Excursion 2 Fossil Grove

Key details

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Theme	In situ remains of Carboniferous lycopod trees, their surrounding sediment, and intrusive late Carboniferous quartz dolerite sills, in Victoria Park, Glasgow.
Features	Sand-filled internal moulds of the root systems and basal portions of lycopods; drifted logs; shale and sandstones, the latter showing bedding plane surfaces sometimes with ripple marks; small scale cross bedding; intrusive quartz dolerite sheets exhibiting rapid lateral changes in thickness.
Maps	O.S. 1:50 000 Sheet 64 Glasgow & surrounding area B.G.S. 1:63 360 Sheet 30 Glasgow
Terrain	Paths in Victoria Park.
Time	30 minutes–1 hour.
Access	Enter Victoria Park from the main gate in Victoria Park Road (where parking is easy) and follow the path past the tennis courts; signs to the Fossil House lead (past the minature golf course) to the western end of the park where the Fossil House is situated. Improvements are gradually being made in the viewing facilities and in the explanatory exhibits. It is hoped to have an attendant in charge from whom the helpful illustrated guide-book (MacGregor and Walton 1972) may be purchased. Being situated in a public park, the opening times are more restricted in winter. It is wisest to check times with the Glasgow Tourist Information Office (041–204. 4400) or with Glasgow City Council direct (041–221. 9600).

Hammering is forbidden and hammers should not be carried.

The Fossil House [NS 538 674], gardens, and fish pond are situated in what was once a whinstone quarry which ceased to be worked over one hundred years ago. Whinstone is a dolerite, and was used as an aggregate for road construction. When the area of the quarry was incorporated into Victoria Park, a path being cut across the lower part of the floor in 1887 revealed the fossil trees, which were then carefully excavated, and the present building constructed to protect them. Although occurrences of similar Carboniferous trees are not uncommon, this is the only site in the world where they have been preserved in situ. Fossil Grove is therefore truly unique and justifies its designation by the Nature Conservancy Council as a Site of Special Scientific Interest. The trees occur in the lower part of the Limestone Coal Group. The following geological itinerary is divided into two parts: the first a visit to the trees inside the building, the second a look at the surrounding rocks exposed in the grounds of Fossil Grove.

The public normally enters at the eastern end of the Fossil House, but the map (Figure 2.1) allows the itinerary to be followed from either end. The first objects noticed by the visitor are undoubtedly the tree stumps themselves (Figure 2.2). There are 11 in all, although only 9 can be clearly seen today. The trees probably represent a mature stand with no saplings as they are roughly equally spaced and of a similar size. It is unlikely that they represent the whole of the plant community living at the time, but only the most durable part was preserved when buried by inundation: little or no foliage such as leaves occurs in association with the trunks. The preserved heights range from 15 cm to 68 cm. The trmiks are elliptical in cross section, the longest diameter orientated in a N.E.–S.W. direction, with average dimensions of 91 cm in the long direction and 61 cm in the shorter. It is interesting to note that the stumps with the greatest preserved height also show the greatest deviation from a circular cross section.

Each stump has four main roots, each of which divides into two equal branches; some do this twice, giving 16 end branches. The roots do not penetrate very deeply downwards, which is very typical of modern swamp dwelling trees. Evenly spaced indentations are present on the roots, which in life were the sites of smaller rootlets capable of absorbing water. The stumps are preserved as internal moulds: when the trees died the soft inner material decomposed, leaving the tough outer bark to enclose a hollow cylinder; this cylinder was then infilled with sand which ultimately formed a mould of the inside of the tree. When the stumps were first discovered they still had a coating of carbonaceous material derived from the decomposition of the bark, but this has since decomposed.

