Birk Knowes

[SO 737 346]–[SN 738 348]

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Introduction

Birk Knowes on Logan Water in the Lesmahagow area, south of Glasgow, is one of a network of Silurian sites in the Midland Valley of Scotland and has been selected to represent late Llandovery age sediments with unusual and palaeontologically important arthropod and fish faunas. Sediments of similar lithology and age are exposed in the Hagshaw Group of the Hagshaw Hills to the south but the late Llandovery Priesthill Group siltstones of Birk Knowes have provided a greater diversity of fossils.

Lesmahagow is just one of a number of Silurian inliers (Figure 3.82) cropping out north of the Southern Uplands Fault along the southern flank of the Midland Valley from Girvan in the west to Loganlee, south of Edinburgh in the east. The outcrops show a range of sedimentary environments from deep marine (see Blair Farm GCR site description) to shallow water (see Gutterford Burn GCR site description). The stratigraphical relationships of the Lesmahagow sequence were originally thought to indicate a Ludlow age but studies by Robertson (1989), Walton and Oliver (1991), Rolfe (1992a), Wellman and Richardson (1993) and Phillips *et al* (1998) indicate an upper Llandovery, Wenlock and possibly Ludlow age.

The remarkable eurypterid arthropods of the inliers were first discovered in the middle of the nineteenth century (Murchison, 1859), followed by the remains of jawless (agnathan) fish (Powrie, 1870). These palaeontological discoveries established an international importance for a number of the Silurian localities in the Midland Valley and especially that of Birk Knowes, which has yielded the enigmatic arthropod *Ainiktozoon loganense* Scourfield,1937, the thelodont *Loganellia scotica* (Traquair, 1899) and the unique agnathan *Jamoytius kerwoodi* (White, 1946). Birk Knowes is the type locality for all three.

Description

The Birk Knowes locality consists of three small outcrops on Logan Water, separated by small faults and with poor exposure but potential for future development. Some 300 m of sediments within the Priesthill Group have been subdivided by Jennings (1961) and Ritchie (1968) into a number of formations on the basis of their lithologies (Figure 3.83). The oldest exposed rocks are the dark, finely laminated siltstones, non-laminated olive mudstones and interbedded greywackes of the Patrick Burn Formation, whose base is not seen but which is at least 400 m thick. Three succeeding formations of siltstones (Castle Formation, Kip Burn Formation and Blueberry Formation) surmounted by shales of the Dunside Formation at the top of the group are exposed at Shank's Castle nearby (see Dineley and Metcalf, 1999). Invertebrate fossils indicate a late Llandovery age for the Priesthill Group (Cocks *et al.,* 1992) and this is supported by the presence of the agnathan thelodont *Loganellia scotica,* which is widely distributed in the upper Llandovery of Eurasia (Märss and Ritchie, 1998). Elsewhere in the inlier the succession continues through the Wenlock age shales, sandstones and siltstones of the Waterhead Group, into the conglomerates and sandstones of the Dungavel Group (possibly Ludlow in age) and finally up into Old Red Sandstone conglomerates.

The fauna of the upper Llandovery sediments comprises rare and scattered marine shelly invertebrates and more concentrated remains of arthropods and agnathans. The latter occur in a few horizons of the laminated siltstones, which have consequently been characterized as 'fish beds' and separated (by some 200 m) as a lower *Jamoytius* Horizon in the Patrick Burn Formation and upper *Ceratiocaris* Beds at the base of the Kip Burn Formation.

Although fossils are not common, over the last hundred years or more of collecting, many hundreds of specimens have been found, including some entire but flattened agnathan fish and a variety of arthropods. Many of the fossils have been

found in small diagenetic calcareous concretions (< 50 mm in diameter and now largely decalcified). Disarticulated remains, such as patches and coprolitic strings of agnathan skin scales and even individual scales (1–2 mm long) are also found, showing that the animals were originally buried by sediment in varying states of decay.

