Whitby–Saltwick

[NZ 901 115]–[NZ 916 109]

Introduction

The cliffs south of Whitby have been the focus of palaeobotanical research for many years, and have yielded some of the best-preserved fossils of the Yorkshire Jurassic strata. Many of the best museum specimens of Middle Jurassic plant fossils originated from these cliffs. The specimens came from a lens within the channel-fill sandstone of the Saltwick Formation. Of the numerous species recorded, particularly noteworthy are the spectacular examples of bennettitalean reproductive organs such as those of *Williamsonia* and *Weltrichia.*

The earliest illustrated records are those of Young and Bird (1822, 1828). The specimens listed by Brongniart (1828a) as coming from Whitby almost certainly originated here, and Phillips (1829, 1835, 1875), Lindley and Hutton (1837), Yates (1855), Carruthers (1870a), Nathorst (1880) and Seward (1897a) described and figured plant fossils from this succession. Seward (1900a) reviewed the 19th century palaeobotany of the Whitby Plant Beds. According to Harris (1961a), the only Yorkshire Jurassic plant fossil Seward ever collected came from here! Many of the specimens used by Nathorst (1909, 1911) in his revision of the structure of bennettitalean flowers were from these beds, as were the ginkgoalen foliage described by Thomas (1913) and the equisetalean stems described by Erdtman (1921). More recently, the Whitby plant fossils were included in Harris' revision of all Yorkshire Jurassic floras (Harris 1941a, 1945b, 1946a–c, 1948, 1949a, 1951, 1952a, 1953), which culminated in his five monographs (1961a, 1964, 1969, 1979a; Harris *et al.,* 1974). Kendall (1948, 1952), one of Harris' students, also published on a number of conifers from Whitby, and specimens from there have been used to study the in-situ spores recovered from fern sporangia (van Konijnenburg-van Cittert, 1978).

Description

Stratigraphy

The stratigraphy of the Middle Jurassic strata near Whitby has been summarized by Rawson and Wright (1992, 1995), although neither provides a detailed stratigraphical section. A schematic view of the cliffs is shown in (Figure 3.13). The main exposure consists of fine-grained sandstones of the Saltwick Formation, which cut down into mudstones of the Dogger Formation. In his unpublished notebooks, Harris identified ten places at this site from which he collected plant fossils see (Table 3.2). The classic Whitby Plant Bed, which has yielded most of the museum-quality material, is towards the base of the Saltwick Formation and is seen best at Long Bight. Higher in the section there is also a bed rich in bennettitalean remains; this is known as the *Zamites* Bed at Jump Down Bight.

(Table 3.2) Location of in-situ plant beds identified by TM. Harris (in manuscript) along the cliffs between Whitby and Saltwick.

			[GR added 2023]
Whitby Haggerlyth	54° 29' 25"	0° 38' 28"	[NZ 88122 11398]
Whitby Jumpdown Bight	54° 29' 18"	0° 35' 30"	[NZ 91329 11245]
Whitby Long Bight Plant Bed	54° 29' 19"	0° 36' 0"	[NZ 90789 11265]
Whitby Long Bight fallen blocks			
Whitby Rail Hole Bight			
Whitby Spittal Beck just below G.L.	54° 28' 32"	0° 35' 50"	[NZ 90998 09816]
Saltwick *Equisetum* and *Coniopteris* Beds	54° 29' 0"	0° 35' 6"	[NZ 91772 10697]

Saltwick *Matonidium* Bed	54° 28' 59"	0° 34' 52"	[NZ 92025 10671]
Saltwick Waterfall Bed	54° 28' 59"	0° 34' 52"	[NZ 92025 10671]
Saltwick *E. laterale* Bed above Waterfall Bed	54° 29' 11"	0° 35' 52"	[NZ 90938 11021]

Palaeobotany

Over 90 species have been reported from Whitby (Table 3.1), (Figure 3.14). The numerous records of species from West Cliff High Whitby or near the Fog Signal are not listed here because these parts of the coast are not within the GCR site. Sometimes, however, locality details are not precise enough to be certain whether the specimens were collected from within the site. In these cases the species records have been included.