Immediately in front of the eastern viewing balcony is a fallen tree trunk about 7 m long which is clearly flattened, due to compression caused by burial in a thick sequence of sediments (A on (Figure 2.1)). It has a much smaller diameter than the stumps. Other pieces of trunk can be seen within the grove; a thicker piece(B) is present on the northern side of the house (right hand side when viewing from the eastern balcony), partially overlying Trunk no.3 (B on (Figure 2.1)), and a prominent piece is present on a projecting rock on the south side of the house (C). Closer inspection reveals a network of diamond-shaped meshes on the surfaces of some of these branches, which are scars left by leaves when they fell off the branch. This pattern has led to the name of 'scale tree' for this type of Carboniferous tree. The bedding planes adjacent to C have ripple marks which are slightly asymmetric, and indicate water flow to the SW: another ripple marked surface (D) is present adjacent to the left of the viewing gallery.

Turning our attention to the rocks of the grove, four different types can be seen from the viewing gallery. The sediment in which the roots occur is a finely laminated sandy muds tone usually described as a shale, and this forms much of the floor of the house. This would have originally been a mud and subsequently a soil horizon in which the trees grew; small rootlets are common, especially in the vicinity of stump 11. A dolerite sill is also present at this level and forms much of the floor in the central areas of the house away from the immediate vicinity of the trunks: the sill can be seen to have an undulating surface. It is a tongue of a much larger intrusive sheet which may be examined hi the grounds outside the Fossil House. These thin tongues of dolerite intruded into the shales have been altered to a rusty yellow coloured rock by the liberation of carbon dioxide from the shales caused by the heat of the intrusion, although this has not affected the thick dolerite of the main mass of the sill. The trunks are preserved within a sandstone with occasional ripple marked bedding planes; none of the trunks reaches the top of this unit.

Overlying the sandstone are shaley sediments, including finely laminated siltstones with sand partings. Bedding planes with a dip to the NE are well displayed within the sandstone and the overlying shale. Further wedges of dolerite sill thickening to to the west occur along the walls of the house, and are best seen from the western balcony. One in the lower shale along the north wall is 80 cm. thick in the west, but tapers out before the eastern viewing gallery is reached; this cuts two of the trunks, including trunk 9 which was repaired with a concrete spacer after damage during the Second World War.

The trees are obviously preserved in position of growth, which is believed to have been a lowland swamp environment. The roots of these trees are named *Stigmaria* (Figure 2.2) and (Figure 2.3), and are typical of a group of Carboniferous plants referred to as lycopods. Many different lycopods had roots and trunks similar to those found at Fossil Grove, so it is not certain to which they should be assigned, although they are commonly placed in the genus *Lepidodendron* (Figure 2.3). These trees grew to a height of 30 m., and had a straight trunk with a crown of branches; the younger parts of the branches and trunk were covered with small leaves which left diamond shaped scars when they fell off. The smaller branches bore cones up to a foot in length, which contained reproductive spores. These great forest-forming trees of the Carboniferous are now extinct, their only living relatives being the small club mosses found on wet hillsides or stream banks at the present day.

The trunks at Fossil Grove are preserved as sand moulds, so no original internal plant material is present. However, lycopod trees have been found with their original tissue preserved at other localities in Scotland (eg. Saltcoats: Excursion 17), so it is possible to describe the type of structure that would have been present in the trees of Fossil Grove. The trunk and branches had a thick strong bark, but only a relatively small amount of wood in the centre which in turn had a soft pith core; between the bark and the wood the cortex was mostly composed of a soft tissue. This structure meant that upon death selective decay occurred, with the soft inner bark, most of the cortex, and the central pith rapidly disintegrating, but the main part of the bark, parts of the cortex, and the inner wood being more resistant. It is this partial

decay, with the trunks retaining their shape after death, that allowed the introduction of sand into the rotting interior of the trunks and hence their preservation as internal moulds.