Palaeontologically, the most interesting member of the fauna is the agnathan *Jamoytius kerwoodi* (180–200 mm long, (Figure 3.84)), which is unique to the locality and is only found in the *Jamoytius* horizon within the Patrick Burn Formation. It has an elongate 'eel-like' body, simple mouth and gill openings supported by a cartilaginous skeleton, possible hypocercal tail (having a large lower lobe) and very thin skin scales.

The thelodont agnathan *Loganellia scotica* is known by a number of complete flattened specimens and many separate scales (Märss and Ritchie, 1998). This is a medium sized thelodont (generally up to 275 mm in length but some specimens may have reached 400 mm, (Figure 3.85)) with a dorso-ventrally flattened head and thorax. The front of the head is blunt with a terminal mouth and fairly well-developed eyes. There are paired lateral fin flaps and an asymmetrical hypocercal tail with two prominent lobes of which the lower is slightly larger. Recent detailing of scale morphology for complete specimens by Märss and Ritchie (1998) reveals significant changes in different parts of the body and has allowed accurate comparison of many isolated scales for the first time.

Unusually amongst the agnathans of the Midland Valley, *L. scotica* has been found in Llandovery sediments of the Welsh Borderlands and Ireland, which gives it considerable biostratigraphical potential. Furthermore it has been shown to have a widespread distribution in the late Llandovery of Eurasia from Laurentia across Avalonia to Baltica.

Various arthropods have been found within the *Jamoytius* horizon including the enigmatic *Ainiktozoon,* the eurypterids *Slimonia, Pterygotus* and *Hughmilleria* and ceratiocarids (Figure 3.83).

Interpretation

The lithology of the late Llandovery sediments at Birk Knowes and their sequential changes up into the Wenlock elsewhere in the Lesmahagow Inlier indicate a marine regression. This interpretation is supported by correlative sequences in the other jailers of the Midland Valley and their changing faunas.

The greywackes of the Patrick Burn Formation are typically marine sediments (Jennings, 1961) and show current depositional movement towards the NNE. The succeeding siltstones and shales are neither diagnostically marine nor freshwater. Indeed there has been continuing debate over interpretation of the environments of deposition of the fish bed horizons. With sediments of this age, when there are few organisms that are known to be characteristically brackish or freshwater in habit, such a diagnosis has depended largely upon an absence of typically marine fossils. But both the sedimentology and occurrence of rare shelly invertebrates in Patrick Burn Formation have supported a marine interpretation. This is further supported by the occurrence of the widespread thelodont *L. scotica.* However, the occurrence of the fish bearing beds of the *Jamoytius* horizon, near the top of the formation with preservation of occasional entire agnathans and very few shelly benthic invertebrates, suggests that bottom conditions were anoxic and that the basin of deposition was becoming increasingly restricted in water circulation. The presence of mobile agnathans and arthropods, most of which were scavengers, supports this interpretation.

Palaeontologically, the locality has yielded two unique genera, both of which have generated considerable interest and debate. Most significant has been the discussion over the zoological affinities of *Jamoytius* within the agnathans. Some modern opinion places *Jamoytius* close to the extant lampreys (Forey and Janvier, 1994); if this designation is correct, *Jamoytius* is of considerable significance to the general discussion of relationships between fossil and extant agnathans (see Janvier, 1996 and Dineley and Metcalf, 1999 for reviews).

