Stonesfield

[SP 392 172], [SP 387 168], [SP 379 172], [SP 387 171]

Introduction

Stonesfield is one of the classic sites for British Jurassic palaeobotany and has been studied for nearly two hundred years. It has yielded the types of nine species and is the type locality for the important form-genera *Taeniopteris* and *Conites. It* is the only known British locality for the distinctive Mesozoic foliage genus *Pelourdea,* and has also yielded what might be the earliest known example of an angiosperm leaf The Stonesfield flora is quite different from the better-known Yorkshire Jurassic flora and appears to have been derived from a quite distinct type of vegetation.

The 'Stonesfield Slate' of Oxfordshire, which was quarried for roofing stone up until 1911, mainly in underground workings (Figure 4.5), has yielded one of the most intensively studied Jurassic floras in Britain. Much of the initial collecting here was by William Buckland, who, in the early 19th century, regularly visited Stonesfield. He went there in the spring to see what had been revealed in the worked stone of the previous year, after weathering the winter's frosts. He was mainly interested in the vertebrate fossils, but also collected the plants and brought them to the notice of contemporary palaeobotanists, especially von Sternberg, Brongniart, and Lindley and Hutton. These authors figured several specimens from here, including a range of conifer twigs and seeds, and cycadophyte foliage (von Sternberg, 1823, 1825, 1833, 1838; Brongniart, 1823, 1828a,b, 1831, 1833, 1849; Lindley and Hutton, 1835, 1837). Kva'eek and Strakova (1997) have recently reviewed the material figured by von Sternberg.

The first attempt at a comprehensive review of the flora was by Phillips (1855, 1871), who created several new species. However, his descriptions and illustrations were poor, even for that time, and his new taxa are almost impossible to use without reference to the original specimens (in the Oxford Museum). Other 19th century contributions were by Morris (1841, 1854), Horton (1860) and Carruthers (1867a, 1869, 1870a). However, the landmark study was by Seward (1904), whose monograph of the British Mesozoic plant fossils (excluding those from Yorkshire) in the collections of the British Museum (Natural History) documented all the known specimens from Stonesfield.

The tilestones at Stonesfield have not been worked since the 19th century and so it has been impossible to obtain any further material since the publication of Seward's (1904) monograph. As a result, little work on the flora has been done subsequently. Edwards (1928) and Elliott (1979) redescribed a specimen originally documented by Carruthers (1867a), showing it to be a dasyclad alga, and there have been contributions on the conifers by Kendall (1949), Florin (1958) and Barnard (1968). Kendall's work is of especial interest as she managed to obtain some cuticles. Hill (1986, fig. 9.3) illustrated stomata in conifer foliage from Stonesfield (see also Shute and Cleal, 1987, fig. 3), further demonstrating the potential for anatomical studies there. A brief review of the flora was given by Cleal and Rees (1998), who are currently undertaking a comprehensive review of the flora, including the first photographic documentation of the specimens.

Description

Stratigraphy

The 'Stonesfield Slate' comprises tilestones that vary from calcareous sandstone to siltstone with impersistent oolitic laminae. They have a characteristic fine, horizontal lamination that allowed the splitting of the 'slates'. The association of marine and non-marine animal fossils and terrestrial plant fossils suggests that the sediments accumulated in shallow marine conditions in a narrow gulf that extended north-east from the main basin in the south (Sellwood *et al.*, 1986).

Poor exposure has hindered the geological study of these deposits. However, understanding of it improved dramatically after a series of boreholes was drilled during the early 1990s (Boneham and Wyatt, 1993). It had been thought that the 'Stonesfield Slate' was a discrete member of the Sharp's Hill Formation (Great Oolite Group) but the boreholes showed that it is in fact a facies occurring at different levels within the lower Great Oolite (Figure 4.6). The mined tilestones from

which plant fossils have been recovered occur at three levels within the Taynton Limestone Formation. They have yielded ammonites of the *Procerites progracilis* Zone, hence placing them in the lower part of the Middle Bathonian Stage (Torrens in Cope *et al.,* 1980a).