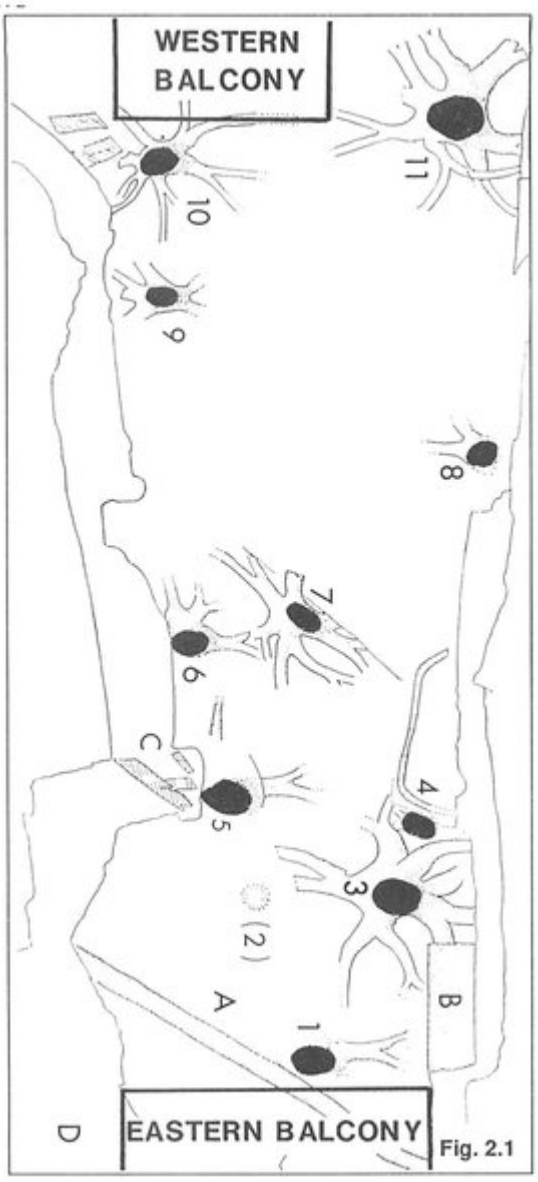
So what were the events leading to the formation of the fossils? The trees were growing in the alluvial mud of a hot humid lowland swamp; an influx of sediment, represented by the siltstones covering the basal portions of the stumps, associated with flooding of the area, killed the trees. It is not clear whether the submergence of the lower parts of the trees in fairly permanent water, or the increased sediment supply was the more important factor in their death. After death the softer tissues of the trees decayed, and the trunks snapped at varying heights above the ground, perhaps due to slight variations in the rate of decay. The standing portions were already partially hollowed before the influx of the sands which subsequently filled them. The sandstone bed containing the trunks is 90 cm thick. It is mostly thick-bedded with only occasional ripple marked surfaces, but becomes thinner bedded with more ripple marks in its upper layers. This suggests the lower parts were deposited in much faster moving waters than the upper parts. This could have been the result of a nearby river channel breaking its levee banks, the water pouring out as a crevasse splay, and flooding the neighbouring areas of the lower lying swamps of the river's flood plain. The velocity of the water would have eventually slowed down, but by then the hollowed trunks had been partially infilled with sand. The ellipsoidal shape of the trunks has usually been attributed to deformation during folding of the rocks at a much later date. However in the scenario presented above, the deformation would have been the result of 'streamlining' or distortion of the hollowed trunks. This would have been caused by sand deposition in a high energy flow regime of sediment laden flood waters coming from the north east (Gastaldo 1986).

The rock gardens outside the fossil house are in quartz-dolerite, the 'whinstone' for which the original quarries were worked. It has already been seen that the thin dolerite tongues thicken westwards, and consistent with this the main sill in the gardens to the NW is seen to be at least six metres thick. The base of the sill can be seen at the end of the fishpond nearest the fossil house, where it rests on cross-bedded sandstone. Opposite the fishpond the edge of the sill intrudes the sediment and lifts up the overlying strata. These sandstone beds are well exposed on smooth surfaced bedding planes where the path from the fossil house descends towards the fishpond. It is possible to measure the true dip of the beds at this point where the bedding planes are well exposed; inside the Fossil House the sections cut through the rocks and exposed along the walls of the house show excellent apparent dips (true dip is the amount and direction of maximum inclination of the bedding plane measured from the horizontal, apparent dip is the amount of inclination in any other direction) . The fishpond therefore lies at one end of the sill. The dolerite of the sill can be examined (but no hammering!) in a narrow passage cut through it opposite the fossil house; it coarsens towards its interior. The dolerite was intruded long after the depostion of the sediments and belongs to an intrusive episode that occurred at the end of the Carboniferous period.

