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# Glencartholm

## Highlights

Glencartholm has yielded one of the best examples of a *Neuropteris antedecens* Zone fossil flora from Britain. Many of the species found here are widely distributed, but there are a number for which this is the only or best locality, such as *Rhacopteris geikiei*, *Sphenopteridium macconochiei* and *Rhodeopteridium machanekii*. Glencartholm has provided particularly fine examples of *Spathulopteris*. It is a site of considerable palaeobotanical significance.

## Introduction

Lower Carboniferous rocks in the bed of River Esk, about 4 km north-west of Canonbie, Dumfries and Galloway [NY 377 795], are best known as a site for fish and crustacean fossils. However, they have also yielded a diverse plant fossil assemblage. They were first discovered in 1876 by A. Macconochie, during the mapping of the area by the Geological Survey. Kidston (1883a) made a preliminary report on the assemblage (see also Kidston, 1886), and later published a systematic account (Kidston, 1903b). Specimens from here were extensively used in the Geological Survey monographs on Carboniferous plant fossils (Kidston, 1923–1925; Crookall, 1955–1975). In addition, there have been accounts of individual taxa from here, including *Pothocites* (Kidston, 1882, 1883b, c; Chaphekar, 1965), *Eskdalia* (Thomas, 1968) and *Lycopodites* (Kidston, 1901b). Thomas's *Eskdalia* study is particularly important since it shows that cuticles are preserved in at least some of the Glencartholm fossils.

## Description

### Stratigraphy

The plant fossils occur in the Glencartholm Volcanic Group, a sequence of tuffs, shales and sandstones near the base of the Upper Border Group (Lumsden *et al.*, 1967). They are interpreted as shallow marine or lagoonal deposits, which were subject to periodic burial from volcanic out-fall. Foraminifera from the sequence suggest a position near the Holkerian–Asbian boundary (George *et al.*, 1976).

### Palaeobotany

The following taxa have been reported to date:

Algae (divisions unknown):

*Bythotrepis acicularis* (Göppert) Kidston

*B. plumosa* Kidston

*B. simplex* Kidston

*B. scotica* Kidston

Lycopsida:

*Eskdalia minuta* Kidston

*Lepidodendron veltheimianum* Sternberg

*Lepidostrobus ornatus* Brongniart

*Lepidostrobophyllum lanceolatum* (Lindley and Hutton) Bell

*Stigmaria ficoides* (Sternberg) Brongniart

*L. fimbriatum* (Kidston) Allen

*Lycopodites stockii* Kidston

Equisetopsida:

*Archaeocalamites radiatus* (Brongniart) Stur

*Pothocites grantoni* Paterson

Filicopsida(?):

*Rhodeopteridium machanekii* (Ettingshausen) Purkyfiova

Progymnospermopsida(?):

*Rhacopteris lindsaeformis* (Bunbury) Kidston

*R. geikiei* Kidston

Lagenostomopsida:

*Sphenopteris bifida* Lindley and Hutton

*Sphenopteridium pachyrrachis* (Göppert) Schimper

*S. macconochiei* Kidston

?*S. crassum* (Lindley and Hutton) Kidston

*Spathulopteris obovata* (Lindley and Hutton) Kidston

*S. decomposita* Kidston

*Cardiopteridium nanum* (Eichwald) Walton

*Carpolithes* sp.

## Interpretation

### Algae

Kidston (1883a, 1903b) described a variety of enigmatic fossils from here, which he interpreted as algal remains. He assigned them to four species of the 'artificial' form-genus *Bythotrepis*, but could draw no conclusions about their affinities.

### Lycopsida

These are relatively rare at Glencartholm, but the most abundant are the stems *Lepidodendron veltheimianum* and rooting structures *Stigmaria ficoides*. In association are strobili described (Kidston, 1903b) as *Lepidostrobus variabilis* Lindley and Hutton, but which Crookall (1966) later transferred to *Lepidostrobus ornatus* (it should be noted that this is a true *Lepidostrobus* as interpreted by Brack-Hanes and Thomas (1983), i.e. a microsporangiate strobilus). Most

*Lepidodendron* species, however, are thought to have borne *Flemingites* strobili, and so there must be some doubt as to whether *L. ornatus* was attached to *L. veltheimianum*.

