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# Craig-y-Fro Quarry

## Highlights

Craig-y-Fro Quarry has yielded one of the best preserved Devonian plant fossil assemblages from Britain, second only to the Rhynie Chert assemblage. It is the type locality for *Gosslingia breconensis* Heard and *Sennicaulis hippocrepiformis* Edwards, and the only locality to yield *Tarella trowenii* Edwards and Kenrick, *Hostinella heardii* Edwards and *Krithodeophyton croftii* Edwards. The latter is of particular interest as being the only record of a member of the Barinophytales from Britain.

## Introduction

This disused quarry, cut in Old Red Sandstone clastic sediments, is in the Brecon Beacons, between the towns of Brecon and Merthyr Tydfil [SN 971 208]. At different times it has been called Brecon Beacons Quarry, Storey Arms Quarry and Craig-y-Fro Quarry, the latter name being adopted here because it is geographically more precise. Plant fossils from here were first described by Heard (1926, 1927, 1939), who noted that some of the specimens were petrifications. His method of preparing these petrifications led to their destruction, however, and the only permanent record of them was a series of photographs, most of which are now believed to be lost (Edwards, 1970a, p. 226). Plant fossils from Craig-y-Fro were also recorded by Crookall (*in* Robertson, 1932) and Cox and Heard (1937). In their classic study on the Senni Beds flora, Croft and Lang (1942) recorded material from this locality and figured a small piece of *Nematothallus*, but most of their material came from Llanover Quarry (p. 67). They made little effort to study the Craig-y-Fro petrifications, and were mainly interested in the coalified compressions. This aspect of the assemblage has only been studied in detail in recent years, following the development of improved sectioning techniques compared with those used by Heard (Edwards, 1968, 1969a, b, 1970a, 1980a, 1981; Edwards and Kenrick 1986; Kenrick and Edwards, 1988a; see also Edwards and Banks, 1965; Shute and Edwards, 1989).

## Description

### Stratigraphy

The geology has been described by Edwards and Richardson (*in* Friend and Williams, 1978). A thickness of about 14 metres of fluvial sandstones and siltstones belonging to the Senni Beds is exposed, and includes four horizons yielding plant fossils (Figure 4.16). The biostratigraphy has been discussed by Edwards and Kenrick (1986), who suggest that it is lower Siegenian, based on palynological evidence.

### Palaeobotany

The plant fossils are preserved mainly as impressions or heavily carbonized compressions. However, some pyritized petrifications also occur. The following assemblage has been described to date:

Phaeophycophyta(?):

*Prototaxites* sp.

*Nematothallus* sp.

Chlorophycophyta(?):

*Pachytheca* sp.

Rhyniopsida:

*Uskiella spargens* Shute and Edwards

Zosterophyllopsida:

*Zosterophyllum llanoveranum* Croft and Lang

*Z* cf. *fertile* Leclercq

*Gosslingia breconensis* Heard

*Deheubarthia splendens* Edwards, Kenrick and Carluccio

Lycopsida:

*Drepanophycus spinaeformis* Göppert

Trimerophytopsida:

*Dawsonites arcuatus* Halle

Barinophytales (*incertae sedis*):

*Krithodeophyton croftii* Edwards

Uncertain affinities:

*Tarella trowenii* Edwards and Kenrick

*Sennicaulis hippocrepiiformis* Edwards

*Hostinella beardii* Edwards

cf. *Taitia* sp.

'spherical or circular bodies *incertae sedis*'

## Interpretation

*Pachytheca* was recorded by Croft and Lang (1942). Heard (1927) had earlier described similar fossils, but with a tuberculate surface. Their internal structure is not well preserved and so they were not named by Heard, and Croft and Lang simply referred to them as 'spherical or circular bodies *incertae sedis*'.

Heard (1939) identified a pyritized specimen as cf. *Prototaxites* (*Nematophyton*) sp. The central part of the specimen had a pseudoparenchymatous anatomy typical of *Prototaxites*. This was surrounded by an amorphous layer referred to by Heard as a cortex, but which may be a product of the breakdown of organic tissue in the outer part of the specimen.

Heard (1939) also identified *Taitia* from here, and was supported in this by Crookall (1930), the original author of the form-genus. However, the figured specimen is poorly preserved and the record has been included in the above species list as doubtful.

The Rhyniaceae is represented by adpressions of *Uskiella spargens* Shute and Edwards (1989). Much of the key information about this species was determined from the petrifications from Llanover. However, the Craig-y-Fro specimens have demonstrated details of the stem branching pattern and the attachment of the sporangia (Figure 4.17).

