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# Bay of Skail

## Highlights

The Bay of Skail has yielded the most diverse *Hyenia* Zone plant fossil assemblage in Britain. It is the type locality for *Protopteridium thomsonii* (Dawson), the oldest and most primitive known progymnosperm (Figure 4.33).

## Introduction

This exposure of the Sandwich Fish Bed, on the west coast of Mainland Island, Orkney [HY 233 196] has yielded some of the best examples of Middle Devonian plant fossils from Britain. Although heavily out-numbered by the fish fossils, plant remains have been recorded from this horizon in Orkney for nearly 150 years (Clouston, 1845; Miller, 1849; Carruthers, 1873; Dawson, 1870; 1871, 1878; Lang, 1925, 1926, 1927a, b; Lang *in* Wilson *et al.*, 1935).

## Description

### Stratigraphy

The geology has been briefly described by Wilson *et al.* (1935). The fish bed is c. 3 metres thick here and consists of thinly laminated, 'varved' sandstones and siltstones. It is believed that it is part of an extensive lacustrine deposit originally extending over large areas of north-eastern Scotland, including Cromarty (the Cromarty Fish Bed), Caithness (the Achanarras Fish Bed) and Shetland (Melby Fish Bed). The 'varved' structure of the bed probably reflects an annual cyclicity, of either algal blooms (Rayner, 1963) or climatically induced variations in sediment input (Trewin, 1985). The chronostratigraphical position of the bed appears to be near the Eifelian–Givetian boundary based on fish and spores (Westoll, 1951; Westoll *in* House *et al.*, 1977; Richardson, 1964).

### Palaeobotany

The plant fossils are preserved mainly as compressions. To date, the following species have been reported:

Lycopsida:

*Thursophyton milleri* (Salter) Nathorst

Progymnospermopsida:

*Protopteridium thomsonii* (Dawson) Kräusel and Weyland

Uncertain affinities:

*Barrandeina pectinata* Hoeg

'Fern' *sensu* Miller (1849)

## Interpretation

The most significant element in the assemblage is *Protopteridium thomsonii*, for which Bay of Skail is the type locality (Dawson, 1878). The nomenclature of this species has undergone a number of changes but, according to Matten and Schweitzer (1982), *P. thomsonii* is the correct combination. It has been most extensively investigated by Leclercq and Bonamo (1971), who have shown that it has a combination of trimerophyte-like sporangial trusses and gymnosperm-like secondary wood (Figure 4.34). Details of the vegetative parts of the plant are not well shown in the specimens found to

date from Bay of Skail, but material from elsewhere suggests that they consist of helically arranged, dichotomous branches. The ultimate sterile appendages may be bi- or trifurcate and often show an incipient, narrow lamina. The combination of trimerophyte- and gymnosperm-like features has resulted in *Protopteridium* being assigned to the progymnosperms, usually to the order Aneurophytales. It is the oldest and most primitive known progymnosperm, and provides valuable evidence as to how they evolved from the trimerophytes, probably in the Middle Devonian.

According to Leclercq and Bonamo (1971), *Milleria pinnata* (Lang) from the Cromarty Fish Bed (Lang, 1925, 1926) should be included in *Protopteridium thomsonii*. It has also been suggested by Kidston (1903a and in Hinxman and Grant Wilson, 1902) that *Caulopteris? peachi* Salter, described by Salter (in Murchison, 1859) from the Achanarras Fish Bed, was the trunk of this plant. Consequently, *P. thomsonii* has often been reconstructed as a semi-arborescent plant (e.g. Seward, 1931, fig. 45). As pointed out by Leclercq and Bonamo (1971), however, the connection has never been proved.

