Culgower Bay

[NC 991 117]

Introduction

This is by far the most significant Late Jurassic flora in Britain, and it rates as one of the most important in Europe. It has yielded over 50 species of plants, including conifers, ginkgos, bennettites and ferns, the latter being particularly abundant and well preserved. They include several species recorded only from this locality and others recorded from only two or three of the other Sutherland floras.

The flora was discovered in the 19th century by an amateur palaeontologist, Marcus Gunn, who was to have collaborated with Albert Seward in describing the material. However, Gunn's death prevented this from happening and his collection was not described until Seward (1911) and Seward and Bancroft (1913) published their more general study on the Sutherland Jurassic flora. No further work appeared in print until that of van der Burgh (1987) and van Konijnenburg-van Cittert and van der Burgh (1989, 1996), upon which this account is based.

(Table 5.1) Floral composition of Lothbeg Point and Culgower Bay. The abundance of fossils is given as follows: +, 1–5 specimens; ++, 6–10 specimens; and +++, >10 specimens. Data from dispersed cuticles have been taken into account (from van Konijnenburg-van Cittert and van der Burgh, 1996).

	Lothbeg	Culgower
SPHENOPHYTA		
EQUISETALES		
Equisetum sp.	+	
PTERIDOPHYTA		
Angiopteris boweri (Seward) van Konijnenburg-van Cittert and van der Burgh	+	++
Aspidistes thomasii Harris	+	+
Asplenium rigidum Vassilevskaja		+
Coniopteris setacea Vakhrameev		+
Gleichenia boodlei		+
G. cycadina (Schenk) Seward	+++	+++
Hausmannia buchii (Andra) Seward	+++	+
H. dichotomy Dunker	++	++
Matonidium goeppertii (Ettingshausen) Schenk	++	+
Phlebopteris dunkeri (Schenk) Schenk	+	+++
Sphenopteris onychyopsis Seward		+
Sphenopteris sp.	+	+
Selleyopteris morayensis van Konijnenburg-van Cittert and van der Burgh		+
Todites denticulatus (Brongniart) Krasser	++	+
T. williamsonii (Brongniart) Seward	+	++
GYMNOSPERMOPHYTA		
CAYTONIAS		
Sagenopteris phillipsii (Brongniart) Presl	+	+++
PTERIDOSPERMS		

Cycadopteris jurensis (Kurr) Hirmer	+	
Dichopterispomehi (Saporta) Seward		+
Pachypteris lanceolata Brongniart	++	+++
CYCADALES		
Nilssonia brevis Brongniart		+
N. orientalis Heer	+	++
Pseudoctenis eathiensis (Richards) Seward	++	++
BENNETTITALES		
Pterophyllum cycadites Harris and Rest	+	++
P. thomasii Harris	+	+
Pterophyllum/Otozamites		+
Williamsonia sp.		+
Zamites buchianus (Ettingshausen) Seward		+
GINKGOALES		
Baiera cf. *muensteris* (Presl *in* Sternberg) Saporta		+
Ginkgo sp.	+	
Sphenobaiera longifolia (Pomel) Florin		+
CZEKANOWSKLALES		
Czekanowskia rigida Heer	+++	+
Phoenicopsis gunnii Seward	++	+
PINALES		
Araucarites milleri Carruthers		+
Brachyphyllum eathiensis Seward		++
Elatides curvifolia (Dunker) Nathorst	+	+++
(with attached male and female cones)		+
Elatocladus jeffiyi (Seward) van Konijnenburg-van Cittert and van der Burgh		+
Masculostrobus zeilleri (Seward)		+
Podozamites sp.		++
Tritaenia scotica van der Burgh and van Konijnenburg-van Cittert	+++	+++

Description

Stratigraphy

The Kimmeridgian succession of the Sutherland coast is dominated by bituminous shales with a fauna, including ammonites, that indicates deposition in a fairly deep shelf-sea. The Boulder Beds, which are interbedded with these shales, range from 1 to nearly 10 m in thickness. They consist of sandstones with boulders, and contain animal remains that indicate shallow water sedimentary environments. The age of the Boulder Bed succession has been determined principally from the ammonites, and the plant fossils at Culgower lie within the *Aulacostephanus exodus* Zone.

The Boulder Beds probably accumulated initially as a submarine fan, from which blocks of sediment slid relatively slowly down the submarine scarp. During deposition in the Culgower area the fault scarp was near sea level and covered by a vegetated delta (Neves and Selley, 1975; Johnson and Mykura, 1989).