Palaeobotany

At Stonesfield, 23 species of fossil plants have been found (based on the revision in progress by Cleal and Rees). These are listed in (Table 4.1). They include the remains of ferns, caytonialeans, cycadophytes (including both bennettites and cycads), ginkgos, conifers and a number of as yet unassigned forms (e.g. *Komlopteris* and *Pelourdea*). There is also the specimen of a leaf, referred to by Seward (1904) as *Phyllites,* that looks remarkably like an angiosperm leaf; as noted above. The conifer *Brachyphyllum expansum is* the commonest element in the flora, followed by the bennettite fronds *Ptilophyllum pectiniformes* with their slender pinnules, and the leaves of unknown affinity that are identified as *Pelourdea macrophylla.*

Stonesfield is the type locality for nine species: *Ptilophyllum pectiniformes, Sphenozamites? bellii, Taeniopteris vittata, Conites bucklandii, Brachyphyllum expansum, Araucarites brodei, Pelourdea megaphylla, Pachypteris macrophylla* and *Carpolithes diospyriformis.* It is also the type locality for two form-genera. One of these, *Taeniopteris,* is a widely used name for entire, cycadophyte leaves that cannot be assigned to either bennettites or cycads. The other, *Conites,* is an earlier synonym of *Bucklandia* Presl in Sternberg, which is a widely used name for bennettite stems.

The fossils are preserved as impressions (*sensu* Shute and Cleal, 1987), sometimes picked out by iron staining or other mineralization. Cuticles have so far been found only in some conifer foliage (Kendall, 1949). One conifer shoot has also yielded evidence of epidermal structure impressed on secondary mineralization (e.g. Hill 1986).

Interpretation

Stonesfield has yielded by far the most diverse and best-preserved fossil flora from the 'Stonesfield Slate'-like facies in southern England. The only other comparable flora has been found in the stratigraphically older Charlbury Formation at Huntsman's Quarry in Gloucestershire. A comparative analysis between these two floras is given in the account of the latter site (see also (Table 4.1)).

(Table 4.1) Fossil floras found in the Middle Jurassic strata of southern England.

	Stonesfield		Huntsman's Quarry
Cf. *Dictyophyllum* sp.	×		
Phlebopteris woodwardii Leckenby	×		
Cf. Coniopteris sp.	×		×
Sagenopteris colpodes Harris	×		×
Ctenis cf. *sulcicaulis* (Phillips) Ward	×		
Ctenis sp.	×		
Ptilophyllum pectiniformes (Sternberg) Rees and Cleal	×		
Ptilophyllum cf. hirsutumThomas and Bancroft	×		
Sbhenozamites? bellii Seward	×		×
?Weltrichia sp.	×		
Cf. *Ctenozamites leckenbyi* (Leckenby) Nathorst	×		
Taeniopteris vittata Brongniart		×	×
Conites bucklandii Sternberg	×		

Ginkgo of *longifolius* (Phillips) Harris	×	
G. digitata (Brongniart) Heer		×
Brachyphyllum expansum (Sternberg) Seward	×	×
Elatocladus cf. *laxus* (Phillips) Harris	×	
Podozamites stonesfieldensis Seward		×
Masculostrobus sp.	×	
Araucarites brodei Carruthers	×	×
Pelourdea megaphylla (Phillips) Seward	×	×
Pachypteris macrophylla (Brongniart) Cleal and Rees	×	
Komlopteris speciosa (Ettingshausen) Cleal and Rees	×	×
Carpolithes diospyriformis Sternberg	×	×
C. conicus Lindley and Hutton		×
C. spp.	×	

Brongniart (1828a) suggested that the Stonesfield flora was broadly similar to that found in the Yorkshire Jurassic strata, and this view has become well established. At first sight it seems significantly impoverished, compared with the more than 200 species in Yorkshire. This is mainly because of the difficulty that there has always been in collecting material from Stonesfield, and the fact that it occurs in relatively coarse-grained, marine deposits; the latter factor probably explains the paucity of ferns. There are nevertheless some notable absentees that are not so easily dismissed, such as the horsetails, which are the most abundant recognizable fossils in large parts of the Yorkshire Jurassic succession (Harris, 1961a). Ginkgoalean foliage is also common in Yorkshire (Harris *et al.,* 1974), but is represented at Stonesfield by just one poor specimen.

More important are the taxa found at Stonesfield but not in Yorkshire. Especially significant is *Pelourdea,* which is one of the most common foliage fossils at Stonesfield. The (relatively) common seeds called *Carpolithes diospyriformis* also have no equivalent in Yorkshire and *Komlopteris is* so far unreported from there, although it is very similar to such species as *Pachypteris papillosa,* which are common. The apparent absence of *Sphenozamites* from Yorkshire may have to be reconsidered in the light of its resemblance to *Otozamites.*

One of the reasons for the differences in comparison between the Stonesfield and Yorkshire floras may be the environmental setting. The latter represents mainly swamp elements in a fluvio-deltaic setting whereas the Stonesfield flora was probably derived from mangrove-like vegetation (mainly *Ptilophyllum*-bearing bennettitaleans) growing along coastal fringes, behind which were periodically drowned lowlands covered mainly by cheirolepidiacean forests. The preferred habitat of the third most common component of the Stonesfield flora, *Pelourdea,* is unknown but probably represents plants that grew either in these lowlands with the conifers, or in drier, marginal habitats.