*Thursophyton milleri* refers to branching axes with microphyllous leaves or spines, but without leaf cushions (Salter, 1858; Lang, 1925). Specimens figured by Penhallow (1892) and Reid and Macnair (1896, 1899) show what appear to be sporangia borne in the axils of the leaves, but Nathorst (1915) and Lang (1925) regarded the evidence as doubtful. Little is known of the anatomy of the axes, other than that they contained annular tracheids (Lang, 1925). The general aspect of the plant suggests affinities with the lycopsids, but further evidence of its anatomy and fertile structures is needed to confirm its taxonomic position.

Lang (in Wilson *et al.*, 1935) reported *Barrandeina pectinata* from Bay of Skail, but the Lang specimens have never been figured. This species belongs to an enigmatic group of Devonian plants with apparently fan-shaped leaves (also including *Enigmophyton* Hoeg, 1942 from the Middle Devonian of Spitsbergen), which Hoeg (in Boureau *et al.*, 1967) has referred to the order Palaeophyllales. The taxonomic position of these Devonian megaphyllous plants is not known.

The 'fern?' figured by Miller (1849) and refigured by Lang (1925, pl. 4, fig. 66) is an extremely faint impression of what appears to be a small, pinna-like structure. Kidston (in Lang, 1925) reported markings on its surface suggesting the presence of spores, and thus it may be some sort of fructification. However, nothing more is known about it.

In addition to the above taxa, *Hostinella racemosa* Lang, *H. globosa* Lang, *Protolpidodendron karlsteinii* Potonié and Bernard, and *Pseudosporochnus krejci* Potonié and Bernard have been described from other localities in north-east Scotland at this horizon (Lang, 1925, 1926, 1927a). Although not yet reported from Bay of Skail, further work there may well reveal them.

Although of rather restricted composition, the Bay of Skail assemblage appears to belong to the *Hyenia* Zone of Banks (1980). Similar assemblages have been reported from other exposures of this fish bed and its correlatives in north-east Scotland, including Lyking Quarry in Orkney, Achanarras Quarry in Caithness, and further south at Coal Heugh and Navity in the Cromarty Black Isle (Peach, 1877; Kidston and Lang, 1923a; Lang, 1925, 1926, 1927a). However, many of these localities have been filled-in and, of those remaining, Bay of Skail yields the most diverse plant fossils of this age.

Coeval assemblages are also known from Germany (Kräusel and Weyland, 1929, 1932, 1938), the former Czechoslovakia (Obrhel, 1968) and Spitsbergen (Høeg, 1942). These are mostly more diverse than the Scottish assemblages, and include a number of taxa not yet reported from Scotland, such as *Aneurophyton*, *Hyenia*, *Pectinophyton* and *Duisbergia*. Bay of Skail is nevertheless of considerable international significance as the type and one of the most important localities for *Protopteridium*, the earliest progymnosperm, and thus probably the remote ancestor of all seed plants, including the angiosperms.

## Conclusion

Bay of Skail has yielded an important assemblage of Middle Devonian plant fossils, about 380 million years old. It cannot compare in diversity with similar aged floras abroad, especially Germany, the former Czechoslovakia and Spitsbergen, but it is the best that is known in Britain. It is particularly important as the best locality for the oldest and most primitive known progymnosperm (*Protopteridium*), which is one of a group of plants thought to be the immediate ancestors of the seed plants (and thus the flowering plants). It is thus of great significance for charting the development of the seed as a

reproductive organ, which was probably the single most important evolutionary event that allowed plants to spread from the lowland, coastal areas into drier, inland habitats.

## References



(Figure 4.33) Bay of Skall. Beds associated with the Sandwich Fish Bed, at the Eifelian–Givetian boundary. (Photo: C.J. Cleal.)



(Figure 4.34) *Protopteridium thomsonti* (Dawson) Kräusel and Weyland. Fertile spike of the oldest known pro-gymnosperm; Natural History Museum, London, specimen V.9425. Sandwich Fish Bed (Eifelian–Givetian boundary), Bay of Skail. x 2. (Photo: Photographic Studio, Natural History Museum, London.)