponsandane Field [SW 479311] and revealed fluvial units of sand and gravel overlying peat. The latter ranges from a few cm to >3 m in thickness and extends over at least 2400 m^2 (Figure 2). The Mount's Bay peat bed rests on the low lying area at the foot of a fossil cliff line extending from near Marazion to Wherry Town. The small Ponsandane brook flows southwards off the Land's End granite plateau and across the lowland at the foot of the fossil cliff.

The underlying solid geology upon which the Chyandour peats lie consists of weathered Devonian slates with quartz veins, while the fossil cliff is carved into the Land's End granite. The seaward extent of this particular peat is unknown, although a borehole 4 km offshore from Penzance has located a peat bed at c. -32 m OD, dated to 12,070±80 BP (James 1990, fig. 1). A former sand dune lies seaward of the Chyandour peat, from Western Green in Wherry Town eastwards towards Long Rock [SW 500 313] and continues towards Crowlas and Marazion.

Borehole logs indicate that depth of the peat beds at Ponsandane Field ranged from 2.3 m above OD to approximately 1.8 m below OD.

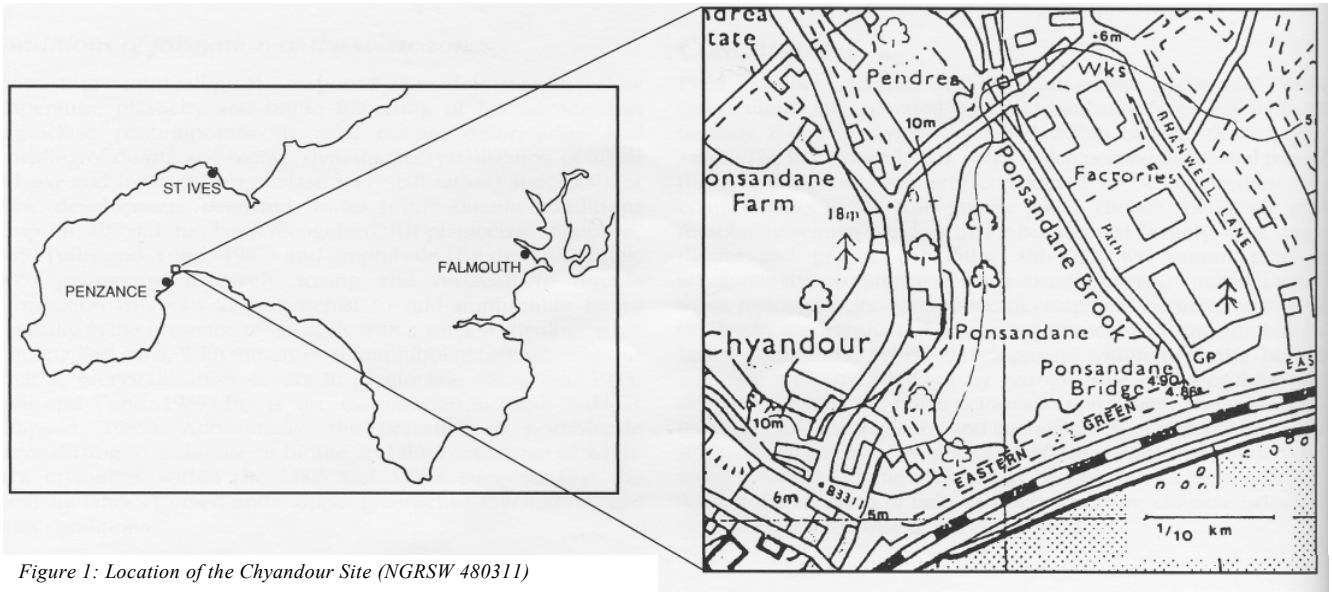

Figure 1: Location of the Chyandour Site (NGRSW 480311)

