
Turin Hill

Highlights

Turin Hill is the best site for plant fossils from the Lower Devonian Arbutnott Group flora, the most typical *Zosterophyllum* Zone flora in Britain, and one of the best examples of its type in the world (Figure 4.10). It has yielded abundant specimens of *Parka* and fertile *Zosterophyllum* and is the type locality for *Cooksonia caledonica* Edwards. It is of international significance for the study of the *Zosterophyllum*-dominated vegetation of the earliest Devonian.

Introduction

The famous Old Red Sandstone palaeontological sites on Turin Hill, which lie near Forfar, Tayside Region [NO 493 535], were extensively worked during the eighteenth and nineteenth centuries for Arbroath Paving Stones (Mackie, 1980). Two of these quarries are particularly well known plant fossil localities: Clocksbriggs Quarry (also known as Wemyss Quarry) and Aberlemno Quarry. Early records of the plant fossils concentrated mainly on the non-vascular species (Miller, 1855, 1857; Peach, 1877; Powrie *in* Warden, 1881; Kidston, 1886, 1893, 1897; Dawson and Penhallow, 1891; Reid, 1895; Reid *et al.*, 1898; see also Niklas, 1976a). Vascular plant fossils were also recorded in some early studies (Peach, 1877; Kidston, 1886; Reid and Macnair, 1899), but were not dealt with in detail until Lang's (1927a) account of *Zosterophyllum*, and subsequently by Lele and Walton (1962a), Walton (1964a) and Edwards (1970b, 1975). In addition to the flora, a diverse freshwater fish and arthropod fauna has been found here (Hickling, 1912; Westoll, 1951).

Description

Stratigraphy

The geology of these quarries is described by Armstrong *et al.* *in* Friend and Williams (1978). Exposed here are interbedded red fluvial sandstones and grey-green lacustrine siltstones belonging to the Dundee Formation of the Arbutnott Group (Campbell, 1913; Armstrong and Paterson, 1970; earlier called the Carmyllie Beds by Hickling, 1908). The plant fossils belong to the *Zosterophyllum* Zone of Banks (1980), indicating a Gedinnian or early Siegenian age for these strata. Palynological and fish evidence supports an early Gedinnian age (Edwards and Fanning, 1985, Table 1; Edwards, 1990).

Palaeobotany

The plant fossils are found mainly in the laminated, lacustrine siltstones. Commonest are impressions picked out by iron staining, but some coalified compressions and petrifications also occur. The following assemblage has been reported to date:

Phaeophycophyta(?):

Prototaxites forfarensis (Kidston) Pia

Chlorophycophyta(?):

Parka decipiens Fleming

Pachytheca sp.

Rhyniophytoids:

Cooksonia caledonica Edwards

Zosterophyllopsida:

Zosterophyllum myretonianum Penhallow

Interpretation

Although *Parka decipiens* (Figure 4.11) was first described from the Lower Devonian of Fife (Fleming, 1831), Turin Hill is probably the best known locality for this species and much of the early debate about its affinities was based on specimens from here (summarized by Dawson and Penhallow, 1891 and Don and Hickling, 1917). It has been variously argued to be of animal origin (Mantell, 1852; Lyell, 1865; Woodward, 1866–1878), to be the seeds of a rush or bur-reed (Fleming, 1831), or the fruiting body of some other enigmatic plant (Dawson and Penhallow, 1891; Reid *et al.*, 1898; Edwards, 1921). However, it is now believed to have been a thalloid plant attached to the substrate by a basal holdfast, and probably spending at least part of its life out of water (Niklas, 1976a, 1976c). Possible affinities with the green algae (Niklas (1976a) and the liverworts (Neuber, 1979) have been suggested. Most recently, Hemsley (1989, 1990a) has suggested that it might have been an evolutionary intermediary between the algae and the bryophytes.

Peach (1877) identified a specimen from here as *Cyclopteris* (photographically re-figured by Hoeg, 1942, pl. 46, figs 10 and 11). This form-genus is usually applied to the basal pinnules of certain Upper Carboniferous medullosan fronds, which is clearly out of the question here. More likely is that it is a specimen of *Parka* viewed from the lower surface (cf. Don and Hickling, 1917, pl. 54, fig. 9).

Niklas (1976a) described a poorly preserved specimen of *Pachytheca* from Turin Hill, and showed that it had a similar growth pattern to *Parka*. Niklas (1976b) also showed similarities in the chemical composition between the two, but pointed out, that the taxonomic significance of this similarity is uncertain.