The site is particularly rich in ferns, bennettites and conifers (16, 24 and 18 recorded species, respectively). There is also an abundance of equisetalean remains, especially of the stems *Neocalamites nathorstii.* In contrast, there are relatively few species of cycads and pteridosperms and only one of *Caytonia.*

Nineteen species were based on type specimens from here, mainly from the Long Bight exposure or from loose blocks on the beach. These are *Annulariopsis simpsonii, Neocalamites nathorstii, Nilssonia thomasii, Pseudoctenis herriesii, Stenopteris nana, Cycadolepis hypene, C. thysanota, Otozamites anglica, O. gramineus, O. simpsonii, Weltrichia setosa, W. sol, W. spectabilis, W. whitbiensis, Williamsoniella papillosa, Eremetophyllum whitbiensis, Ginkgo whitbiensis, Czeckanoswkia furcula* and *Inxostrobus whitbiensis.*

Interpretation

The fact that so many type specimens are from this section of coast is partly because the plant assemblage is especially diverse and partly because collecting has been undertaken here from the earliest days of palaeobotanical study. Only one other Yorkshire Jurassic site included in the GCR has more species, namely the Gristhorpe Bed at Red Cliff.

Although much of the material that has been found originated from fallen blocks, it has been possible to use evidence of association to relate separate organs to the same parent plant. The linking of two groups of bennetitalean organs in this material has been particularly important. The classic example was based on the materials in the *Zamites* Bed at Whitby, where the fronds *Zamites gigas* are closely associated with the female flower *Williamsonia gigas* and the male flower *Weltrichia sol.* It was recognized from an early date that they almost certainly belonged to the same plant (Young and Bird, 1822; Yates, 1855; Carruthers, 1870b; Seward, 1897a; Nathorst, 1909, 1911). Another well-documented example in the main Whitby Plant Bed is the association noted by Nathorst (1909) of the fronds *Ptilophyllum pectinoides* (Nathorst identified them in error as *P. pecten* — see Harris, 1969) and the female flowers *Williamsonia hildae.* Harris (1969) also linked to the same plant the male cone *Weltrichia whitbiensis* and the scale leaves *Cycadolepis hypene* on the combined evidence of association and similarity of cuticles. Cridland (1957) and Harris (1969) reported the close association of the pollen-producing *Williamsoniella papillosa* (here in its type locality), a hairy scale leaf identified as *Cycadolepis* sp., and the leaf *Nilssoniopteris major,* all of which are now regarded as having belonged to the same plant. Other proposed connections are between the frond *Otozamites beanii* and the male flower *Weltrichia setosa;* and between the frond *O. gramineus,* the male flower W. *spectabilis* and the scale leaves *Cycadolepis spbeniscus* (Harris, 1969). Hence Whitby has played a central role in the development of the taxonomic concept of the Bennettitales, which is one of the most important groups of Mesozoic plants throughout the world. It is anticipated that further examination of associated organs in the fallen blocks will yield additional evidence of botanical affinities.

Whitby is the only known locality for unequivocal specimens of another type of bennettitalean male flower, *Weltrichia setosa.* Harris (1969) reported a fragment from Cloughton Wyke that could belong to this species but it is too poorly preserved to be sure.

The plant beds have also proved important for the study of fossil conifers (Harris, 1979a). The taxodiacean *Elatides thomasii,* which is a characteristic species of the lower Saltwick Formation, is particularly abundant here and often has attached male and female cones. In addition, there are abundant examples of (?)taxodiacean foliage *Elatocladus*

ramosus and *Torreya gracilis,* this being the only known locality for the latter. The Taxaceae conifers are represented by *Marskea jurassica* with several attached female cones and one male cone, and *Poteridion ballei,* for which this is the only known locality. A third family of conifers, the Podozamitaceae, is also abundant here as the foliage species *Lindleycladus lanceolatus.*

The Czekanowskiales are not particularly common or diverse at Whitby, although there are some fragments of foliage that have yielded well-preserved cuticles (*Czekanoskia furcula* — see Harris, 1974a). More significantly, this is the only known locality for *Ixostrobus whitbiensis,* which Harris *et al.* regarded as a czekanow-skialean male reproductive organ.