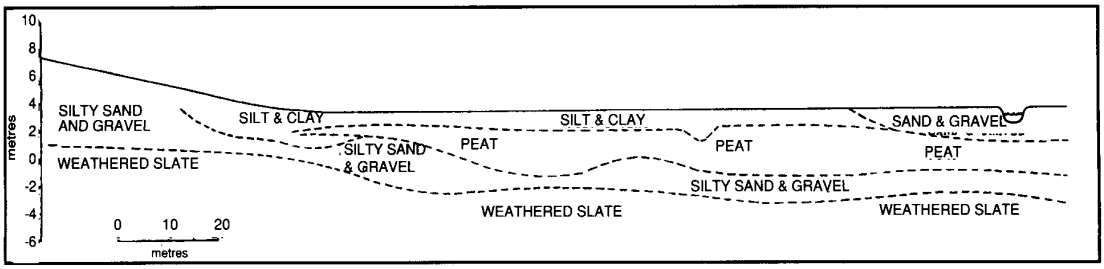

Figure 2: Geological cross section of the site at Chyandour

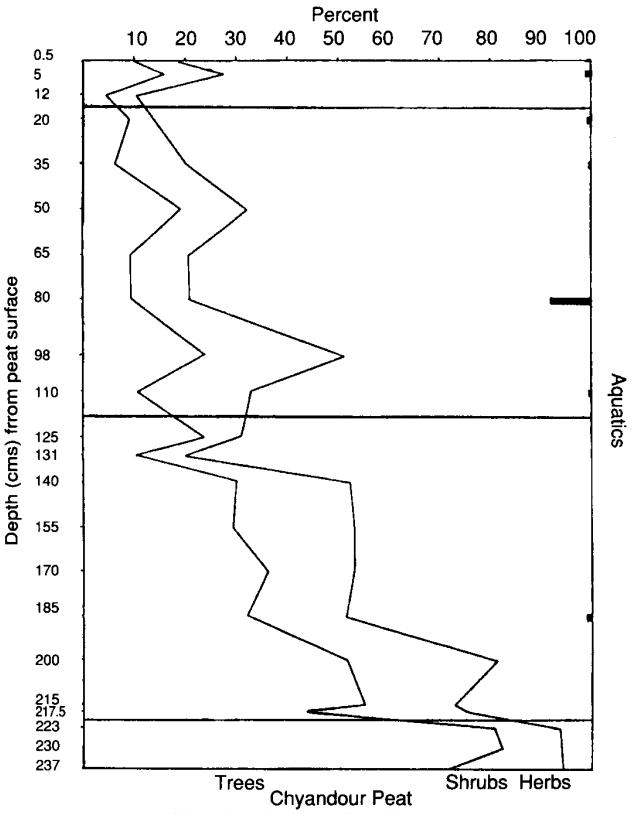

Figure 3: Zonation of the Chyandour peat by pollen component

Boreholes sunk by contractors building bypasses and industrial estates around Mount's Bay confirmed the landward extent of the peat beds eastwards from Penzance. This, together with documentation from the last century, shows that virtually all the lowland area between Marazion and Wherry Town was covered with peat beds at some point in the Holocene period. The following discussion of the palaeoecology of the Chyandour peat bed is based on a large monolith cut from one of the temporary faces of the peat excavation by the construction company.

METHODS

1) Coring

This study is taken from borehole group A in the series by James (1990). The sample was from a peat face exposed during construction of the Penzance bypass at Ponsandane Field in 1988/9; it was obtained using a drainpipe, due to short notice and rescue conditions.

2) Sampling

The core was initially sampled at 15 cm intervals. Six additional samples were taken several weeks later to clarify changes taking place in the highest and lowest 20 cm, especially in the transition from gravel to only occasionally sandy peat. A sample added at 131 cm showed sufficient differences from its neighbours to pose more questions than it answered; it was inserted to fill in the sharp drop in *Alnus* and *Filicales* shown on the count sheets for samples 125 and 140 (this was less significant when the percentages were worked out).

3) Preparation

Samples were boiled in 5% potassium hydroxide and 150 ml water for 15 minutes. Mineral material was separated by pouring the sample into a large clock glass and swirling gently until the sediment settled. After centrifuges in absolute alcohol and in TBA, the samples were left to evaporate overnight and mounted in silicon oil.

