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# Eathie Fishing Station

[NH 779 635]

## Introduction

This site has yielded a well-preserved Kimmeridgian (Late Jurassic) assemblage of conifers, bennettites and cycads. Significantly, the fossils are preserved as permineralizations, showing fine detail of their internal cell structure. They include some of the best examples of bennettite flowers ever to have been found as well as some finely preserved conifer cones. Remarkably the flora has not been studied since the early 20th century and is in serious need of revision.

Miller (1857) first described the plant petrifications at Eathie and his specimens are now nearly all in the collections of the Royal Scottish Museum, Edinburgh. Richards (1884) published a short account on Miller's cycadean species, but it was not until early in the 20th century that they were looked at again by Seward (1911, 1912) and Seward and Bancroft (1913). There has been little attempt to re-examine this site and its fossils, which is rather remarkable in view of the small number of petrification sites that exist in rocks of this age.

## Description

### Stratigraphy

The exposed succession here is summarized in (Figure 5.8). Cope *et al.* (1980a) dated it as Kimmeridgian, based on the work of Waterstone (1951) and Ziegler (1962). There are green mudstones at the base with some thin limestone nodules and bands that belong to the *Rasenia cymodoce* Zone. The plant petrifications most probably come from this part of the succession. The higher beds yield a fauna of *Amoebites* and raseniids characteristic of the upper part of the *R. cymodoce* Zone and the basal *Aulacostephanoides mutabilis* Zone. Fossiliferous nodules, containing the ammonite *Pictonia baylei*, have also been found 10 km to the north of Eathie, indicating that the basal Kimmeridgian strata are preserved offshore in this region.

### Palaeobotany

The plant fossils are preserved as petrifications and reveal a considerable degree of anatomical detail (Figure 5.9). Miller considered that he had three species of conifer cones and a number of different conifer shoots. Seward (1911) named the shoots as his new species *Taxites jeffryi*. Others Seward named as *Elatides curvifolia* (Dunker) Nathorst, and *Sphenolepidium* cf. *kurrianum* Dunker, although it is not clear if these come from Eathie. He also named isolated cone scales as *Araucarites milleri* after Miller. Miller's imbricated stem (Miller, 1857, fig. 149) was described by Seward and Bancroft (1913) as a new species, *Brachyphyllum eathiense*. In the same paper, they named Miller's conifer cones as two new species, *Masculostrobus woodwardii* and *Conites juddii* (the latter in four forms).

Miller described cycad-like foliage under the name of *Zamites pectinata* and figured two cones that he thought might belong to a cycad intermediate between the fertile apices of *Cycas revoluta* and the cones of *Zamia pungens*. One of his leaves (Miller, 1857, fig. 133) was named *Zamites eathiensis* by Richards (1884) and then *Pseudoctenis eatbiensis* by Seward (1911). The other (fig. 134) was named *Nilssonia orientalis* Heer by Seward (1911). The cycad-like cones were described in another paper by Seward (1912) as *Williamsonia pecten* (Phillips), which is in fact a bennettite fructification.

## Interpretation

The site has yielded a well-preserved assemblage of Kimmeridgian (Late Jurassic) plant petrifications, consisting of the remains of conifers, bennettites and cycads. They preserve fine detail of the internal cell structure. Of particular interest are the bennettite flowers known as *Williamsonia scotica* Seward, which are among the best-preserved examples of such organs. Well-preserved conifer cones have also been described from here, including *Maculastrobus woodwardii* and

*Conites juddii*. The flora has not been studied since the early 20th century and is in serious need of revision. It is a site of considerable potential for understanding the detailed structure of the Mesozoic gymnosperms.