A partially permineralized, branched axis, over one metre long, was described by Miller (1855, 1857) as part of a *Lepidodendron* stem. Most of the specimen is now believed to be lost, but Lang (1926) suggested that the holotype of *Cryptoxylon forfareense* Kidston was originally part of it. Kidston (1897) originally described the structure of the stem as being cellular, but Kidston and Lang (1924) later showed that it was pseudoparenchymatous and so transferred it to *Nematophyton* (syn. *Prototaxites*). Lang (1926) described a second species of *Prototaxites* from the Arbuthnott Group as *Nematophyton caledonianum*. To date, it has not been reported from Turin Hill but its presence might well be anticipated.

Slender branching axes occur commonly in the Arbuthnott Group (Figure 4.12), and were initially believed to be either part of an eel-grass type plant (Miller, 1857), or the vegetative part of a plant which bore *Parka* as its fruiting body (Dawson and Penhallow, 1891). Miller described rounded bodies attached laterally to some of these axes and argued that they might be leaves. Penhallow (1892) recognized them to be sporangia, however, and erected the name *Zosterophyllum myretonianum*. The Turin Hill specimens have not yielded such well-preserved cuticles as have been described from Myreton Quarry (Lele and Walton, 1962a), but they have included some exceptionally complete specimens which have allowed the gross morphology of the plant to be reconstructed (Lang, 1927a; Lele and Walton, 1962a; Walton, 1964a). Numerous fertile specimens have also been found here e.g. (Figure 4.13) and formed the bulk of the material used by Edwards (1975) in her study on the morphological variation of the species. Although several species from other localities have been subsequently placed in *Zosterophyllum* (reviewed by Edwards, 1975), *Z. myretonianum* remains the best understood. The form-genus is of particular importance since it is the effective type of the Zosterophyllopsida, an important class of early land plants, probably related to the lycopsids ('club-mosses'). This subdivision is generally accepted to be the evolutionary precursor that played such an important role in the later Palaeozoic floras.

Edwards (1972) described a second zosterophyll, *Z. fertile* Leclercq, from the Arbuthnott Group near Arbroath (probably Kelly Den, but locality details are not clearly recorded), but it has not so far been reported from Turin Hill.

For many years, *Zosterophyllum* was the only type of vascular plant known from the Arbuthnott Group. More recently, however, Edwards (1970b) has described specimens from Aberlemno Quarry as *Cooksonia caledonica*. These show naked, dichotomous axes with terminal, globose sporangia, typical of *Cooksonia*, but the sporangia often have a marginal

rim. The latter may only be a preservational feature, but may alternatively be the remains of a dehiscence mechanism (Edwards and Edwards, 1986). If the latter eventually proves to be correct, then the generic position of this species may have to be revised.

Several localities in the vicinity of Forfar and Arbroath have yielded the Arbuthnott Group flora (Kidston and Lang, 1924; Lang, 1926, 1927a; Lele and Walton, 1962a; Edwards, 1970b, 1975). Many of these have, however, been subsequently filled or flooded. In particular, Myreton Quarry, from where Lele and Walton (1962a) obtained cuticles of *Zosterophyllum*, has been landscaped. Of the sites still remaining, the Turin Hill quarries yield easily the most abundant and well-preserved plant fossils.

The Arbuthnott Group flora is the most typical *Zosterophyllum* Zone assemblage (*sensu* Banks, 1980) known from Britain. Other assemblages from this zone have been recorded from Caldy Island, Dyfed (Lang, 1927a, 1937), Newton Dingle, Shropshire (Edwards and Richardson, 1974) and Targrove Quarry (see above). However, these all contain a much lower proportion of zosterophylls. *Zosterophyllum* Zone assemblages also occur in Spitsbergen (Hoeg, 1942), the former Czechoslovakia (Obrhel, 1968) and Kuznetsk (Stepanov, 1975), but none has been reported to yield such well-preserved specimens. Turin Hill is thus of international importance for the study of the *Zosterophyllum*-dominated vegetation, which seems to have occurred widely in the lowland terrestrial habitats during the earliest Devonian of the northern hemisphere; the radiation of this vegetation marked the first phases of the diversification of the land floras in this part of the world (see Chapter 3 for comments on the more 'advanced' floras found in Gondwana).