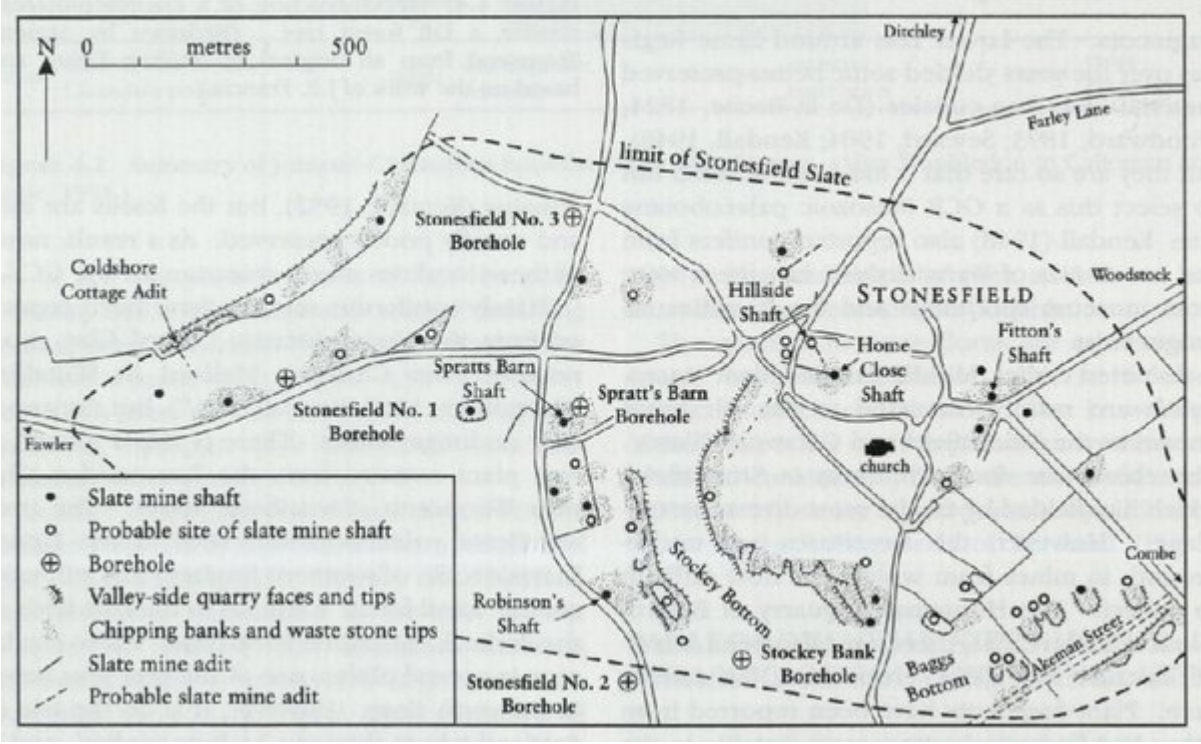
The Early Jurassic flora of the Venetian Alps of Italy (de Zigno, 1856–1885; Grandori, 1913; Wesley, 1956, 1958) bears some resemblance to that from Stonesfield. As for the Yorkshire assemblage, it is much more diverse, which makes direct comparison difficult, but *Pelourdea* is known from it, and *Sphenozamites* is one of the commonest bennettite frond-types. De Zigno also recorded (but did not illustrate) specimens of *Pachypteris macrophylla.* What makes the comparison interesting is that, like that at Stonesfield, the Venetian flora is preserved in marine (or possibly lagoonal) deposits and therefore represents comparable vegetation.

Also similar are French floras found in marine Oxfordian–Kimmeridgian deposits, as reviewed by Barale (1981). There is no evidence of *Pelourdea* or any comparable foliage, but cheirolepidiacean remains are common. Some of the foliage appears to be indistinguishable from *Brachyphyllum expansum,* although the associated cones (*Masculostrobus dorchensis* Barale) are more elongate than those at Stonesfield. No *Ptilophyllum* has been reported, but some of the *Zamites* present (e.g. *Z. feneonis* (Pomel) Ettingshausen, *Z. pumilo* Saporta) have very slender leaflets and may conceivably have occupied a similar ecological niche. *Pachypteris desmomera* from near Lyons is very similar to (and possibly conspecific with) the Stonesfield species *P macrophylla.* According to Barale, the French floras represent vegetation from temporarily emergent, coastal habitats and may include mainly halophytic plants.