4) Counts and identification

Approximately 200 pollen grains and spores were counted per sample. These were identified using a Nikon microscope, mostly at x400 and at x1200 phase contrast. Identifications were made using the reference collection at the Sheffield University Environmental Archaeology Laboratory. *Corylus* and *Myrica* were amalgamated as Coryloid.

RESULTS

As the section from which this pollen series was obtained was only exposed for a matter of hours (in poor lighting conditions), macrobotanical information could not be gained from the stratigraphy. The core was X-rayed, however, and this information is shown in place of the (probably more useful) usual conventions.

The upper 12 cm of peat was pale brown: peat beneath this was nearly black. Some sand occurred throughout the core, mostly in the bottom 125 cm. Sub-rounded gravels were present in the bottom 20 cm.

ZONATION (Figures 3, 4 and 5)

CP1

Alnus-Quercus

The lowest LPAZ shows an arboreal pollen component of up to 85% of total pollen and spore count; herbs make up only about 12%. *Alnus* is 74% of total count, with *Quercus* and *Betula* present in low frequencies. *Hedera* is present in all three samples at up to 3.2%. Gramineae and Cyperaceae are at a minimum. The only herbs in this zone are Umbelliferae and *Plantago media/ major. Pteridium* is rare. The zone corresponds to the 20 cm of gravel at the bottom of the column.

CP2

Alnus-Coryloid-Salix

Arboreal pollen declines throughout this zone. Gramineae and *Pteridium* rise to 13 and 25% respectively in the beginning of the zone. *Salix* reaches its highest frequencies. *Hedera* is present intermittently; single grains of *Pinus*, *Fagus* and *Lonicera* were noted. Herb frequencies increase with diversity of species including *Plantago lanceolata* and *Rumex* species.

CP3

Cyperaceae-Gramineae

Alnus produces low counts in this zone, and *Quercus* and *Betula* is intermittent. *Salix* is consistently present but in lower counts than in CP2. Cyperaceae counts increase, dominating the uppermost sample by 64.7% of total pollen/spore count. *Typha* and *Scheuchzeria* appear and *Plantago lanceolata* increases. Total herb pollen continues to increase at the expense of trees and, towards the end of the zone, of Coryloid pollen. Sand in the peat becomes very infrequent in this part of the core.

CP4

Alnus-Cyperaceae-Gramineae

A change in peat colour to paler brown corresponds to increased *Quercus* and *Alnus* pollen. *Polypodium* re-emerges after an intermittent presence in CP3. Herb species diversity remains high,