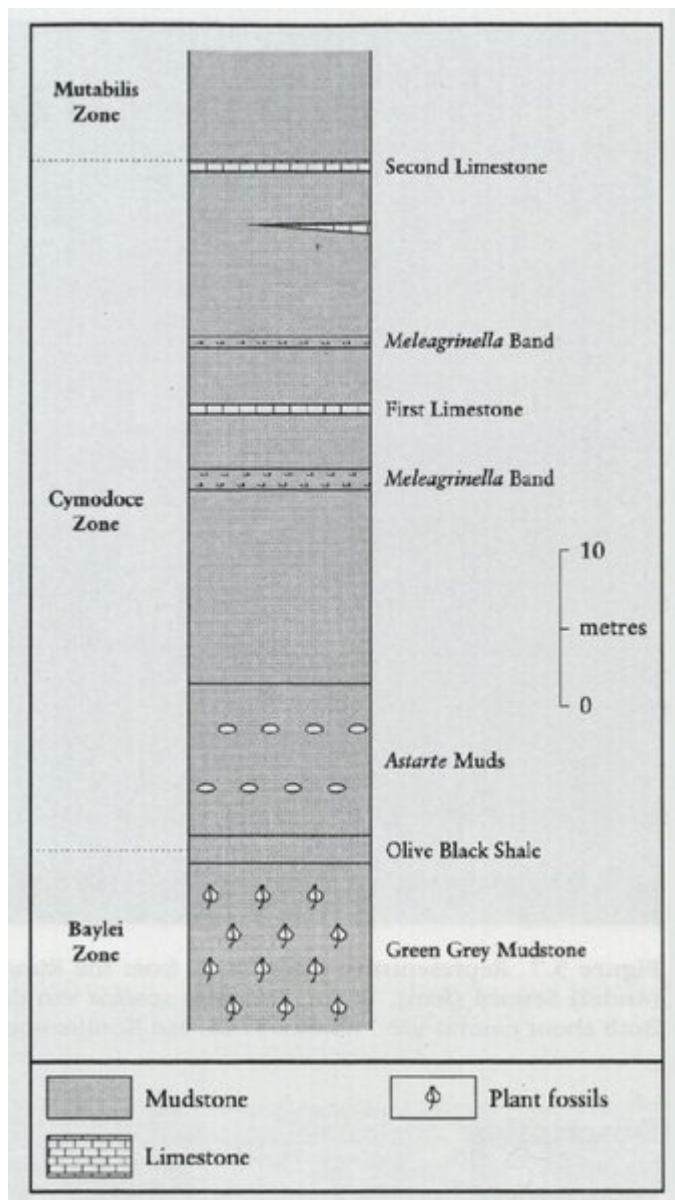
The permineralized plants at Eathie must have been fragments that were carried into the sediments now represented by the green mudstones. Carbonates forming the limestone in bands within the mudstones would also have penetrated and preserved the plant fragments and formed nodules around them.

The flora is difficult to compare directly with the other Scottish Jurassic assemblages because it has been preserved in a different way. The only other locality where there are permineralized plants is at Helmsdale. Unlike the other localities, Eathie is dominated by both bennettites and conifers.

