Freshwater East

Highlights

Freshwater East has yielded the most diverse Silurian flora from anywhere in the world, and is particularly rich in rhyniophytoid species (Figure 3.17). This has proved of great importance for determining the ranges of morphological variation of these primitive land plants, and particularly of their reproductive structures. It is the type locality for *Cooksonia cambrensis* Edwards and *Tortilicaulis transwalliensis* Edwards, and has yielded the oldest known examples of spiny axes.

Introduction

Sandstone exposures on the north side of Freshwater East Bay, Dyfed [SS 024 981] have yielded a variety of upper Silurian plant fossils. The fossils were first noted here by Dixon (1921), and a number were included in Lang's (1937) classic study on English and Welsh P■ídolí Series floras. A more recent account of part of the flora has been provided by Edwards (1979a).

Description

Stratigraphy

The geology of this site has been described by Dixon (1921). The plant fossils were found in a 0.3 m-thick grey sandstone within the Milford Haven Group (Figure 3.18) and (Figure 3.19). King (1934) correlated these beds with the Ledbury Marl Formation of the Welsh Borderland, and a P■ídolí age has been confirmed by spores described by Richardson and Lister (1969). Allen and Williams (in Edwards, 1979a) have interpreted this part of the Freshwater East sequence as having accumulated on coastal mudflats.

Palaeobotany

The following species have been reported from here:

Phaeophycophyta(?):

Nematothallus pseudovasculosa Lang

Prototaxites sp.

Chlorophycophyta(?):

Pachytheca sp.

Rhyniophytoids:

Cooksonia hemisphaerica Lang *emend.* Edwards

C. cambrensis Edwards

cf. *C. caledonica* Edwards

cf. *C. pertoni* Lang

Cooksonia sp.

Tortilicaulis transwalliensis Edwards

cf. *Salopella* sp.

Hostinella sp.

Psilophytites sp.

The specimens are preserved as adpressions. Occasionally, some iron oxide and iron sulphide occurs on them, but no evidence of permineralization has been found (Edwards, 1979a).

Interpretation

This flora is characterized by an abundance of fertile rhyniophytoid specimens. By far the commonest were identified as *Cooksonia* by Edwards (1979a), who used 83 of the most complete examples to analyse the variation in sporangial shape and attachment. This allowed her to identify five form-species from here, one of which (*C. cambrensis*) was new. It also allowed her to emend Lang's (1937) diagnosis for *C. hemisphaerica.* She recognized the problem of identifying species on what are relatively minor differences, but argued that it was the only practical way of analysing such morphologically simple and fragmentary plant fossils. This is by far the most diverse *Cooksonia* assemblage reported from anywhere in the world.

Tortilicaulis transwalliensis was described from a number of unbranched axes bearing terminal, elongate bodies (Figure 3.20). The latter were presumed to be sporangia, although no spores were obtained from them. Neither was any evidence of tracheids found in the axes. A distinctive feature of the species is that the axes have a nonrigid appearance, often seeming to be twisted. It has elongate sporangia, similar to those of *Sporogonites,* but lacks some of the well-defined characters of the latter, such as the longitudinal folds and the sterile basal region. Consequently, Edwards placed it in a separate form-genus. Edwards also found some features shared with certain extant bryophytes, particularly the twisted axes, but again the preservation precluded an assignment.

A small number of specimens were axes, this time showing no evidence of twisting, which bore rather smaller, elongate sporangia. Edwards (1979a) compared these with *Salopella* of Edwards and Richardson (1974), but was unable to place them in any particular species.

As is normal in P■ídolí age floras, fragmentary sterile axes are far commoner than the fertile specimens. The most common are smooth, either simple or dichotomous axes, which were identified as *Hostinella* by Edwards (1979a). No evidence of tracheids has been found in these specimens. Edwards also described three specimens showing a cluster of branches, which she compared with the 'K-branching' thought to be from the base of the *Zosterophyllum* plant (Walton, 1964a). However, she emphasized that there was no unequivocal evidence that the Freshwater East specimens were basal structures, and that they could equally be from the aerial part of a plant.

