
Leny Quarry

[NN 615 098]

Introduction

Leny Quarry is the principal locality for the Leny Limestone, which is the only unit along the Highland Boundary Fault zone that yields identifiable Cambrian fossils. The site is of national significance because the presence of Lower Cambrian fossils there is a crucial factor in the arguments on the age of the Dalradian Supergroup and of the Grampian orogeny. The fauna provides an age constraint on the larger division to which the Leny Limestone belongs, whether it be part of the Upper Dalradian succession or part of the Highland Border Complex, as discussed below.

Harkness (1861, p. 258) described the limestone of Leny Quarry, just north of the Highland Boundary Fault, as occurring near the base of a northwardly ascending succession that passes up into the gneissose rocks (now regarded as part of the Dalradian Supergroup) forming the hills to the north. He was unable to find any fossils. Soon after, Nicol (1863, p. 186) gave a more detailed description of the quarry, including a sketch-section, and introduced the term 'Leny Limestone'. Clough later mapped the Callander–Aberfoyle area, and although he did not publish his findings in detail, he reported that it did not 'seem possible to draw any line between the grits (that lie immediately north-west of the Leny Limestone) and the Dalradian Rocks farther to the north' (Clough, in Geikie, 1897, p. 28). Later workers who have mapped the area have inverted Harkness' succession, but all have agreed with Clough that the exposed sections through these rocks (for example in Keltie Water) show stratigraphical continuity from the Ben Ledi Grit Formation of the upper Dalradian succession southwards to the Leny Limestone and equivalent strata close to the Highland Boundary Fault (Stone, 1957; Harris, 1969; Tanner, 1995). By contrast, Bluck and Ingham (in Bluck *et al.*, 1997) discussed problems presented by the notion of a stratigraphical connection with the Dalradian and considered the continuity to be apparent only.

Pringle (1939, p. 252) announced the discovery of trilobites in the Leny Limestone (which, following McNair's (1908) use of the name 'Kilmahog Quarry', he referred to as the 'Kilmahog Limestone'). Commonest among them was the predominantly Middle Cambrian genus *Pagetia*. He never published his full results but left manuscript notes, some of which were used to prepare this account. Following the description of the genus *Pagetides* (Rasetti, 1945) from late Lower Cambrian rocks, Stubblefield (1956) revised the identification of the pagetiids and gave the age of the Leny Limestone as late Early Cambrian. These results were taken by some workers to indicate that the upper part of the Dalradian is of early Cambrian age (Tanner, 1995; in Bluck *et al.*, 1997). Other workers prefer to associate the Leny Limestone with the Highland Border Complex (Bluck and Ingham, in Bluck *et al.*, 1997), a collective term for small outcrops of ophiolitic rocks, dark-coloured shales and cherts, with other volcanic and clastic rocks, that crop out within the Highland Boundary Fault zone (Curry *et al.*, 1984). The Highland Border Complex includes the fossiliferous Dounans Limestone of definite Ibexian (= Arenig) age at Lime Craig Quarry (see site report) (Ingham *et al.*, 1986) and some possibly younger rocks that are thought to have had a different metamorphic history from the Dalradian rocks. Bluck *et al.* (1992) concluded that the complex, including the Leny Limestone (Brasier *et al.*, 1992b), is part of a terrane that is stratigraphically and structurally separate from the Grampian Terrane to the north.

Description

Leny Quarry is a ravine-like excavation extending for about 200 m approximately along strike from south-west to north-east (Figure 13.1). The quarry was opened in about 1745 to work beds of grey limestone interbedded with black slates but was little used after the 1860s. The general dip is 40–60° to the north-west, but there is much folding and faulting and some local evidence that the beds young to the south-east and are overturned. To the north-east of the quarry are grey grits and cleaved sandy slates, part of the Keltie Water Grit Formation of Tanner (1995), locally intruded by a felsite dyke that is exposed in the north-west side of the quarry towards its northern end, where it is in faulted contact with a poorly exposed metabentonite, the identity of which was confirmed by R. J. Merriman (pers. comm., 1994).

On the south-east side of the quarry are further grey grits and slates for some 130 m, before the faulted contact with strata of the lower Old Red Sandstone is reached. A large dolerite dyke intruded on the south of the quarry has in places thermally metamorphosed the Leny Limestone.

The main limestone, a grey sandy rock, weathering brown and shot through with sets of bedding-normal calcite veins that give a distinctive appearance, is mainly quarried away and its outcrop covered with talus, but part remains supporting the north-west side of the quarry (cf. Nicol, 1863, fig. 4). Harkness (1861) reported the thickness to be 'about eight feet' (2.5 m), though Nicol (1863, p. 186), who observed 15 feet (nearly 5 m) in a part of the quarry then being worked, may have seen a place where there was structural duplication. Clough recorded a bed 5 feet (1.5 m) thick, diminishing to no more than 1 foot (0.3 m). This main bed is practically unfossiliferous, though Pringle observed fragments of phosphatic brachiopod shells.