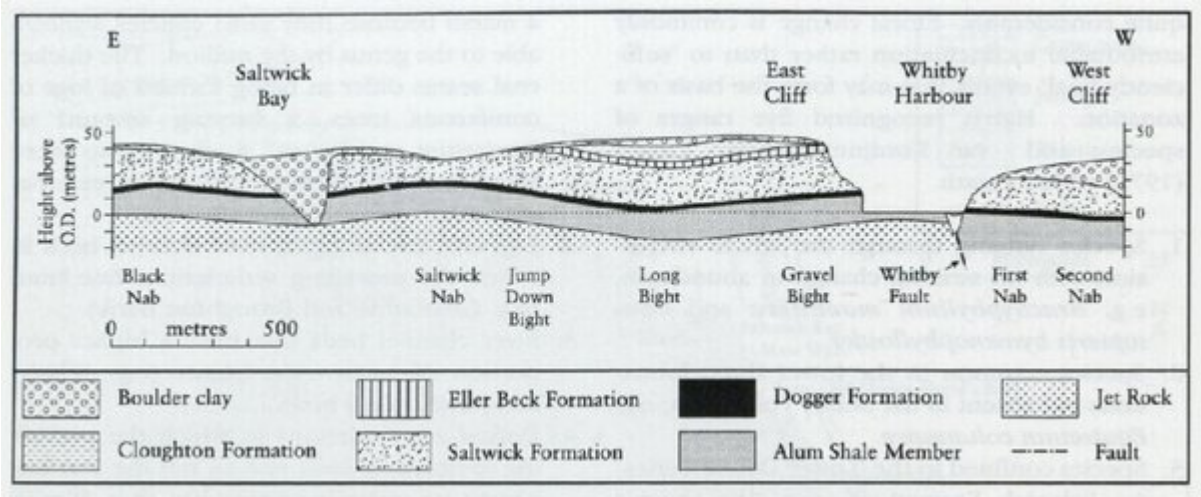
The ferns, although represented by a diversity of species, are not especially abundant here. The most complete record is in Harris (1961a). The most notable occurrence is a bed rich in well-preserved matoniacean fronds, *Matonidium goeppertii* at Saltwick. Van Konijnenburg-van Cittert (1978) used specimens of *Todites denticulatus* from Whitby in her study of in-situ osmundaceous fern spores.

It might be thought that this well-studied assemblage would yield some valuable information about the ecology of the early Middle Jurassic Epoch. Using the published records alone presents serious difficulties in developing such a study, as so much of the material came from fallen blocks that cannot always be accurately placed within the local lithostratigraphy. Nevertheless, there is considerable scope here for such work through additional fieldwork.

Conclusions

The cliff section between Whitby and Saltwick is one of the classic localities for the Yorkshire Jurassic flora, with a long history of investigation stretching over nearly two centuries, and providing a unique insight into the vegetation growing in Britain 170 Ma ago. It has yielded over 90 plant species, two of which are unique to the locality, and it is the type locality for 19 species. The coastal section has provided particularly important information about the structure of bennettitalean reproductive organs and yields numerous examples of conifer shoots with cones still attached. It is an outstanding site for its superlative plant remains and, particularly, their bearing on bennettitalean history. It is a valuable locality that will no doubt yield many more exciting discoveries.

References



(Figure 3.13) Schematic view of the cliffs between Whitby and Saltwick, showing the main stratigraphical units exposed. (Redrawn from Rawson and Wright, 1992.)