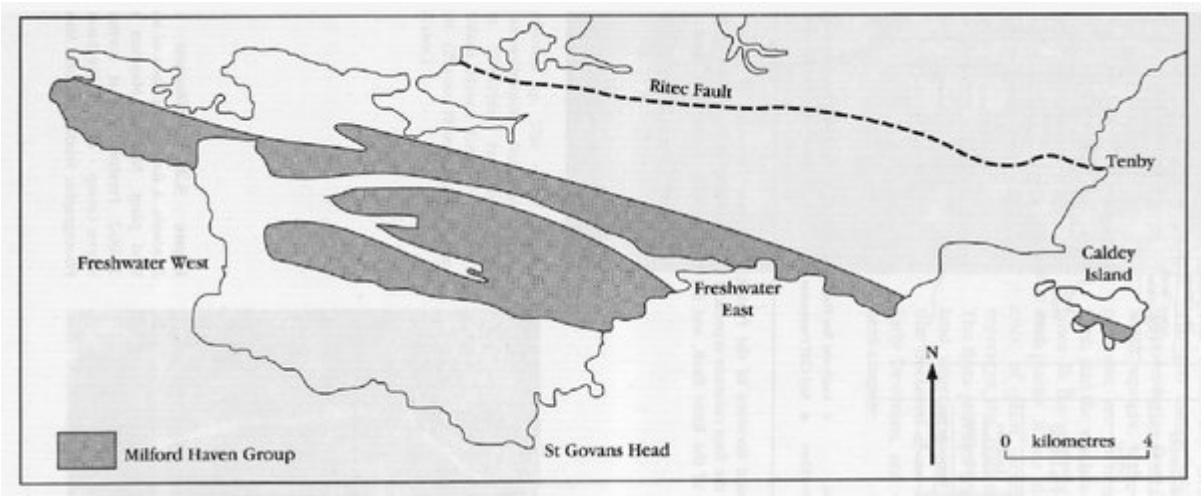
Of considerable interest was Edwards' discovery of four examples of axes, one of which shows a dichotomy, with spines attached (Figure 3.21). In the absence of attached reproductive structures, it was impossible to say what group of plants they belonged to, and so they were placed in the generalized form-genus *Psilophytites.* Their interest is in being the oldest examples of spiny axes recorded from anywhere in the world.

Conclusion

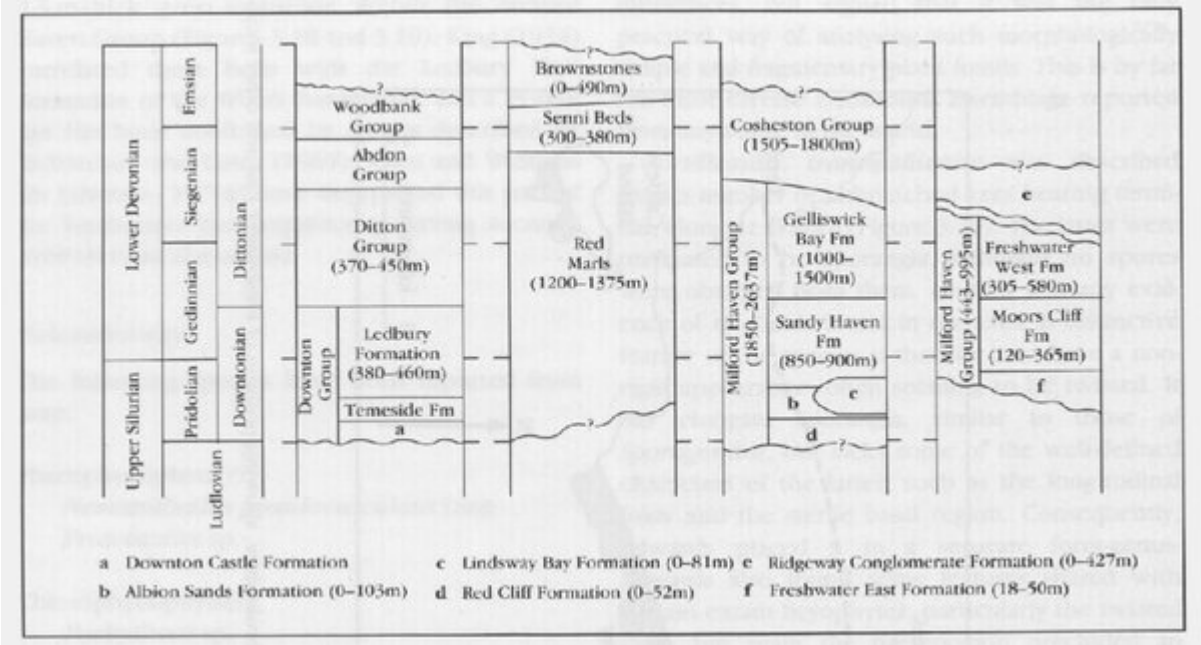
The Freshwater East plant fossils, which are 410–420 million years old, represent the most diverse Silurian flora from anywhere in the world. Small, upright, leafless plants, known as rhyniophytoids, are particularly abundant and diverse here, and the site has been of considerable importance in the study of these archetypal, primitive land plants. It has also yielded the earliest evidence of plant stems with spines, which may represent the evolutionary precursors of leaves. The flora provides a highly significant insight into land vegetation just before the major radiation that occurred about 10 million years later in the Early Devonian, and which is the subject of the next chapter.