A second lycopsid plant represented at Glencartholm had stems belonging to the form-genus *Eskdalia*. Kidston (1883a, 1903b) interpreted it as a fern stem, but Thomas (1968) demonstrated that it was a ligulate lycopsid (see also Chaloner *in* Boureau *et al.*, 1967; Thomas and Meyen, 1984; Rowe, 1988c). A key aspect of Thomas's study was the preparation of cuticles, which yielded evidence of the ligule, stem stomata and 'resistant excrescences'. However, no evidence of a parichnos was found. It appears to be a wide-ranging form-genus, having been reported from Puddlebrook (see above), and from several localities in Siberia (Thomas and Meyen, 1984). It is also very similar to the '*Lepidodendron* *perforatum* Lacey, 1962 from North Wales (Rowe, 1988c). Nevertheless, Glencartholm remains one of the most important localities for this form-genus.

There seems to be a consistent association between *Eskdalia* and the isolated sporophylls *Lepidostrobophyllum fimbriatum* (cf. also Puddlebrook Quarry — see above). However, the only species of *Eskdalia* to which strobili have been found attached have sporophylls of a different type (*E. variabilis* (Lele and Walton) Rowe, 1988c). This problem has been discussed under Puddlebrook Quarry (p. 169).

A poorly preserved specimen of an herbaceous lycopsid was described by Kidston (1884, 1901b) as *Lycopodites stockii*. It shows a leafy shoot with sporangia arranged both in a terminal strobilus and amongst the leaves. Bower (1908) argued that this arrangement of sporangia points to it belonging to the subsection *Phlegmaria*, in the classification established for extant species. It is one of the earliest known examples of a fossilized lycopodiacean with fructifications preserved.

## Equisetopsida

The equisetes are represented here by the ubiquitous (in the Lower Carboniferous) *Archaeocalamites radiatus*. Strobili found in close association were identified by Kidston (1882) as *Pothocites calamopsoides* Kidston (Figure 5.45), but he later recognized that they were indistinguishable from *P. grantoni* (Kidston, 1883b, c).

## Filicopsida(?)

Glencartholm is the best known locality for *Rhodeopteridium machanekii*. It has yielded several large specimens, showing the distinctive large, deeply incised pinnules. Relatively little is known of the branching architecture or pinnule variation in these fern-like plants, and so large specimens such as those found here have considerable significance.

## Progymnospermopsida(?)

The commonest type of foliage which probably belongs to this group is *Rhacopteris lindsaeformis*. Kidston (1903b) initially identified it as *Rhacopteris inaequilaterata* (Göppert) Stur. However, he later revised this identification (Kidston, 1923c), although he still listed Glencartholm as a locality yielding *R. inaequilaterata*; this was probably just a clerical error.

Glencartholm is the type and best known locality for a second species of ?progymnosperm foliage, *R. geikiei*. It has very distinctive pinnules, which are deeply incised with slender lobes, but not markedly asymmetrical, as in most other deeply incised rhacopterid species.

## Lagenostomopsida

The most abundant pteridosperm fossils found here to date are fronds. The most abundant belong to the Lagenostomales. Three species of *Sphenopteridium* have been recorded. *S. pachyrrachis* is by far the most common (Figure 5.46). ?*S. crassum* has never been illustrated, but there must be a strong possibility that the ?*S. crassum* is merely a small form of *S. pachyrrachis*. The third, *S. macconochiei*, is only known from Glencartholm. Details of the venation and rachis ornamentation appear to support its inclusion in *Sphenopteridium*, but, compared with the other known species of the genus, it has more robust, subrhomboidal, entire-margined pinnules.

Kidston (1924) figured a fructification from here as *Sphenopteris bifida*, but details of the sterile part of the frond were not given to support the identification.