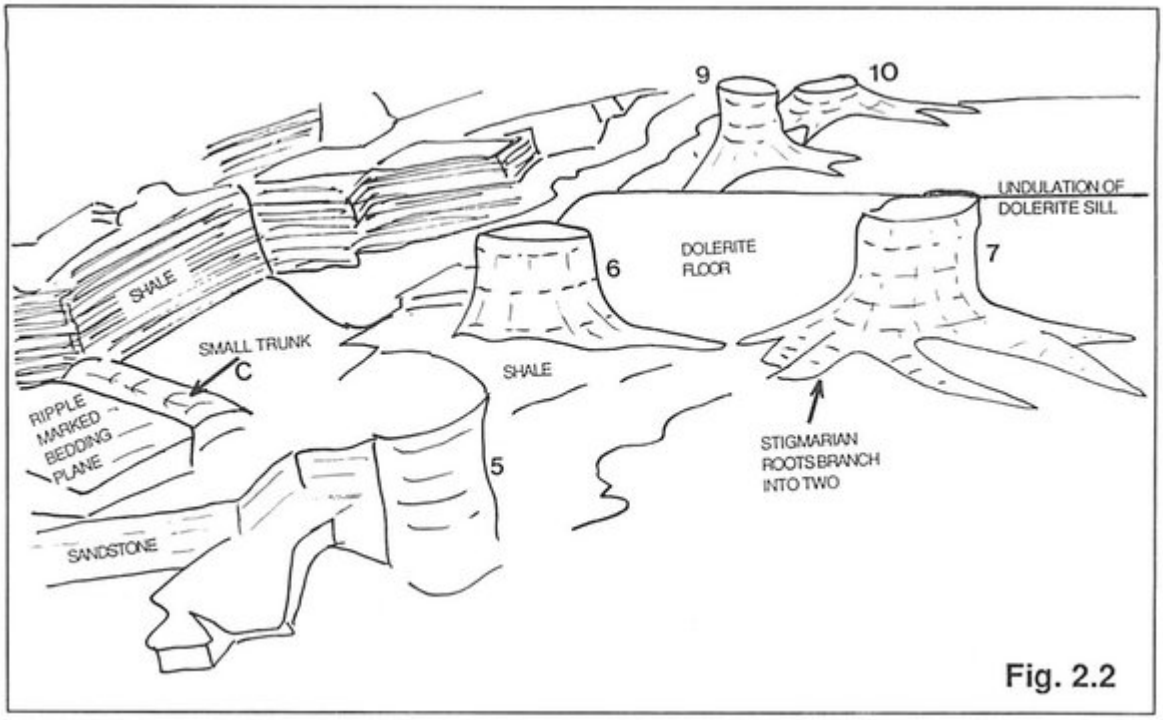
References

MACGREGOR, M. and WALTON, J., 1972. The story of the fossil grove. Glasgow D.C. Parks Dept., 32pp.