Whitby Haggerlyth	54° 29' 25", 0° 38' 28"
Whitby Jumpdown Bight	54° 29' 18", 0° 35' 30"
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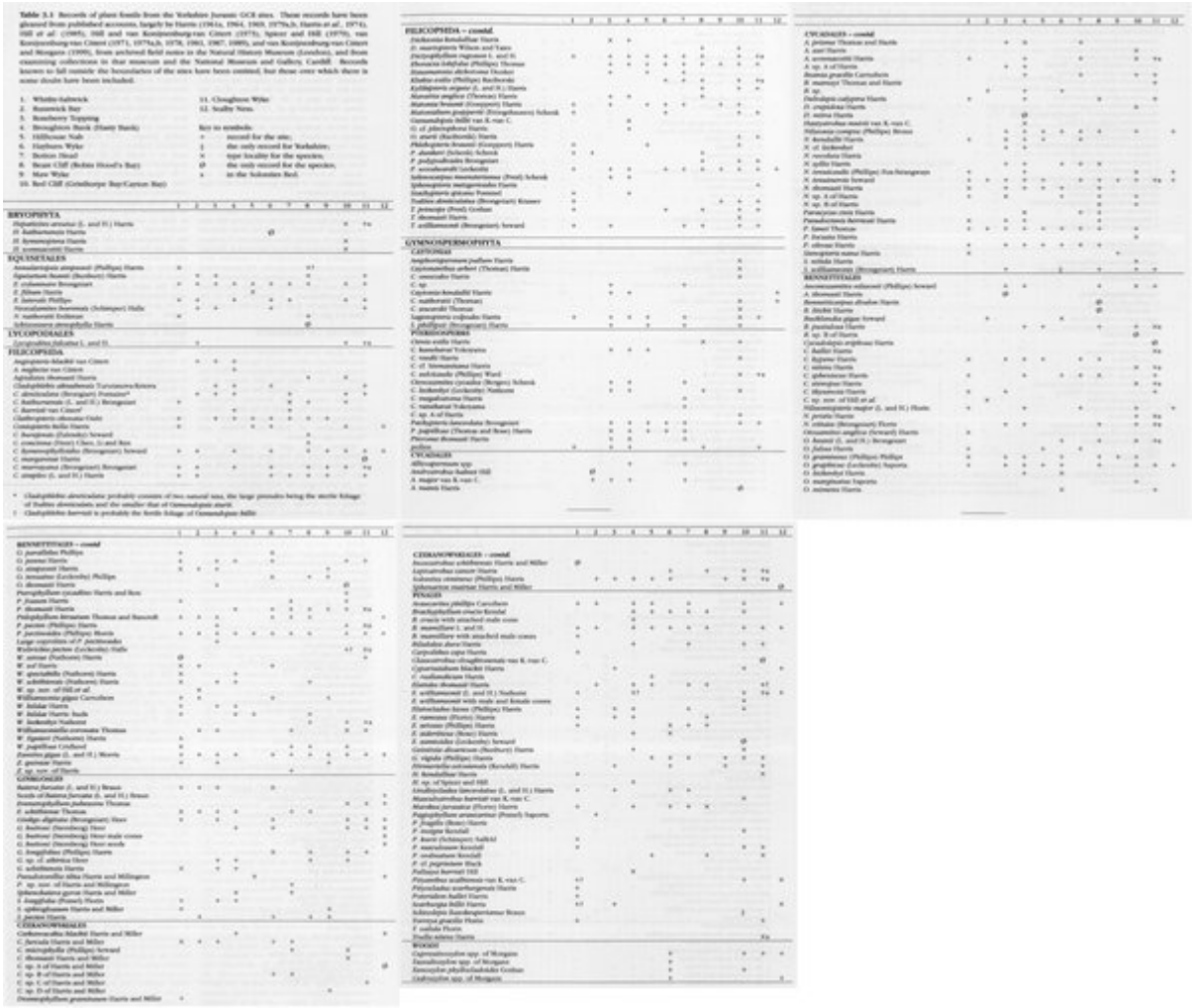

(Table 3.1) Records of plant fossils from the Yorkshire Jurassic GCR sites. These records have been gleaned from published accounts, largely by Harris (1961a, 1964, 1969, 1979a,b; Harris et al., 1974), Hill et al. (1985), Hill and van Konijnenburg-van Cittert (1973), Spicer and Hill (1979), van Konijnenburg-van Cittert (1971, 1975a,b, 1978, 1981, 1987, 1989), and van Konijnenburg-van Cittert and Morgans (1999), from archived field notes in the Natural History Museum (London), and from examining collections in that museum and the National Museum and Gallery Cardiff. Records known to fall outside the boundaries of the sites have been omitted, but those over which there is some doubt have been included.

(Figure 3.14) Solonites vimineus (Phillips) Harris. These very long unbranched leaves are typically 150–200 mm long and usually less than 1 mm wide. The leaves often appear in spreading out masses, as shown here, and occasionally are found in bundles of 10–15 attached to small shoots that are covered in scales. Laboratory of Palaeobotany and Palynology, Utrecht, specimen S.14865, Saltwick Formation, south of Whitby, × 0.8. (Photo: J.H. A. van Konijnenburg-van Cittert.)