References

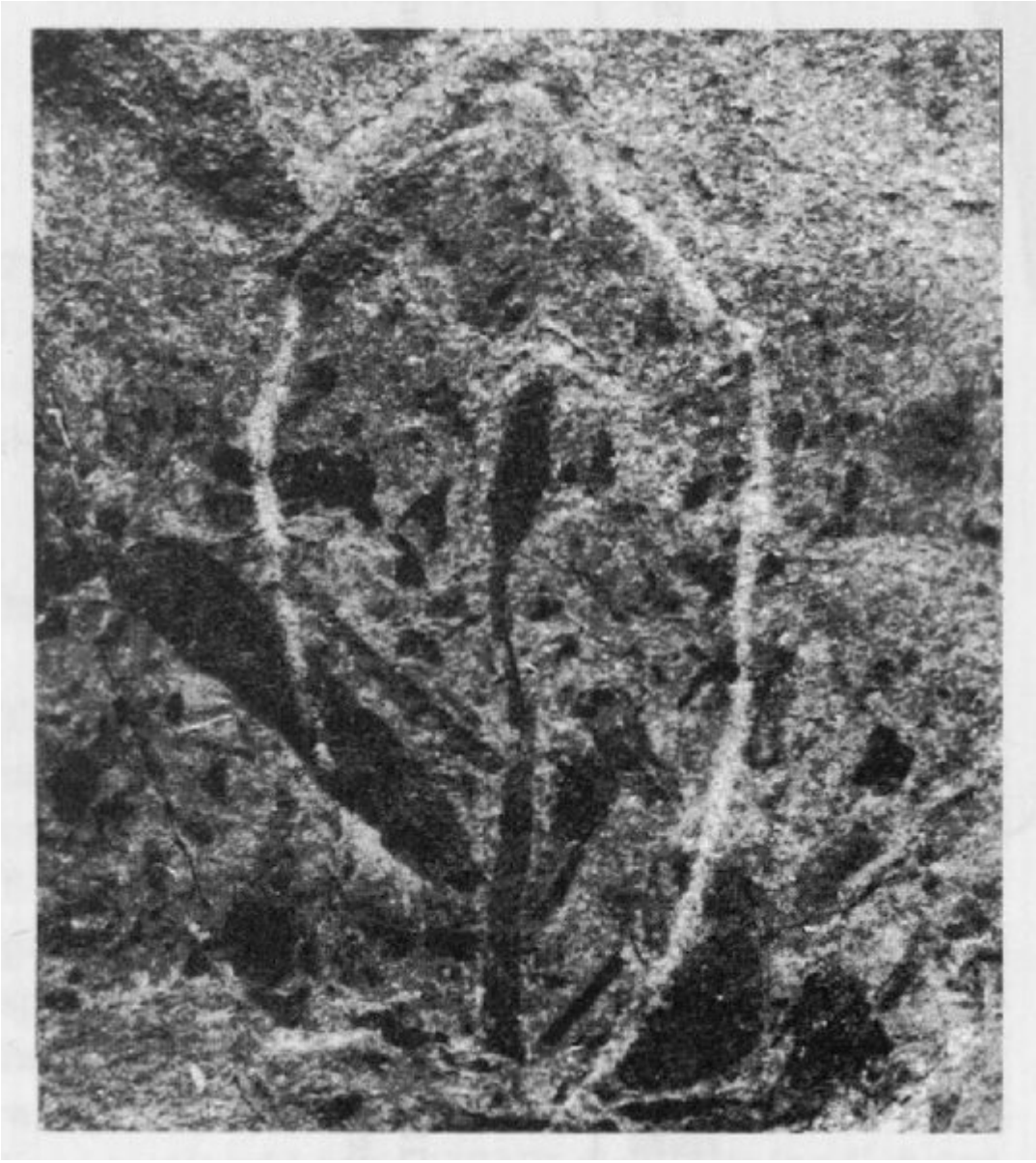
(Figure 3.17) Freshwater East. View across bay towards the Late Silurian plant-bearing exposures in the Freshwater East Formation. (Photo: C.J. Cleal.)