Much of the anatomical detail of *Zosterophyllum llanoveranum* described by Edwards (1969a) was based on the limonite petrifications from Llanover Quarry, but the same features could also be seen in the Craig-y-Fro pyrite petrifications. She

noted, however, that petrified sporangia are more abundant at Craig-y-Fro, and that they yielded better preserved spores. She also found evidence of a possible tapetal structure surrounding the spores, not seen in the Llanover Quarry specimens.

Craig-y-Fro is the type locality for *Gosslingia breconensis* (Figure 4.18). The original descriptions (Heard, 1926, 1927) were brief, but covered the main features of the plant, and his conclusions have been mostly supported by subsequent studies (Croft and Lang, 1942; Edwards and Banks, 1965; Edwards, 1970a). The only significant exception is his interpretation of the small protuberances found below the branches of the axes, which he believed to be the remains of specialized 'sporangiferous branches'. The specimens described by Croft and Lang (1942) showed that the sporangia were in fact attached laterally to the axes, and were not aggregated into terminal spikes as in *Zosterophyllum*.

The most comprehensive description of *Gosslingia* is by Edwards (1970a), whose study was based mainly on specimens from Craig-y-Fro. Taxonomically significant features discussed by Edwards include the exarch xylem strand with an oval cross-section, and the laterally borne sporangia with a well developed distal dehiscence structure. Both features support its inclusion within the Zosterophyllopsida, as do details of the structure of the tracheids (Kenrick and Edwards, 1988a). Edwards discussed the nature of the axillary 'tubercle' found below each dichotomous branching point on the main axis, concluding that it was probably the remains of a third branch originally attached to the axis below the dichotomy, but which became detached either before or during preservation. The discovery by Banks and Davis (1969) of a subaxillary branch in *Crenaticaulis*, another member of the Zosterophyllopsida, lends support to this interpretation.

Another probable member of the Zosterophyllopsida has been described from Craig-y-Fro by Edwards and Kenrick (1986) as *Tarella trowenii*. *Tarella* shares many features with *Gosslingia*, particularly the organization, orientation and general distribution of the sporangia, but it differs in having sporangia distributed in two vertical rows on opposite sides of the axes, in having isotomous branching of the main axial system, and in showing no evidence of axillary tubercles. *Tarella* also has prominent protuberances on the surface of the axes, not seen in *Gosslingia*, although the exact nature of these structures is uncertain. So far, no undoubted petrified axes of *Tarella* have been reported. Consequently, the form of the xylem strand is unknown, a feature essential before the form-genus can be unequivocally placed in the Zosterophyllopsida (Edwards and Edwards, 1986).

A species unique to Craig-y-Fro is *Krithodeophyton croftii* Edwards, 1968. It has naked, dichotomous axes bearing terminal, fertile spikes. The latter comprise of two vertical rows of alternating sporangia and sterile bracts. It compares closely with *Protobarinophyton* described from the Lower Devonian of Siberia (Ananiev, 1957), and is generally placed in the order Barinophytales. If this assignment is correct, it is the only member of the Barinophytales to have been described from Britain, and the oldest member of the order reported from anywhere in the world.

A number of petrified axes were included in *K croftii* by Edwards (1968), but were later transferred by Edwards (1980a) to a separate species, *Hostinella heardii*. They are of only passing botanical interest, consisting merely of naked, dichotomous axes with a terete, centrarch xylem strand. However, Edwards (1980a) used them to explain how the tracheids became petrified. This seemed to have occurred in two phases: firstly, the filling of the tracheid lumen with pyrite; and then the replacement of the cell wall by pyrite. Little or no organic material seems to have remained (see also Kenrick and Edwards, 1988a).

A second type of petrified axis has been described as *Sennicaulis hippocrepiiformis* Edwards (1981). It is represented by just a few specimens of smooth surfaced axes with a terete centrarch xylem strand, consisting of tracheids with distinctive helical and annular secondary thickenings. It probably belongs to either the Rhyniopsida or Trimerophytopsida.

The 'pyritized fructification' described by Heard (1939) is a small capsule containing 250 µm diameter spherical objects. The latter were interpreted by Heard as spores, but they are far too large for this (they are more the size of megaspores) and show no evidence of a trilete mark. It is impossible to be certain at present exactly what this structure was.