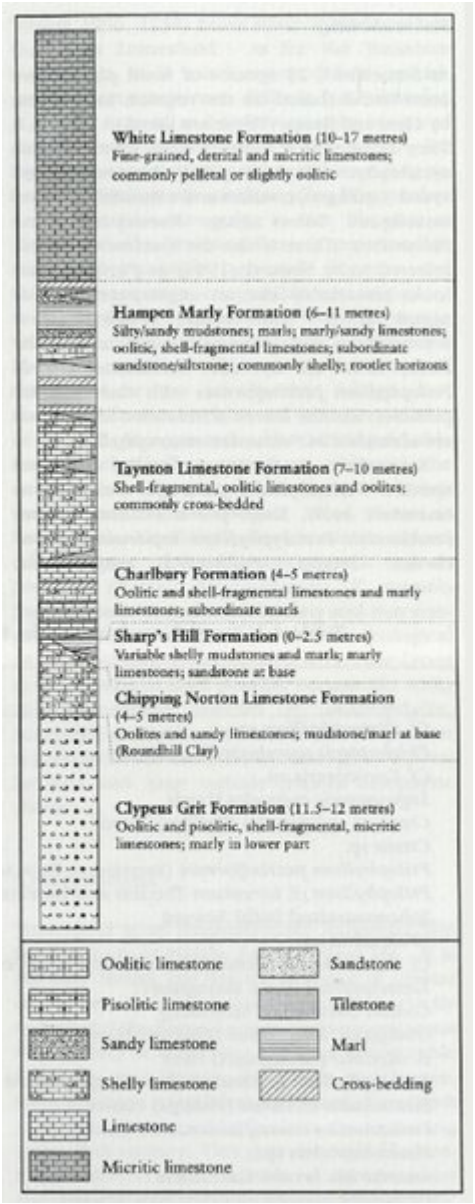
Conclusions

Stonesfield is an internationally important site for the study of Middle Jurassic plant life. It is the best British site for the remains of coastal vegetation. Its composition contrasts markedly with that of the better-known, contemporaneous swamp flora of Yorkshire. Although comparable floras are now known from Italy and France, there has been a much longer history of research at Stonesfield, extending back to the beginning of the 19th century. This gives Stonesfield a central position in any discussion on the taxonomy and nomenclature of these types of plant fossils. The flora mainly represents a mixture of mangrove vegetation dominated by bennettites, and lowland forests dominated by conifers, which grew along the southern coast of Britain some 170 Ma ago.

References



(Figure 4.5) Map of the area around Stonesfield village, showing the principle working for the Stonesfield 'Slate'. (After Boneham and Wyatt, 1993.)



(Figure 4.6) Generalized sequence through the Great Oolite Group of the Stonesfield area, showing the different levels at which the Stonesfield 'Slate' facies is developed (After Boneham and Wyatt, 1993.)

	Stonesfield		Huntsman's Quarry
Cf. *Dictyophyllum* sp.	×		
Phlebopteris woodwardii Leckenby	×		
Cf. Coniopteris sp.	×		×
Sagenopteris colpodes Harris	×		×
Ctenis cf. *sulcicaulis* (Phillips) Ward	×		
Ctenis sp.	×		
Ptilophyllum pectiniformes (Sternberg) Rees and Cleal	×		
Ptilophyllum cf. *hirsutum* Thomas and Bancroft	×		
Sphenozamites? bellii Seward	×		×
?Weltrichia sp.	×		
Cf. *Ctenozamites leckenbyi* (Leckenby) Nathorst	×		
Taeniopteris vittata Brongniart		×	×
Conites bucklandii Sternberg	×		
Ginkgo aff. *longifolius* (Phillips) Harris	×		
G. digitata (Brongniart) Heer			×
Brachyphyllum expansum (Sternberg) Seward	×		×
Elatocladus cf. *laxus* (Phillips) Harris	×		
Podozamites stonesfieldensis Seward			×
Masculostrobus sp.	×		
Araucarites brodei Carruthers	×		×
Pelourdea megaphylla (Phillips) Seward	×		×
Pachypteris macrophylla (Brongniart) Cleal and Rees	×		
Komlopteris speciosa (Ettingshausen) Cleal and Rees	×		×
Carpolithes diospyriformis Sternberg	×		×
C. conicus Lindley and Hutton			×
C. spp.	×		

(Table 4.1) Fossil floras found in the Middle Jurassic strata of southern England.