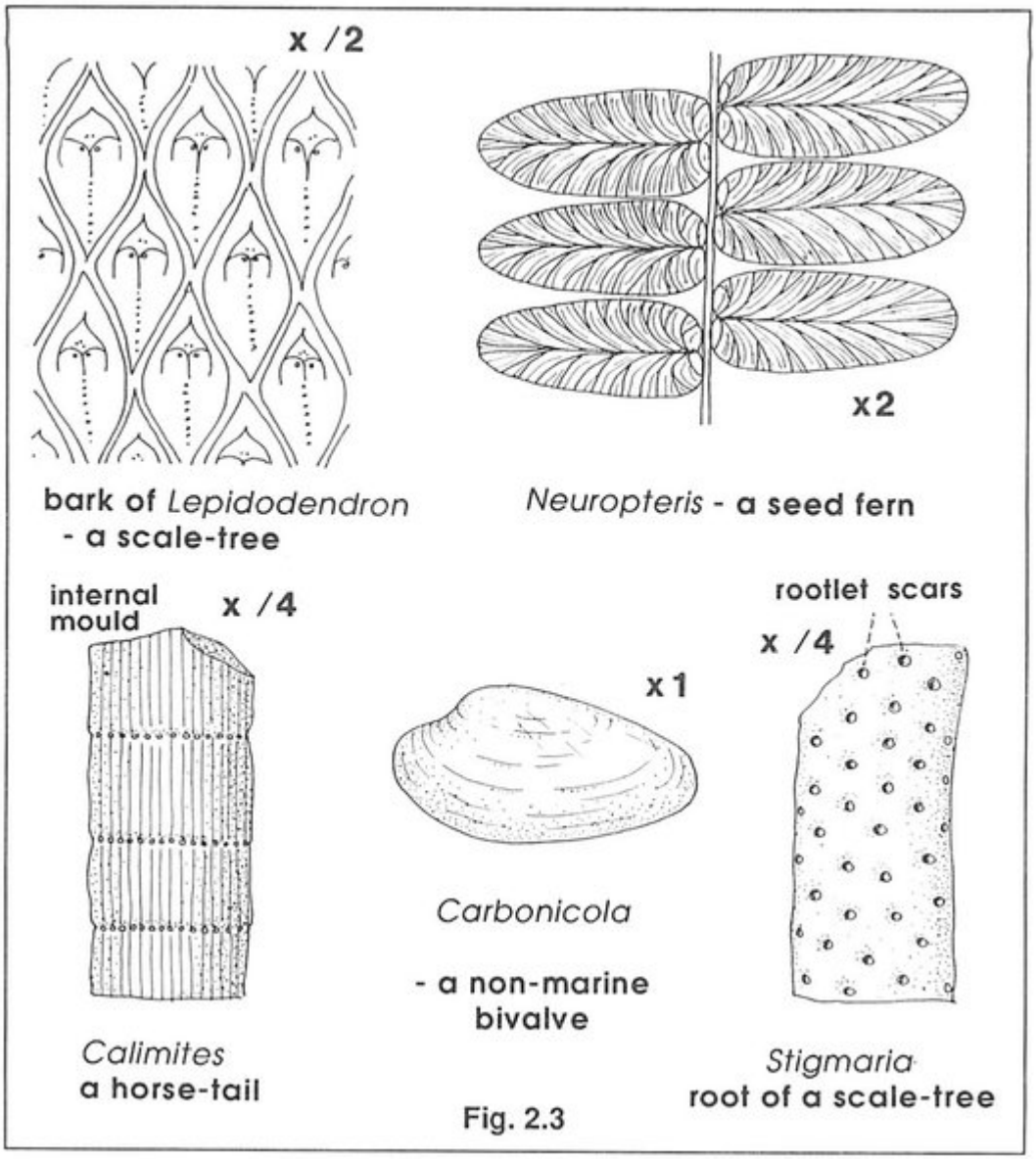
GASTALDO, R.A., 1986. An explanation for lycopod configuration, 'Fossil Grove' Victoria Park, Glasgow. Scott. J. Geol. 22, 77–83.



(Figure 2.1) Ground plan of Fossil Grove. See text for explanation (After MacGregor and Walton 1972).



(Figure 2.2) Sketch of the features seen from the eastern balcony. Numbers and letters refer to (Figure 2.1).



(Figure 2.3) Carboniferous non-marine fossils.