Today the Kimmeridgian beds form a low-lying platform stretching out to sea from the base of low cliffs (Figure 5.4). The strata are much faulted and contorted, with a seaward dip and a strike that is roughly coincident with the coastline. The

richer plant beds are at the northern end of the bay.

Palaeobotany

A list of the 36 species from Culgower Bay is given in (Table 5.1) (see also (Figure 5.5)). Of these, the ferns *Gleichenites boodlii* and *Selleyopteris morayensis,* and the conifers *Araucarites milleri* and *Masculostrobus zeilleri* are known only from this locality: There are also specimens referred to simply as *Williamsonia* sp., *Otozamites* sp., *Brachyphyllum* sp., *Podozamites* sp. and *Elatocladus* sp., which might yet be determined as new species limited to Culgower. The fern *Sphenopteris onychyopsoides* is known only from Culgower, Lothbeg and Crakaig. The czekanowskialean *Phoenicopis gunnii* and the conifer *Taxodiophyllum scoticum* have been found only at this locality and the nearby Lothbeg Point, while the conifer *Taxites jeffreyi* is known only from Culgower and Eathie.

The fossils are preserved in a coarse calcareous sandstone, which has not led to good preservation. Nevertheless, the more robust cuticles of some seed plants survive and can be prepared. Dispersed cuticles have also been extracted from sediments at Culgower Bay and Lothbeg Point as part of a small palynofacies study (van Konijnenburg-van Cittert and van der Burgh, 1996). Some could not be determined to species level because they were fragments of the less characteristic species of such genera as *Nilssonia* and *Pseudoctenis* (Figure 5.5). Others of the genera *Czekanowskia* and *Phoeniciopsis* were far too small to be assigned to species with any degree of certainty.

Specimens of *Masculostrobus* and the male cone of *Elatides curvifolia* (Figure 5.5) have yielded pollen grains.

Interpretation

This important Upper Jurassic palaeobotanical site has yielded an exceptional fossil flora of Kimmeridgian (Late Jurassic) age, with over 50 species of conifers, ginkgos, bennettites and ferns. The assemblage is an interesting mixture of characteristically Early–Middle Jurassic and Early Cretaceous elements, and is thus transitional between typical Jurassic and Cretaceous floras. Many of the species have a wide geographical distribution, but others are more restricted and/or otherwise only known from such regions as Spitzbergen, Australia and the Far East. Several have been recorded only from this locality and others from only two or three of the Sutherland coast exposures.

Van Konijnenburg-van Cittert and van der Burgh (1989, 1996) suggested that the relatively large size of the fragments found at Culgower indicates a site of deposition close to the shore, possibly in a shallow basin within a delta. The deposits include boulder beds that are thought to have slid down the slope of one of the regional faults, stretching and cracking the larger leaves in the process. The authors' ecological analysis of the flora has suggested a lush river-border vegetation with many ferns and gymnosperms making up over half of the assemblage. This riparian habitat merged into both freshwater backswamps, with *Elatides curvifolia* and *Taxodiophyllum scoticum,* and into upland forest, with plants such as *Aspidistes thomasii, Elatocladus* sp. and *Phoenicopis gunnii.* The influence on the fossil assemblage of the only heathland plant, *Phlebopteris dunkeri,* and saltmarsh plants such as *Gleichenites cycadina, Hausmannia buchii, H. dichotoma* and *Pachypteris lanceolata,* are restricted, although the latter obviously less so.