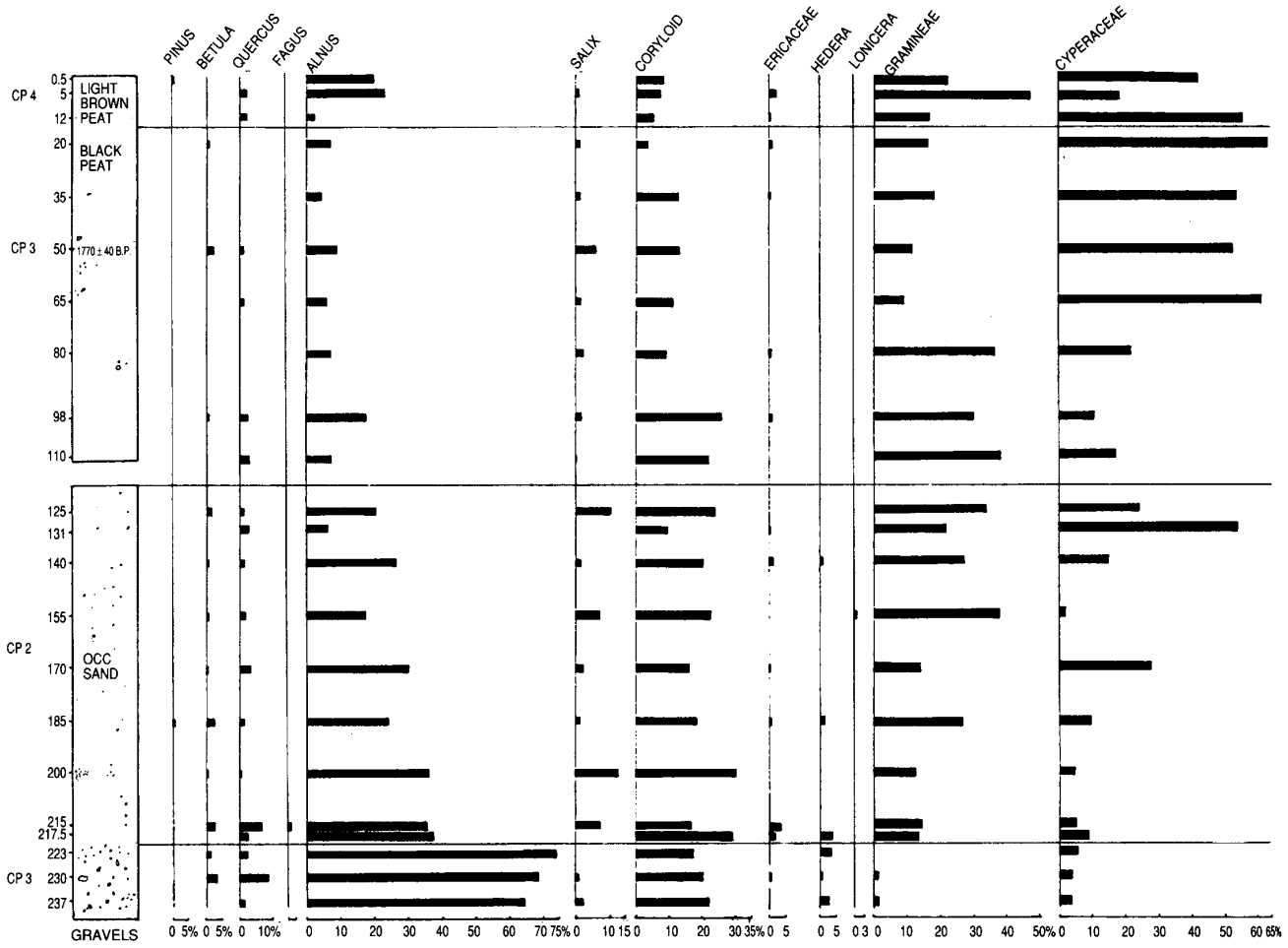

Figure 4: Chyandour peat percentage arboreal! pollen diagram

with Tubuliflorae and Liguliflorae temporarily reaching over 5% of the total pollen and spore count. *Sphagnum* and Ericales both increase slightly, and *Typha* is still present.

INTERPRETATION

Zone CP1 can be interpreted as representing an alder carr which grew in and around the poorly draining Ponsandane Brook. The gravel indicates that the stream was still flowing, at least seasonally. The extremely low herb count seems to indicate little open land in the area. However, there is no evidence to suggest that any of the arboreal pollen from this zone is not of local origin. The catchment of Ponsandane Stream is such that upland tree pollen should be taphonomically favoured; its underrepresentation suggests that the region was largely cleared of its trees by the local zone CP2. The contradiction may stem from the filtration effects of the dense alder carr which would reduce the amount of herb pollen reaching the site.

In CP2 the expanding *Pteridium* suggests an increasing dryness. The single grain of *Fagus* occurs in sample 215 in this zone; this is another species which prefers a well-drained soil. Coryloid pollen increases, probably because of a rise in *Corylus,* which also prefers a dry soil. Arboreal pollen counts decrease and the sudden abundance of herbs shows an opening-up of the environment. This coincides with the slight sandiness of the peat which occurs from depths of c.215 to 118 cm. This sand may have been brought in as a result of the increased erosion which occurs when vegetation is cleared.

In CP3 the ponding of Ponsandane Brook is notable; *Typha* and *Scheuchzeria* species appear and sedges increase dramatically. *Quercus* and *Betula* become intermittent as the environment becomes wetter and more open.

In zone CP4 the trees are returning, but open ground in the area does not appear to be diminishing greatly and herb species remain diverse.

The presence of *Typha* shows that there is standing water about, and the slight increase in both *Sphagnum* and Ericales suggests that raised bog may be developing somewhere in the region.