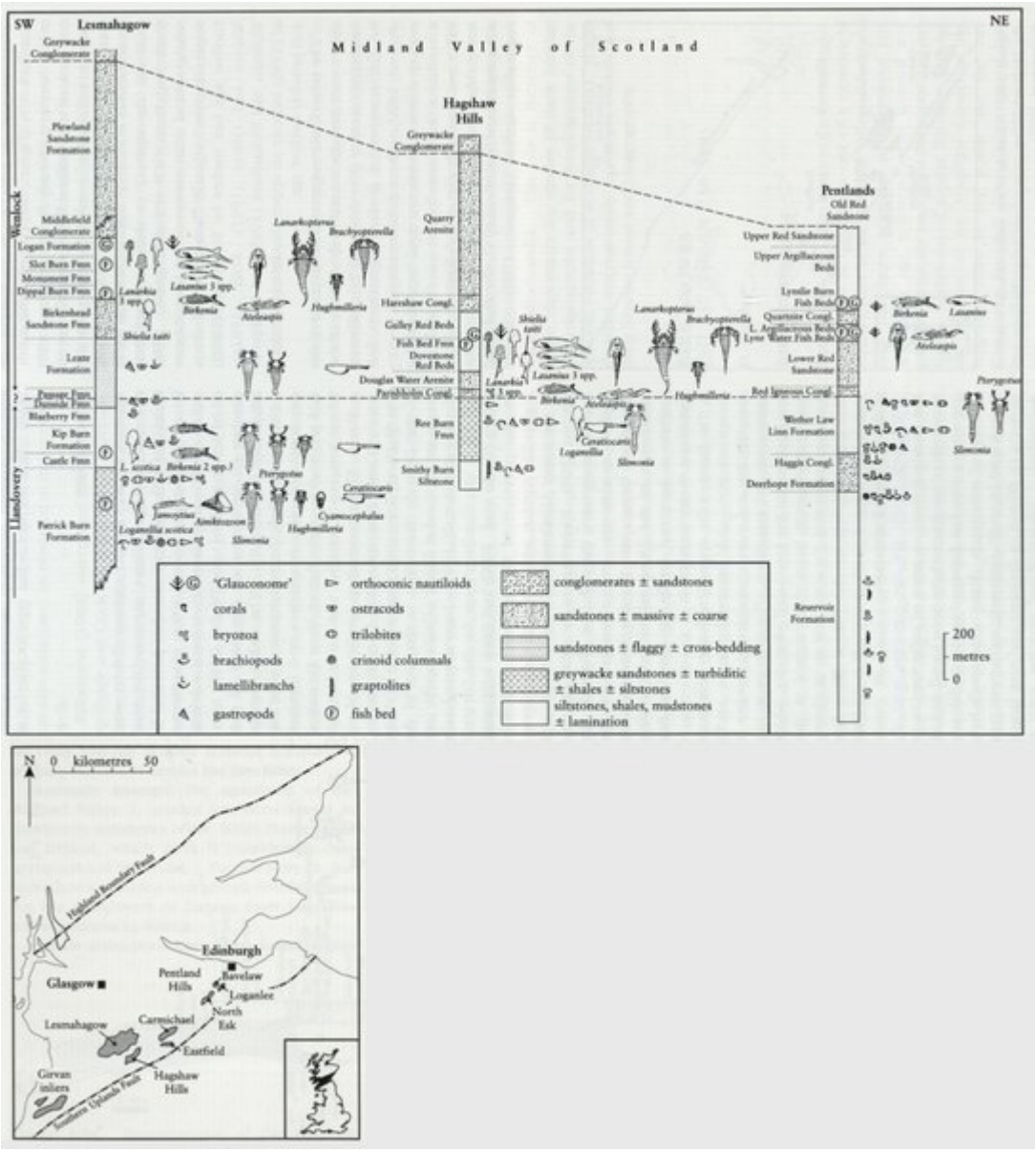
Ainiktozoon loganense Scourfield (1937) is palaeontologically the most curious member of the Birk Knowes fauna, with little comprehension of its affinities until recently. Its apparently bizarre morphology with an anterior compound eye, deep 'basket-like' body and jointed tail (total length up to 120 mm, (Figure 3.86)) misled early investigators into considering that it had chordate affinities (Ritchie, 1985). However, the recent realization that the so-called 'branchial basket' is in fact a carapace, that the 'eye' is paired and that the trunk bears paired paddle-like limbs (Brugghen *et al.,* 1997) altered the

whole perception of the animal and placed it more reasonably within the thylacocephalan arthropods. There may be some affinity with an as yet undescribed North American thylacocephalan from the Silurian of Waukeshau, Wisconsin.