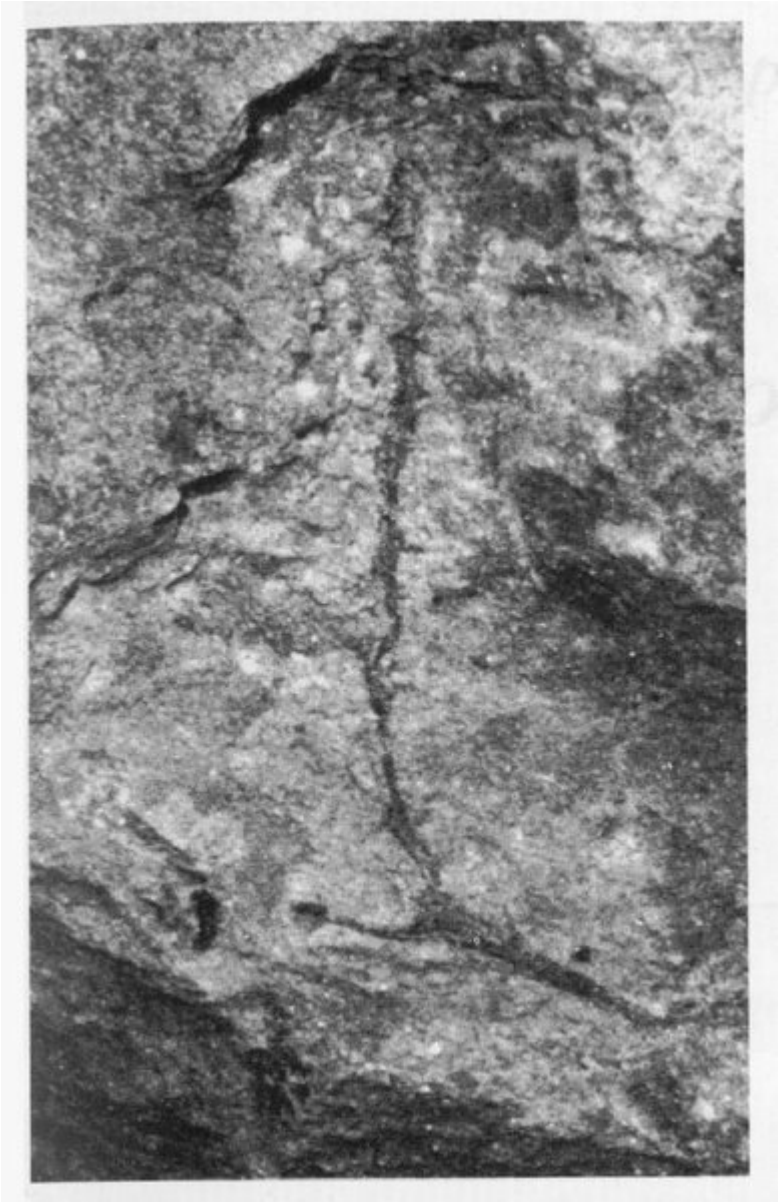
(Figure 3.18) The outcrop of the Milford Haven Group (Upper Silurian and Lower Devonian) in Pembrokeshire, showing position of Freshwater East and other localities that yield plant fossils. Based on Williams et al. (1982, figure 2).



(Figure 3.19) Lithostratigraphical divisions of the P■ídolí and Lower Devonian of South Wales and the Welsh Borderland. From left to right, the four columns represent the sequences in (1) the Welsh Borderland, (2) central South Wales, (3) Dyfed north of the Ritec Fault, and (4) Dyfed south of the Ritec Fault. Based on Friend and Williams (1978, figure 31).



(Figure 3.20) Tortilicaulis transwalliensis D. Edwards. A fertile specimen of an early rhyniophytoid land plant; National Museum of Wales, specimen 77.6G2. Freshwater East Formation (lower Milford Haven Group — Pildoll), Freshwater East. x 4. (Photo: Photographic Studio, National Museum of Wales.)



(Figure 3.21) Psilophytites sp. The oldest known examples of a plant axis with spines; National Museum of Wales, specimen 77.6G56a. Freshwater East Formation (lower Milford Haven Group -Freshwater East. x 10. (Photo: Photographic Studio, National Museum of Wales.)