DISCUSSION

Godwin (1956) states that under coastal stability there is a tendency for the alder carr which develops during a marine transgression to be succeeded by raised bog. This is clearly not happening at Chyandour, although low Ericales and *Sphagnum* occur intermittently throughout the column. Although *Alnus* declines through CP2 and 3, there is no indication that this is due ti) rising acidity.

The drop in arboreal pollen in zone CP2 seems likely to be the result of human interference. The forest was not drowned, raised bog did not envelop it, and the drier environment of CP2 did not further its development into a mature fen wood. No great lenses of sand have occurred, so the trees are unlikely to have succumbed to encroaching dunes. Likewise there is no charcoal to indicate an episode of burning, as at Prah Sands (French, 1983).

The herb species which occur at Chyandour are largely those of open and disturbed ground. Pastoral and arable indicators coincide, although ruderals appear to be in the minority. The Chenopodiaceae are interpreted as belonging to the open and/or ruderal category rather than as salt marsh indicators, mainly because the frequencies fall in line with other such herbs. There are no great frequencies of Chenopodiaceae which might suggest salt marsh formation, nor have large numbers of other salt marsh species been noted. The *Artemisia* and the lone *Plantago maritima* may represent such a habitat, but again, it is not a local facies. It is clear that the Chyandour peat bed was formed under freshwater conditions.

The pooling of Ponsandane Stream could have occurred behind any coastal barrier, but the fossil dunes to seaward were probably responsible. The absence of obligate dune species can be explained by the fact that many are palynologically identifiable only to family (e.g. Gramineae) or genus.