The south-east side of the quarry exposes a succession a few metres thick of black slate alternating with up to six thin (10 cm scale) beds of dark-grey limestone in a total thickness of 36 cm. These strata are folded and faulted but locally contain very thin layers with small fossils, mainly trilobites and a few brachiopods. Similarly fossiliferous is a small faulted mass of limestone on the north-west side of the quarry, near its mid-length (Figure 13.1); but Pringle recorded in his manuscript that searches along strike, from Leny Glen to Keltie Water, have failed to reveal other localities with identifiable fossils (Pringle, in MS).

The commonest fossils are trilobites (Figure 13.2), many being referable to *Pagetides*, of which more than one species is present. In addition there are small specimens of corynexochids and ptychopariids, together with brachiopods, tubular organisms and sponge spicules. Despite the work of Lamont (1975), the fauna is still in need of full illustration and detailed assessment.

Interpretation

The trilobites from the Leny Limestone are unquestionably of Laurentian provincial affinity and are (in terms of the Laurentian succession) of late Early Cambrian age. They give evidence of the only undisputed Cambrian rocks along the Highland Border. Lamont's (1975) records of trilobites of Moroccan type (Daguinaspidae, Gigantopygidae?) are not upheld (T.P. Fletcher, pers. comm., 1990). The species present are akin to those that inhabited the outer edge of the Laurentian shelf (Conway Morris and Rushton, 1988, p. 98).

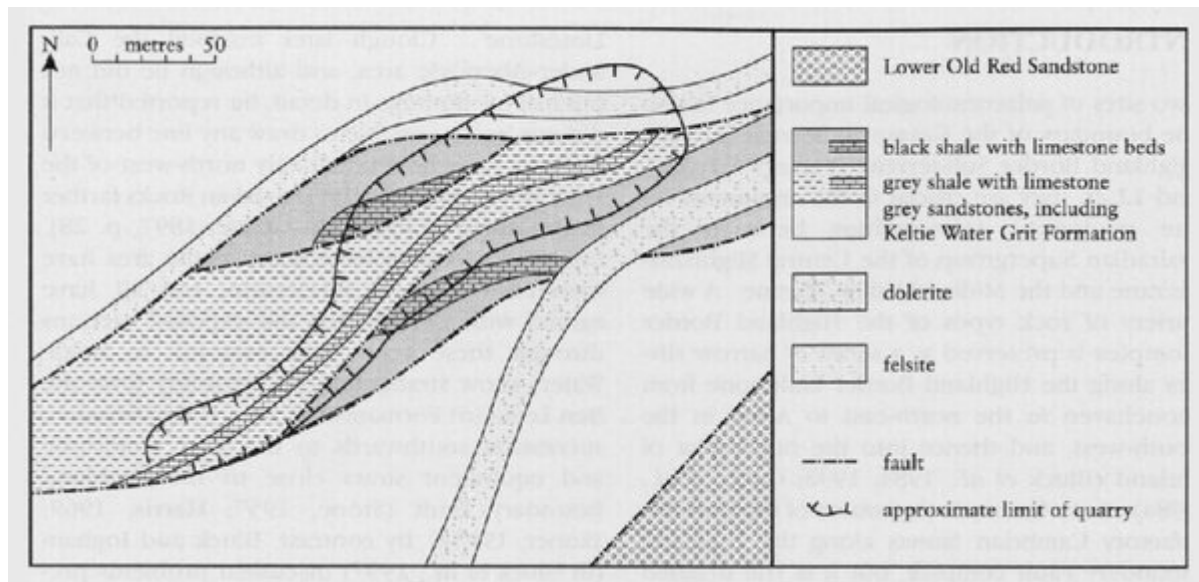
Whichever way the stratigraphical position of the Leny Limestone is interpreted, its late Early Cambrian age has important implications. If the Leny Limestone is part of the Upper Dalradian succession, as appears to all those who have mapped the ground (Tanner, 1995; in Bluck *et al.*, 1997), its fauna provides a minimum age for the deposition of that part of the upper Dalradian Supergroup and fixes a maximum age for the subsequent deformation event, which, according to radiometric measurements, seems to have been after about 510–520 Ma (Tanner and Leslie, 1994; Tanner, 1995), or approximately equivalent to Branchian (late Lower Cambrian) times (Davidek *et al.*, 1998). This interpretation requires structural separation of the Leny Limestone from outcrops of other rocks of the Highland Border Complex but poses problems concerning deposition of the Leny Limestone on a cooling crustal block (Bluck and Ingham, in Bluck *et al.*, 1997) and is further complicated by Molyneux's (1998) confirmation that the acritarch reported from the upper Dalradian of the Banff Nappe at Macduff, Banff (nearly 200 km to the north-east) is of Tremadoc age or younger.