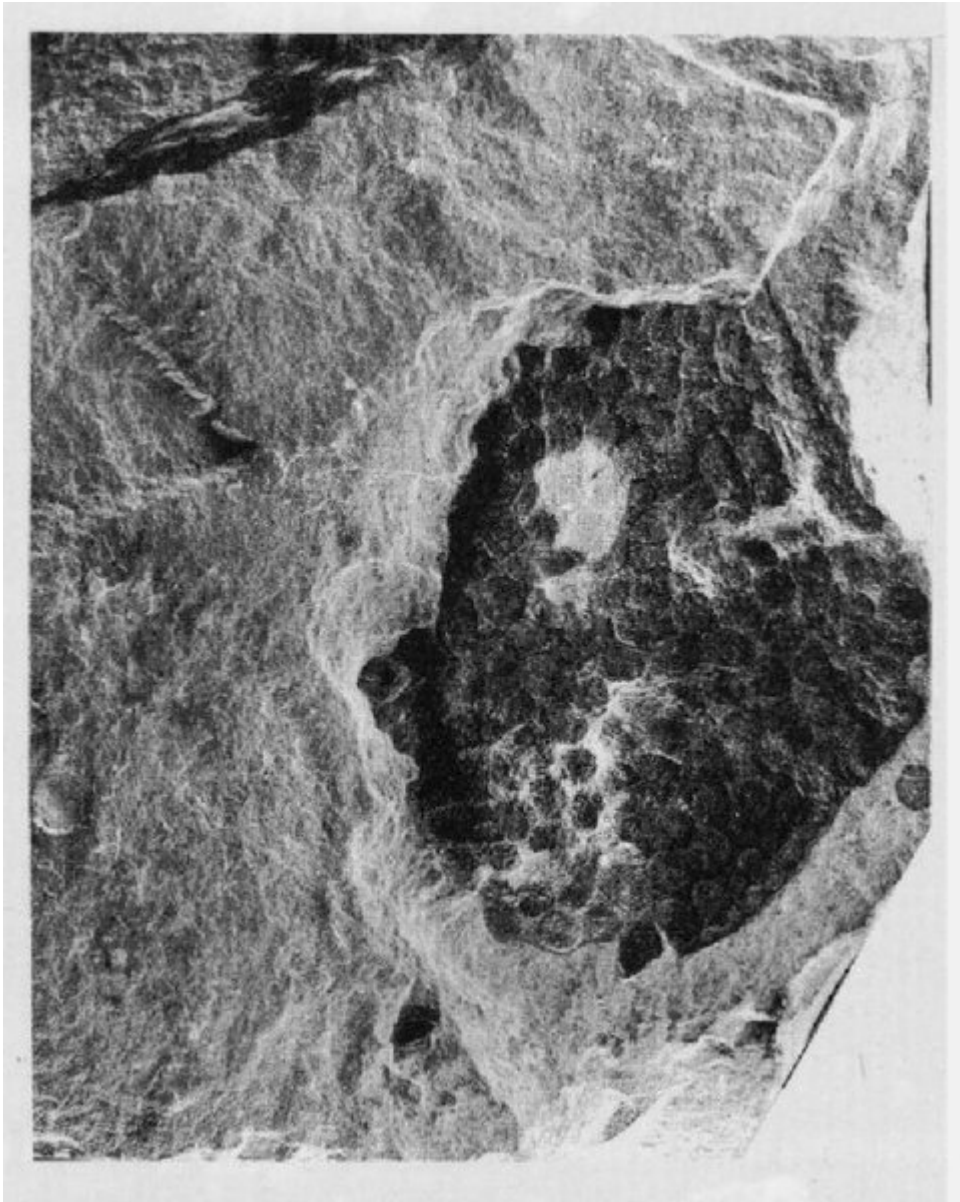
Conclusion

Turin Hill yields the best example of a *Zosterophyllum* Zone flora (about 400 million years old) from anywhere in the world. Other floras of this type have been reported from South Wales, the Welsh Borders, Spitsbergen, Czechoslovakia and Siberia, but none have yielded such well-preserved specimens. Most significant here is the presence of well-preserved examples of the unusual alga *Parka*, and of the early vascular plant *Zosterophyllum*. The latter is important as it is regarded as ancestral to the club-mosses which, in the Late Carboniferous (310–300 Ma), formed extensive tropical forests that resulted in thick, economically important coal deposits (see Chapter 6). The site is also important as the type locality for *Cooksonia caledonica*, a remnant of the primitive rhyniophytoid stock that more typically occurs in the Upper Silurian, and which is thought to represent the earliest type of upright land plant.