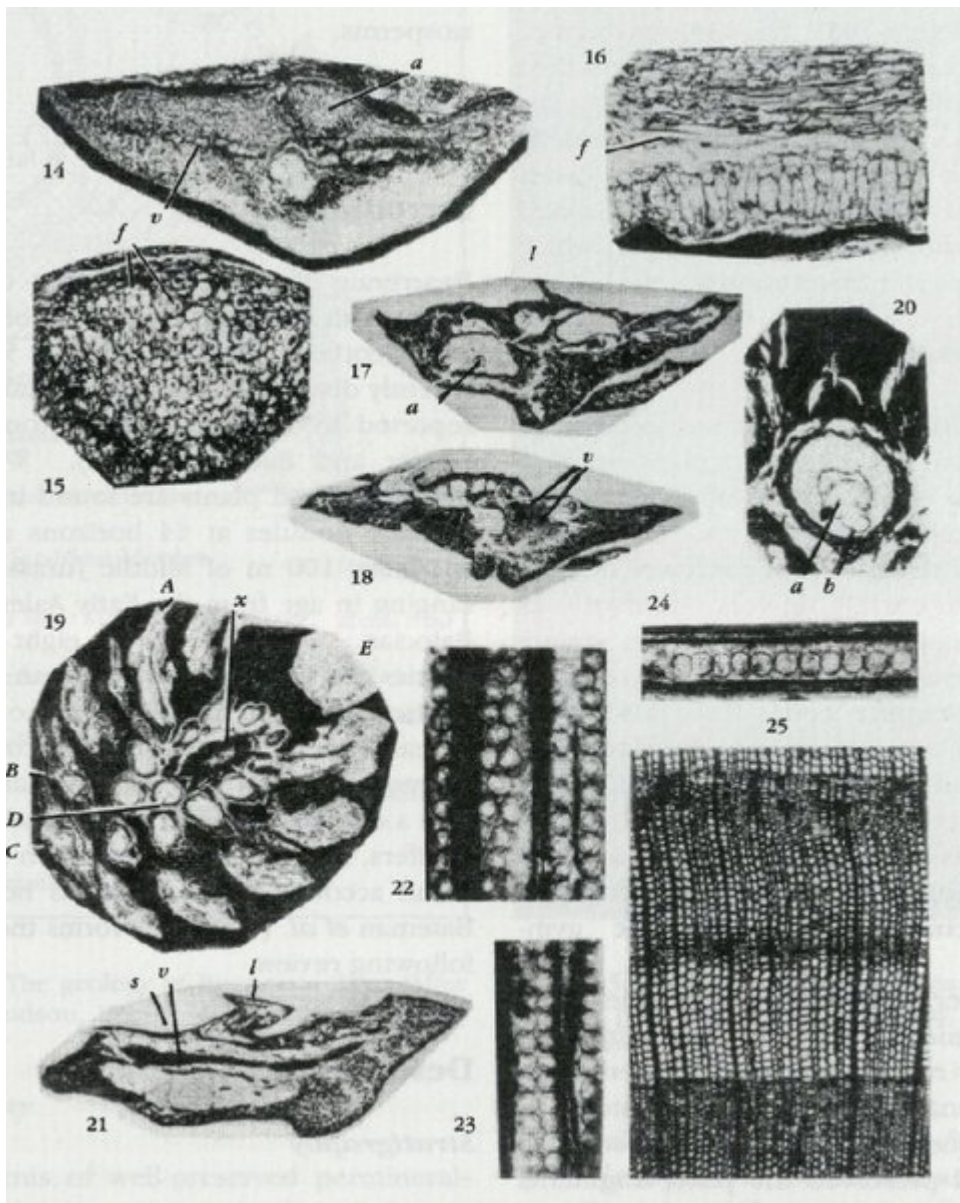
## Conclusion

Eathie Fishing Station is an outstanding site for Kimmeridgian permineralized plants with four species of gymnosperms having been named from here. The presence of permineralized *Williamsonia* flowers and bennettite leaves, as well as conifer shoots, and cones makes it an extremely valuable succession for the study of these plants and is a site worthy of future investigation, especially for understanding the detailed structure of the Mesozoic gymnosperms.

## References



(Figure 5.8) Generalized sequence of Kimmeridgian rocks exposed near Eathie, showing position of plant bed. (After Gitmez and Sarjeant, 1972.)



(Figure 5.9) Petrified plants from Scotland as figured by Seward and Bancroft 1913. The gymnosperm cones *Conites juddii* Seward and Bancroft were collected by Hugh Miller at Eathie Bay in weathered calcareous nodules. Parts 14–16 are of a section of a cone scale showing crushing of parenchyma at *a*, thick fibres or idioblasts at *f* and an almost continuous line of vascular stands stretching across the cone scale at *v*. Part 14  $\times$  c.4, Part 15  $\times$  15, Part 16  $\times$  18. Part 19 is an oblique longitudinal section of a cone with secondary xylem (*x*), x.c.l. The obliquely cut cone scale *A*, enlarged in Part 21, shows a vascular strand (*v*) and a ligular outgrowth (*l*) with *s* indicating the likely position of the missing seed. The transversely cut cone scales *B* (enlarged in Part 17  $\times$  3) and *C* (enlarged in Part 18  $\times$  3) show the ligule (*l*), vascular bundles (*v*) and more crushed parenchyma (*a*). In the cavity of cone scale *D* (enlarged in Part 20  $\times$  3.5) the identity of the structure marked as *a* and *b* are still speculative. The single specimen of gymnosperm wood, *Cedroxylon hornet* Seward and Bancroft, comes from Helmsdale, near the northern limit of the Jurassic rocks in Sutherland. In transverse section growth rings of tracheids are clearly visible, Part 25  $\times$  25. Longitudinal sections show bordered pits approximately 20  $\mu$ m in diameter, Parts 22–24  $\times$  150.