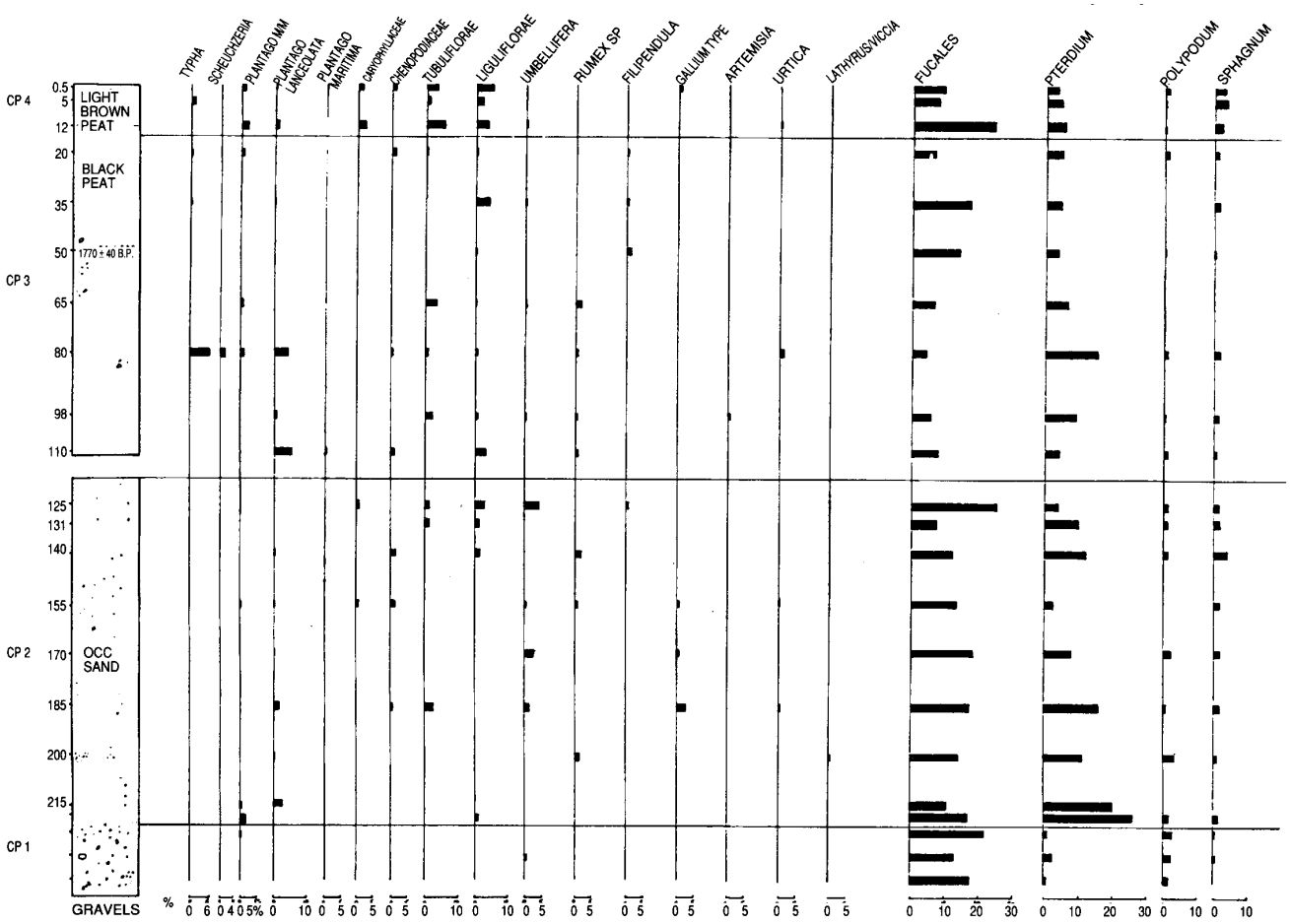

Figure 5: Chyandour peat percentage non arboreal pollen diagram

The most frequent early colonizer of south coast dunes is *Ammophilia arenaria,* and the most frequent fixed dune species is *Festuca arenaria;* both live only on sand dunes (Hepburn, 1944); neither can be specifically detected. Further, many species regularly found on sand dunes are just as frequent in other habitats. *Plantago lanceolata* is one such species, growing as a later dune colonizer and on fixed dunes (Hepburn, 1944). Some Caryophyllaceae live on dunes or coastal sand, as well as some Compositae and Umbelliferae. In summary, failure to show a presence of obligate dune species means we must leave open the possibility of the Chyandour peat bed having been formed behind some other coastal barrier.

It is interesting that no *Ulmus* pollen was found, as it appears at Prah Sands (radiocarbon dated at *c.* 480 years earlier). *Ulmus* pollen is highly resistant and morphologically distinctive, so its absence or infrequency must be a real reflection of local and regional environment.

The coastal peats at Chyandour, St. Helier, Southampton, the Somerset Levels, and others all produce pollen zones representing alder carr. The increase in Alder is normally attributed to pollen zone VII in which the climate became wetter. A rise in *Ulmus* and *Tilia* is also characteristic of this zone. Because alder carr is a natural stage in the freshwater hydrospere, its occurence on coastal sites cannot be safely correlated, or used to interpret, regional climate or vegetation. In earlier periods of rapid sea level rise, local correlation is easier; Godwin (1940) shows the similarity in both the botanical content and the level of samples formed during zone VIb in Swansea Bay, and had similar success with zone VIc. The slower rate of marine transgression in zones VIIke this kind of exercise far more complicated, and assessment of compaction, tidal range, isostasy etc. have also to be made.

Regional pollen assemblage zones can be defined where a series of LPAZs from different sites show correlations in the general forest composition. Unfortunately, the lack of comparative sites and the paucity of arboreal pollen through most of the column make it impossible to delineate such zones at Chyandour. The Chyandour peat is dated at a level of 2 m. OD to 1770 ± 40 B>P.

This places LPAZ CP 3 in pollen zone VIII, which spans the last 2000 years at least. The absence of such crucial indicators as *Ulmus* and *Tilia* make it impossible to say anything further about the Godwin pollen zonation scheme.

FUTURE STUDIES

The buried river channels beneath Mount's Bay provide a succession of sediments spanning most of the Holocene. These channels need to be mapped and both the sediment and the pollen content should be analysed. This analysis would enable palynologists to tie sites such as Chyandour and Prah Sands into a local pollen zonation scheme. Such a suld be the first of its kind in the coastal lowlands of Cornwall.

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