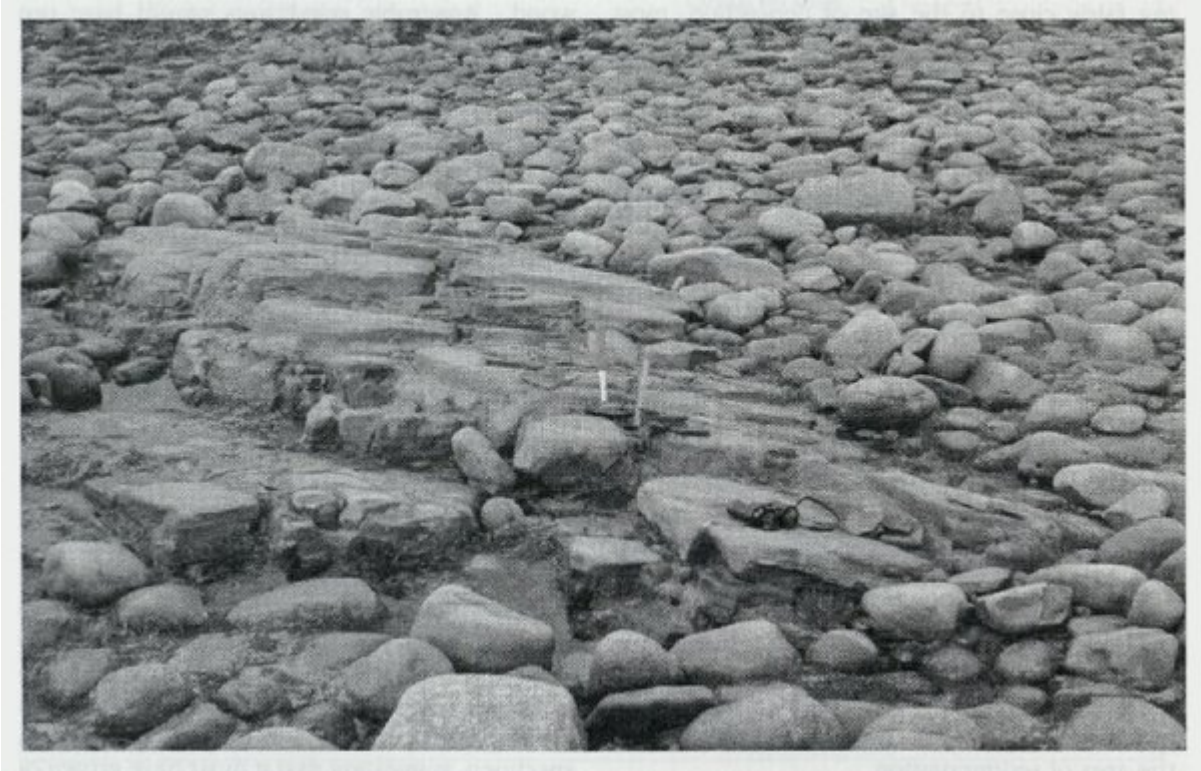
Conclusions

The Culgower assemblage is the most important Kimmeridgian (Late Jurassic) flora in Britain and possibly Europe, providing a valuable insight into the vegetation growing here 140 Ma ago. Of the nearly 40 species that have been found, four are unique to the site and several others may also eventually prove to be so. The large assemblage is less affected by taphonomic sorting than assemblages at the other Sutherland sites and therefore gives a fuller picture of the flora that existed at the time.