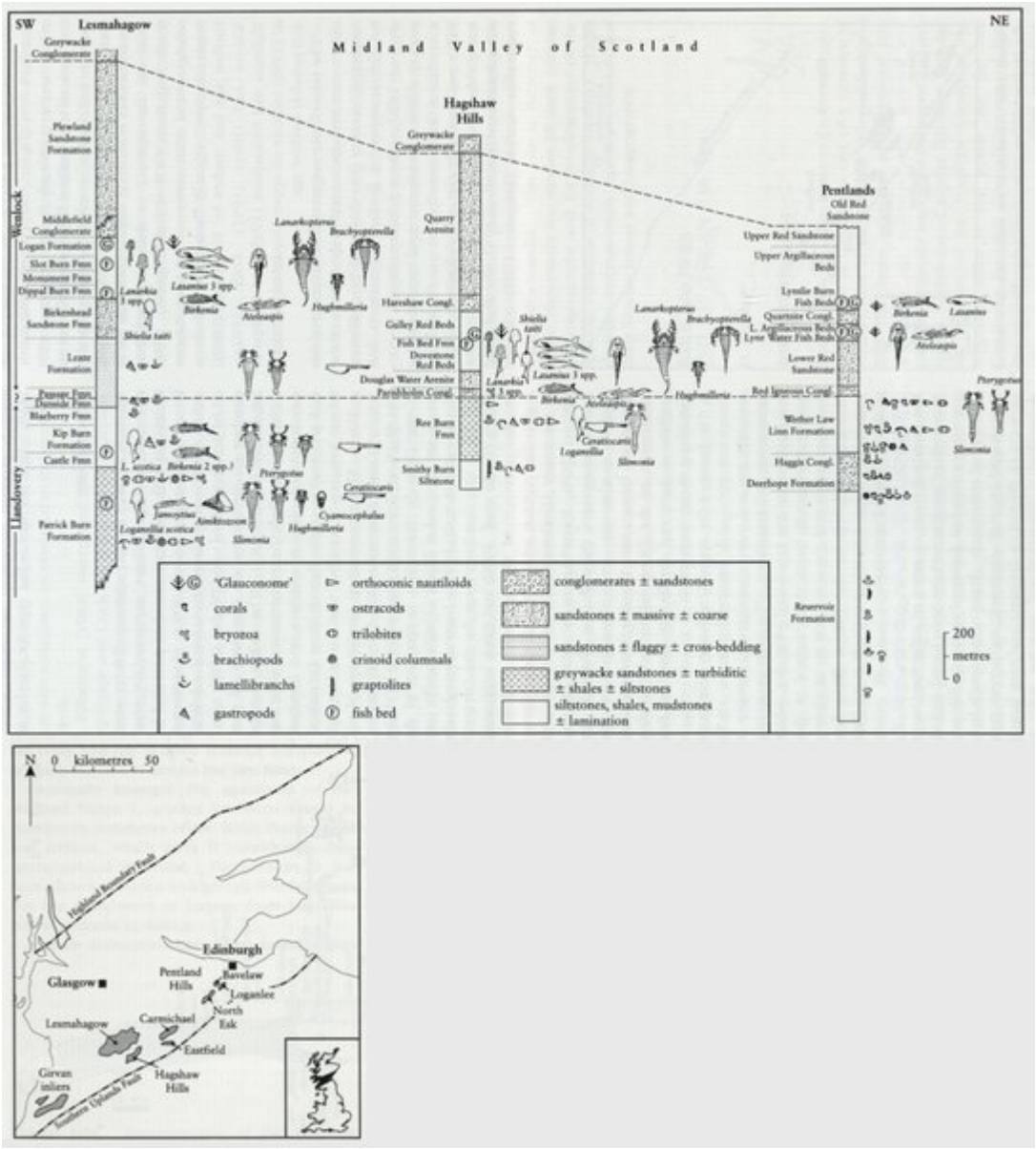
Conclusion

The conservation value of Birk Knowes is twofold. It has national significance as an excellent example of late Llandovery sediments in the Midland Valley of Scotland. The site has already attained GCR status for its fish fauna, which has elevated it to international significance as a result of its being the type locality for the unique agnathan *Jamoytius kerwoodi* and the biostratigraphically significant thelodont *Loganellia scotica,* which allows correlation with late Llandovery sediments in Wales, Ireland and elsewhere in Laurentia and Baltica. In addition it is the type locality for the unique Silurian thylaco-cephalan arthropod *Ainiktozoon loganense.*

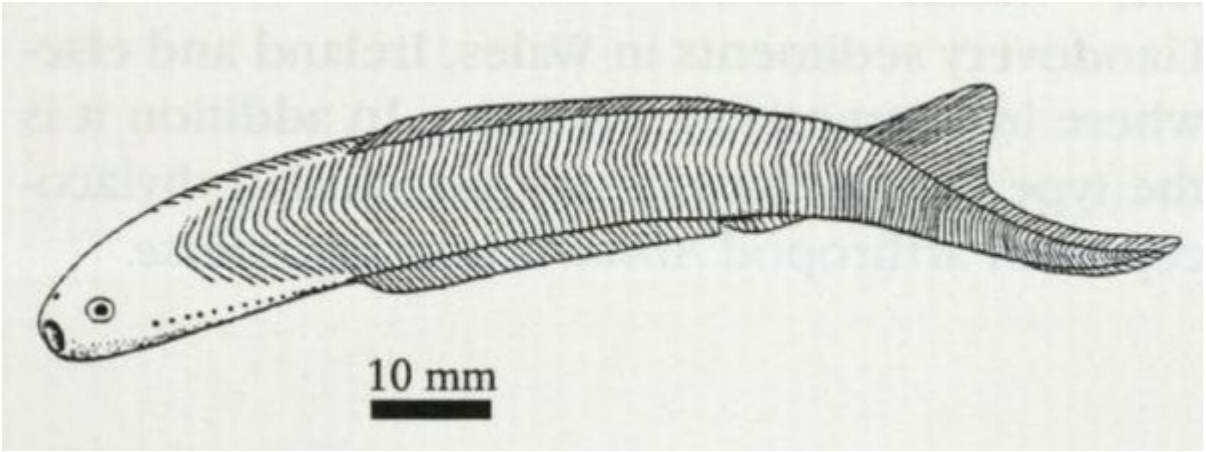
References



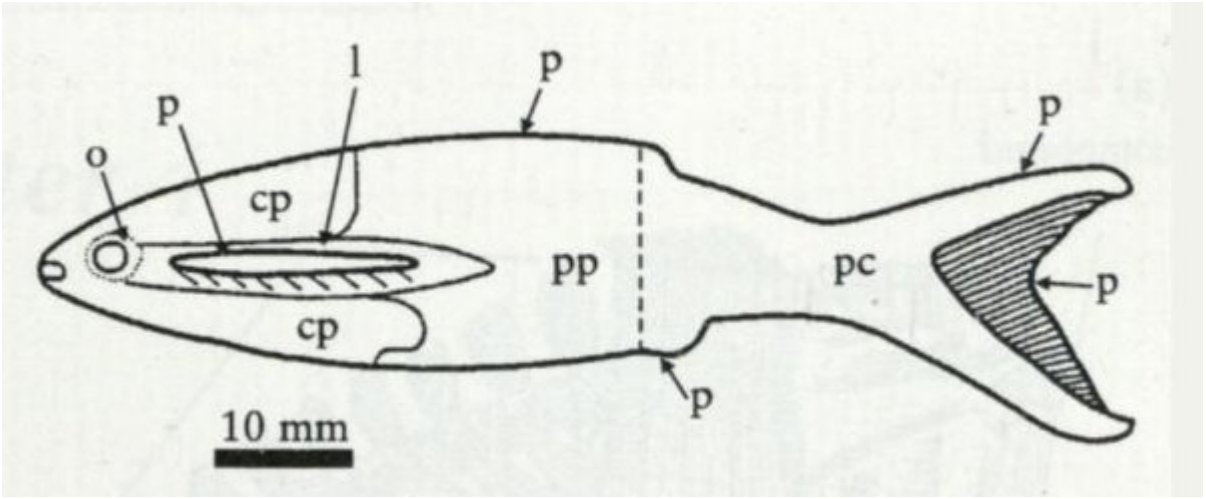
(Figure 3.82) Location of the main Silurian inliers of the Midland Valley of Scotland (after Wellman and Richardson, 1993).