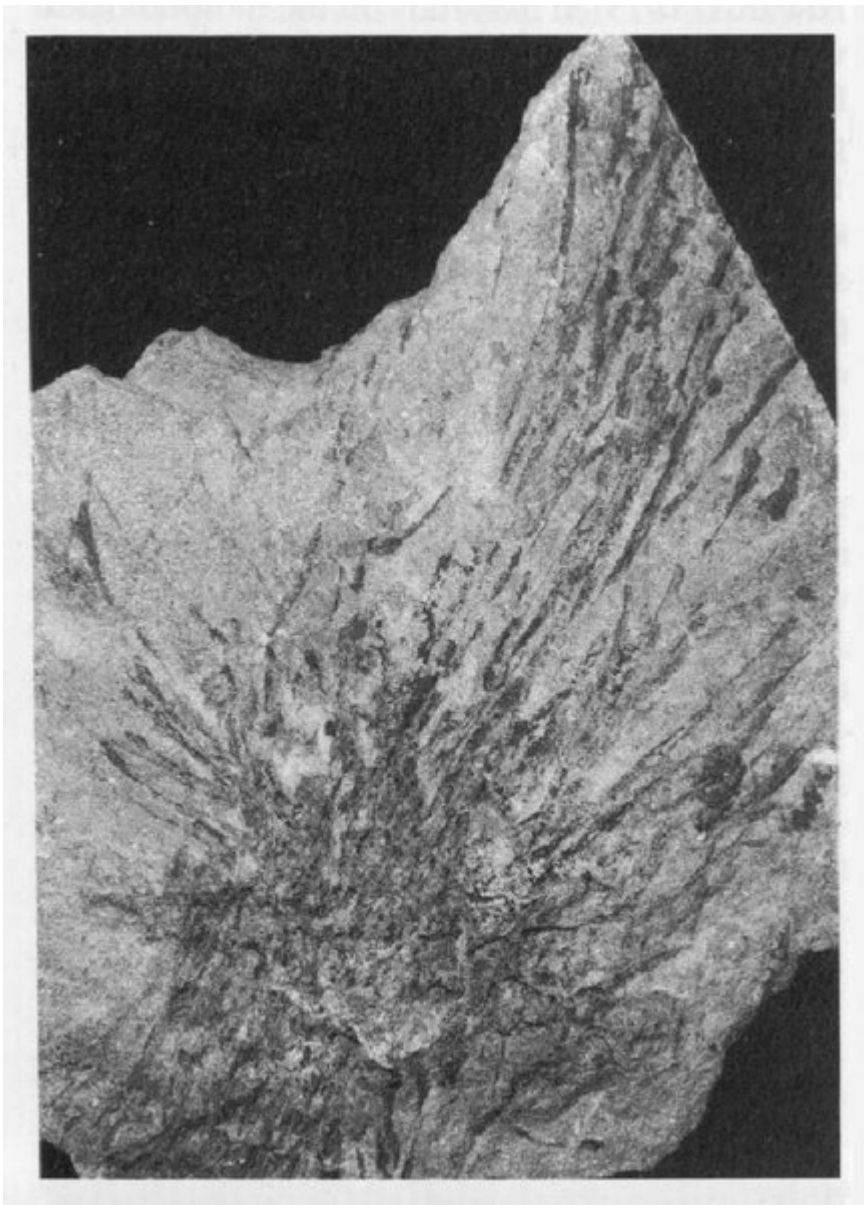
[References](#)



*(Figure 4.10) Turin Hill, Aberlemno Quarry. Strike section along flaggy deposits of the Gedinnian Dundee Formation.
(Photo: C.J. Cleal.)*



(Figure 4.11) *Parka decipiens* Fleming. Enigmatic, possible early land plant, consisting of a cutinized thallus covered with discoid sporangia; Natural History Museum, London, specimen V.24951. Dundee Formation (Gedinnian), Carmylie, Tayside. x 2. (Photo: Photographic Studio, Natural History Museum, London.)



(Figure 4.12) *Zosterophyllum myretontanum* Penhallow. Tangled mass of axes at the base of the plant that gave rise to the vertical shoots; Natural History Museum, London, specimen V.58041. Dundee Formation (Gedinnian), Balgavies Quarry, near Forfar, Tayside. x 0.5. (Photo: Photographic Studio, Natural History Museum, London.)



(Figure 4.13) *Zosterophyllum myretonianum* Penhallow. A fertile spike with sporangia arranged around the axis; Natural History Museum, London, specimen V.58047. Dundee Formation (Gedinnian), Clocksbriggs Quarry, Turin Hill. x 2. (Photo: Photographic Studio, Natural History Museum, London.)