If, however, the Leny Limestone is regarded as part of the Highland Border Complex (Bluck and Ingham, in Bluck *et al.*, 1997), it is much older than other sedimentary rocks in the complex, outcrops elsewhere having yielded Ordovician ages: a secure Arenig age at Lime Craig Quarry (see site report) and more dubious records of younger Ordovician rocks elsewhere (Curry *et al.*, 1984). This interpretation demands a structural separation of the Leny Limestone from the Dalradian succession and discounts the appearance of stratigraphical and lithological continuity between the Leny Limestone and the adjoining Dalradian rocks. Tanner (in Bluck *et al.*, 1997) favoured the view that parts of the Highland Border Complex (including the Leny Limestone) belong with the Dalradian, whereas the remainder are parts of an arc system (possibly linked to the Midland Valley Terrane).

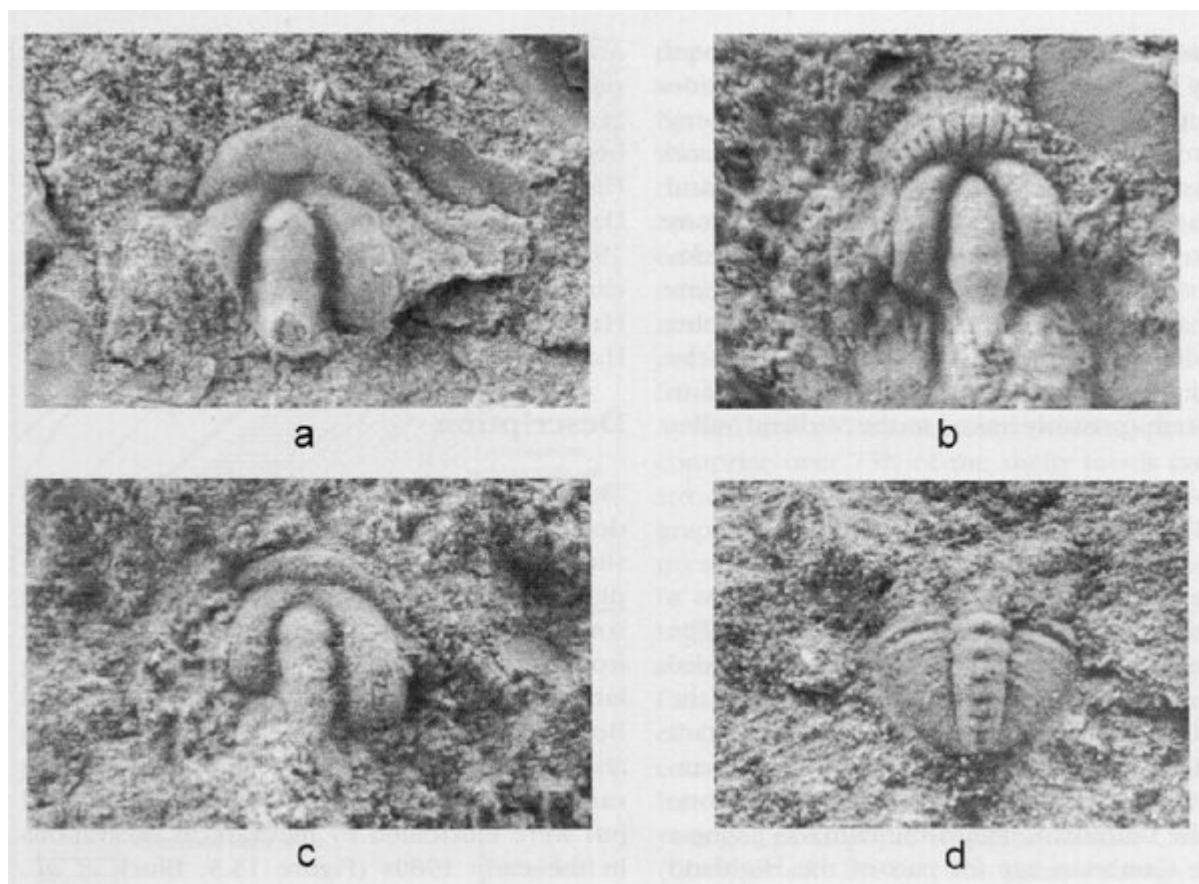
Conclusions

The Leny Limestone in Leny Quarry contains a very significant Lower Cambrian fauna. The structural affiliation of the Leny Limestone is disputed. For some, who regard it as part of the Dalradian Supergroup, it gives an important Early Cambrian date for the top of the succession; Others, who separate the Leny Limestone from the Dalradian, regard the fauna as giving a unique Cambrian age for part of the Highland Border Complex.

References



(Figure 13.1) Geological map of Leny Quarry, after Pringle (unpublished).



(Figure 13.2) Pagetiid trilobites from Leny Limestone, Leny Quarry. Three cephalia, (a) x10, (b) x12, (c) x15, and a pygidium, (d) x15.