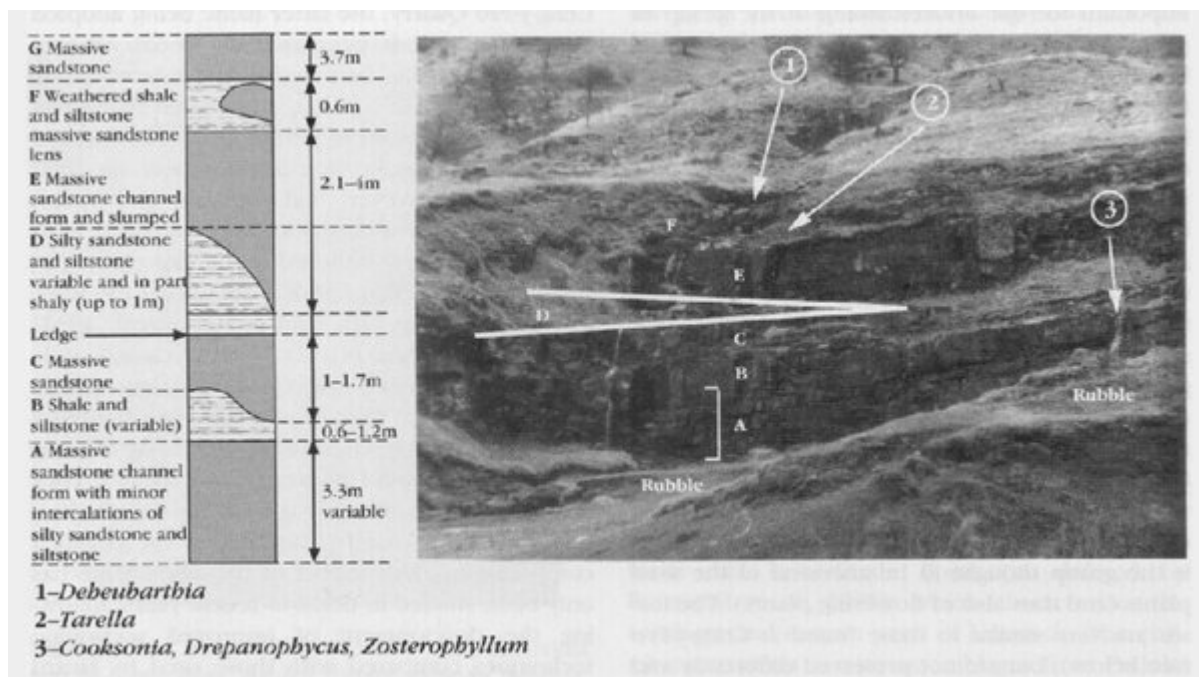
The Craig-y-Fro assemblage is part of what is known as the Senni Beds group of floras, as described by Croft and Lang (1942). It belongs to the *Psilophyton* Zone of Banks (1980), and to the European phytogeographic subunit of Raymond *et al.* (1985) (comparable assemblages are dealt with in the discussion on Llanover Quarry, earlier in this chapter). It is

second in diversity only to that found at Llanover Quarry, and includes some taxa not found there (*Tarella trowenii*, *Krithodeophyton croftii*, *Hostinella heardii*). It also yields pyrite petrifications, which show the internal anatomy of the plants in finer detail than the limonite petrifications of Llanover. Other than the Rhyrie Chert assemblage, they represent the most completely known Devonian fossil plants from Britain.

## Conclusion

Craig-y-Fro Quarry has yielded some of the best preserved Devonian plant fossils in Britain, second only in quality to those found in the Rhynie Chert (see below). They are about 400 million years old, and represent a flora typical of the southern and eastern margins of Laurussia. It is the best locality for two important types of early land plants, *Gosslingia* and *Tarella*. The first, and possibly the second of these are zosterophylls, which represent the ancestors of the club-mosses that dominated much of the land vegetation later in the Palaeozoic, including the Late Carboniferous equatorial coal swamps (see Chapter 7). It also has the earliest known example of a barinophyte (*Krithodeophyton*), which is one of the early groups of plants that adapted to the land environment during the Devonian, but which soon after disappeared, leaving no evolutionary successors. The fossils here are very similar to those from Llanover Quarry (see earlier in this chapter), but are more robustly preserved, which often makes them easier to study anatomically. Similar assemblages have also been reported from Belgium and Ukraine, but they have not been studied in such detail, and do not yield such well-preserved anatomical details.

## References



(Figure 4.16) Craig-y-Fro Quarry. Sedimentological log through the exposed part of the Senni Beds, and a view of the quarry face showing the main beds. Also shown are three of the main plant-bearing horizons. Partly based on Friend and Williams (1978, figure 40). (Photo: D. Edwards.)



(Figure 4.17) *Uskiella spargens* Shute and D. Edwards. Branched axes bearing terminal sporangia; Natural History Museum, London, specimen V.26461a. Senni Beds (Siegenian), Craig-y-Fro Quarry. x 1. (Photo: Photographic Studio, Natural History Museum, London.)



(Figure 4.18) *Gosslingia breconensis* Heard. Branched axes with some lateral sporangia; Natural History Museum, London, specimen V.26575. Senni Beds (Siegenian), Craig-y-Fro Quarry. x 0.5. (Photo: Photographic Studio, Natural History Museum, London.)