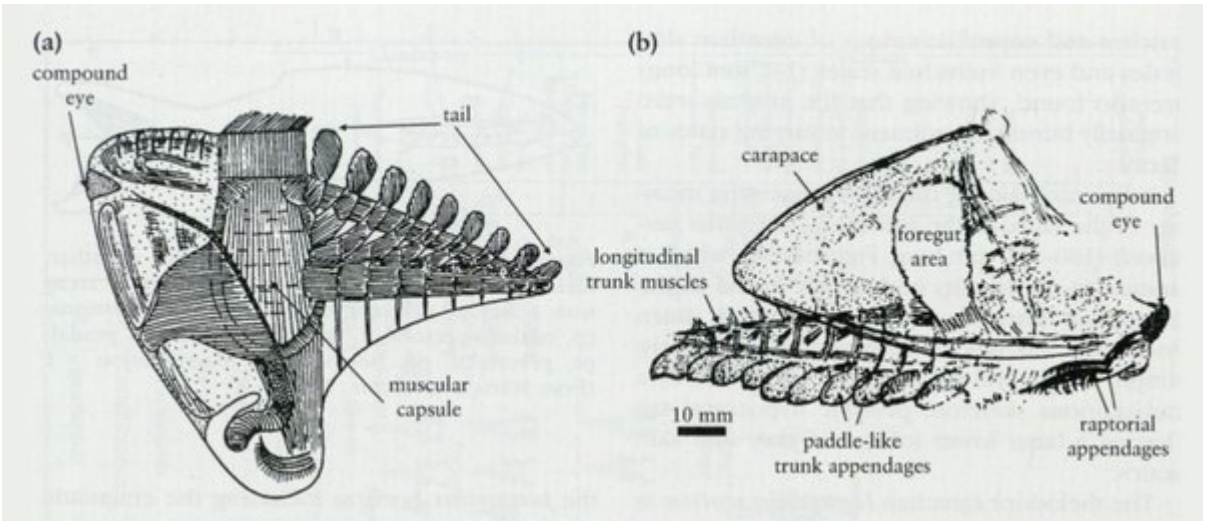
(Figure 3.83) [Correlation of faunal succession across the main Silurian inliers of the Midland Valley of Scotland, Lesmahagow, Hagshaw Hills, Pentlands. 2023 Note: Figure is incorrectly captioned in the Book and PDF]



(Figure 3.84) Reconstruction of the agnathan Jamoytius kerwoodi White by Ritchie, 1968, showing terminal round mouth, elongate body scales, paired lateral fin lobes, single anal and dorsal fins and asymmetrical tail.



(Figure 3.85) The body profile of the agnathan thelodont Loganellia scotica (Traquair) and areas with scales of different morphology. Abbreviations: cp, cephalopectoral; 1, lateral; o, orbital; p, pinnal; pc, precaudal; pp, postpectoral. Magnification x 1 (from Märss and Ritchie, 1998).



(Figure 3.86) Ainiktozoon loganense Scourfield. (a) interpreted as a possible chordate by Ritchie, 1985. (b) inverted and reinterpreted as a thylacocephalan arthropod by Brugghen et al. 1997 (drawing D. Palmer after Brugghen et al.).