A number of relatively large portions of *Spathulopteris* fronds has been illustrated from here (Kidston, 1924). Neither of the recorded species (*S. obovata* and *S. decomposita*) is rare or particularly distinctive. Nevertheless, the Glencartholm material is of interest as providing some of the best examples of this form-genus to be recorded in the literature. Fructifications or stem/rachis anatomy are unknown, but the fronds are believed to belong to the Calamopityales (see discussion on Loch Humphrey Burn, above).

Two small specimens of *Cardiopteridium nanum* have been found here. The taxonomy of this species has had a complex history (Walton, 1941), but it is now generally assumed that a range of species names used in the past in fact just reflects a marked degree of infra-specific variation in this taxon. Walton retained a distinction at the rank of forma between the large and small types of pinnules, but this seems to be an artificial division of doubtful utility.

## General remarks

The occurrence together at Glencartholm of *Spathulopteris* and *Cardiopteridium* clearly indicates that the assemblage belongs to the lower part of the *Neuropteris antedecens* Zone (*Diplopteridium* Subzone) of Cleal (1991). There is some comparison with the Wardie Shales assemblage (p. 181), which has a number of species in common, such as *Rhacopteris lindsaeformis*, *Pothocites grantoni* and *Lepidodendron veltheimianum*. The Wardie assemblage, however, has a higher proportion of lycopsids. There are also differences in the pteridosperm composition, such as the presence at Wardie of *Sphenopteris affinis* instead of the closely related *S. bifida*. Also comparable among the British Visean assemblages is that from Teilia Quarry (p. 175), but the similarity here seems to be mainly at the rank of form-genus, the only species in common being *Archaeocalamites radiatus* and *Sphenopteridium pachyrrachis*.

Outside of Britain, the nearest comparison is with assemblages reported from the Pollak Stollen Formation of Upper Silesia (Patteisky, 1929; Hartung and Patteisky, 1960), which includes among others *Lepidodendron veltheimianum*, *Rhodeopteridium machanekii* and *Sphenopteridium pachyrrachis*. However, most of the other Lower Carboniferous assemblages from central Europe differ markedly from that found at Glencartholm, both in overall balance and in species composition (for reviews of these assemblages see Hirmer, 1939 and Vakhrameev *et al.*, 1978). The reason for these differences has not been properly investigated, and it is not clear whether it reflects palaeoecological or biostratigraphical variation, or even just taxonomic and/or collecting bias. However, as one of the best documented fossil floras of the Upper Visean of Europe, Glencartholm will clearly play a central role in unravelling the patterns of vegetational distribution within the palaeoequatorial belt.

## Conclusion

Glencartholm has yielded one of the best documented fossil floras from the upper part of the Lower Carboniferous of Britain, representing vegetation growing some 330 million years ago. Only two species have been found here, the possible fern *Rhodeopteridium machanekii* and the seed plant *Sphenopteridium macconochiei*. It has also yielded some exceptionally complete examples of leaves of the ?progymnosperm (i.e. probably belonging to the immediate ancestors of seed plants) *Rhacopteris*, and of the early seed plant *Spathulopteris*, which have proved important for understanding the affinities of these plants. The club-mosses here include a small, leafy form (*Lycopodites*) very similar to the living *Lycopodium*. In contrast to many other fossil floras of this age from northern Britain, however, club-mosses are relatively rare and probably represent vegetation growing in drier habitats. A much closer comparison can be made with fossil floras found in continental Europe, in particular from Upper Silesia (Poland).

## [References](#)



(Figure 5.45) *Pothocites grantoni* Paterson. Cone of archaeocalamitid equisetopsid; Natural History Museum, London, specimen V.195. Glencarholm Volcanic Group (Holkerian–Asbian), Glencarholm. x 1. (Photo: Photographic Studio, Natural History Museum, London.)



(Figure 5.46) *Sphenopteridium pachyrrachis* (Göppert) Schimper. Almost complete pteridosperm frond; Natural History Museum, London, specimen V.186. Glencartholm Volcanic Group (Holkerian–Asbian), Glencartholm. x 1. (Photo: Photographic Studio, Natural History Museum, London.)