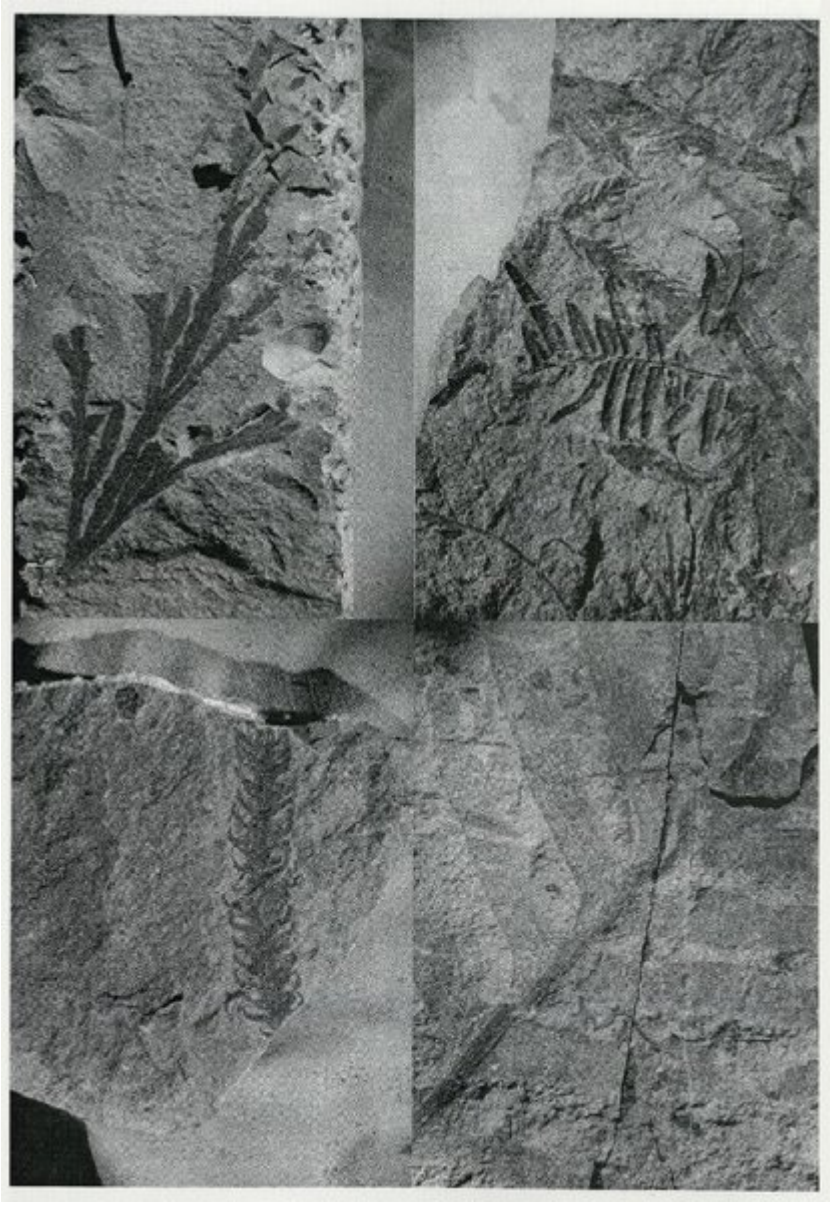
References

	Lothbeg	Culgower
SPHENOPHYTA		
EQUISETALES		
Equisetum sp.	+	
PTERIDOPHYTA		
Angiopteris bowerí (Seward) van Konijnenburg-van Cittert and van der Burgh	+	++
Aspidistes thomasii Harris	+	+
Asplenium rigidum Vassilevskaja		+
Coniopteris setacea Vakhrameev		+
Gleichenia boodlei		+
G. cycadina (Schenk) Seward	+++	+++
Hausmannia buchii (Andrä) Seward	+++	+
H. dichotoma Dunker	++	++
Matonidium goeppertii (Ettingshausen) Schenk	++	+
Phlebopteris dunkeri (Schenk) Schenk	+	+++
Sphenopteris onychyopsis Seward		+
Sphenopteris sp.	+	+
Selleyopteris morayensis van Konijnenburg-van Cittert and van der Burgh		+
Todites denticulatus (Brongniart) Krasser	++	+
T. williamsonii (Brongniart) Seward	+	++
GYMNOSPERMOPHYTA		
CAYTONIAS		
Sagenopteris phillipsii (Brongniart) Presl	+	+++
PTERIDOSPERMS		
Cycadopteris jurensis (Kurr) Hirmer	+	
Dichopteris pomelii (Saporta) Seward		+
Pachypteris lanceolata Brongniart	++	+++
CYCADALES		
Nilssonia brevis Brongniart		+
N. orientalis Heer	+	++
Pseudoctenis eathiensis (Richards) Seward	++	++
BENNETTITALES		
Pterophyllum cycadites Harris and Rest	+	++
P. thomasii Harris	+	+
Pterophyllum/Otozamites		+
Williamsonia sp.		+
Zamites buchianus (Ettingshausen) Seward		+
GINKGOALES		
Baiera cf. muensteris (Presl *in* Sternberg) Saporta		+
Ginkgo sp.	+	
Sphenobaiera longifolia (Pomel) Florin		+
CZEKANOWSKIALES		
Czekanowskia rigida Heer	+++	+
Phoenicopsis gunnii Seward	++	+
PINALES		
Araucarites milleri Carruthers		+
Brachyphyllum eathiensis Seward		++
Elatides curvifolia (Dunker) Nathorst (with attached male and female cones)	+	+++
		+
Elatocladus jeffryi (Seward) van Konijnenburg-van Cittert and van der Burgh		+
Masculostrobus zeilleri (Seward)		+
Podozamites sp.		++
Tritaenia scotica van der Burgh and van Konijnenburg-van Cittert	+++	+++

(Table 5.1) Floral composition of Lothbeg Point and Culgower Bay. The abundance of fossils is given as follows: +, 1–5 specimens; ++, 6–10 specimens; and +++, >10 specimens. Data from dispersed cuticles have been taken into account (from van Konijnenburg-van Cittert and van der Burgh, 1996).



(Figure 5.4) Kimmeridgian plant beds at Culgower Bay, Sutherland. (Photo: B.A. Thomas.)



(Figure 5.5) N. Representative plant fossils from the Kimmeridgian of Culgower Bay. Upper left, Pachypteris lanceolata Brongniart (pteridosperm), × 0.5. Upper right, Phlebopteris dunkeri (Schenk) Schenk (fern), × 1. Lower left, Elatides curvifolia (Dunker) Nathorst (conifer), × 1. Lower right, Pseudoctenis eathiensis (Richards) Seward (cycad), × 0.5. (Photos: J.H.A. van Konijnenburg-van Cittert.)