Leckhampton Hill, Gloucestershire

[SO 946 183]–[SO 952 187]–[SO 951 179]

M.G. Sumbler

Introduction

The extensive GCR site known as 'Leckhampton Hill' lies within the Leckhampton Hill and Charlton Kings Common SSSI, and includes all of the principal geological sections there. The quarries in the western face of the hill (Figure 3.38) provide the thickest single section through the Inferior Oolite Group in the Cotswolds and form the type section of the Birdlip Limestone Formation (Lower Inferior Oolite) (Figure 3.39).

When combined with the smaller quarries on the hilltop, they provide an almost complete section through the group, totalling over 50 m, with all of the component formations being represented. The sections at Leckhampton Hill have been described by numerous geologists from the time of Murchison (1834) (e.g. Brodie, 1851, 1853; Wright, 1860; Buckman, 1893a, 1895; Woodward, 1894; Richardson, 1904, 1906, 1933; Gray, 1924; Murray, 1968; Ager and Mudge, 1973; Murray and Hancock, 1977; Mudge, 1978a,b, 1995, and references therein). The accounts differ greatly in content and detail, and also in the thicknesses given for the various units exposed; these discrepancies relate both to differences of interpretation over the classification of the succession, and also the general difficulty of measuring some units in the steep and dangerous quarry faces.

Description

Particularly useful summary sections are given by Richardson (1906), Ager (1969) and Macfadyen (1970). The following is based largely on their accounts supplemented by data from the other sources cited above and personal observation. Some thicknesses (notably of the Gryphite Grit, Scottsquar and Cleeve Cloud members) remain slightly uncertain.

	Thickness (m)
Salperton Limestone Formation	
Upper Trigonia Grit Member	
Limestone, brown, ferruginous, irregularly bedded, shelly, bioclastic calcarenite; many fossils (mostly preserved as empty moulds) including *Trigonia costata* (Parkinson), *Liostrea, Trichites, Globirhynchia subobsoleta* (Davidson), *Nucleolites sinuatus* (Parkinson) and serpulids	1.6
Aston Limestone Formation	
Notgrove Member	
Limestone, pale-grey, ooidal grainstone, well bedded; oyster-encrusted top with abundant deeply penetrating worm-borings; sporadic disarticulated bivalves	0.6
Grypbite Grit Member	
Limestone, grey to brown; hard, bioclastic calcarenite, with some marly layers and bedding planes covered with *Gryphaea bilobata* J. de C. Sowerby in upper part; more sandy with *Lobothyris buckmani* (Davidson), burrowing bivalves, serpulids and oysters in lower part; bioclastic calcilutite at base	5.6
Lower Trigonia Grit Member	

Limestone, yellowish-brown, rubbly, bioturbated, bioclastic, 'iron-shot' (with ferruginous peloids), calcarenite; shelly with burrowing bivalves, colonial serpulids (*Sarcinella*), corals and the brachiopod *Aulacothyris meriani* (Oppel); conglomeratic in lower part (Macfadyen, 1970)	1.8
Birdlip Limestone Formation	
Harford Member	
Marl, yellowish-brown	0–0.46
Scottsquar Member	
'*Upper Freestone*'	
Limestone, pale-grey, well-bedded, poorly sorted, massive, peloidal and ooidal packstones and grainstones, shell debris and sporadic fossils; corals, bivalves and brachiopods including *Plectothyris ftmbria* (J. Sowerby)	*c.* 7.5
'*Oolite Marl*'	
Limestone, cream to white marl and calcilutite with scattered ooids and peloids; rich and varied fauna of burrowing bivalves, brachiopods (notably *Plectothyris fimbria*), nerineid gastropods and corals	3.2
Cleeve Cloud Member	
Limestone, pale-grey, well-sorted, medium-grained, ooidal grainstone; poorly fossiliferous; strongly cross-bedded in upper part	10.4
Limestone, yellowish-buff, slightly sandy, in massive beds, bioturbated with many trace fossils; sporadic shelly fossils	13.3
Crickley Member	
'*Pea Grit*'	
Limestone, yellowish-buff, rubbly, pisoidal packstone; sporadic fossils including bivalves and brachiopods	3.7
'*Lower Limestone*'	
Limestone, yellowish-cream, shell-detrital, peloidal packstone, strongly bioturbated; sporadic pisoids in upper part	3.3
Leckhampton Member	
Limestone, yellowish to orange-brown, rubbly, ferruginous, bioclastic, sandy limestone with marly bands; many fossils including bivalves, brachiopods and belemnites; somewhat conglomeratic base with phosphatized material ('coprolites') derived from Lias Group below 5.3	
Lias Group	
Clay, dark-grey, silty and finely sandy, micaceous, highly disturbed by land-slipping	

The principal exposures occur at four sites named, following Sumbler and Barron (1996), the Limekiln Quarry [SO 949 285], Devil's Chimney Quarry [SO 946 184], Hilltop Quarry [SO 950 185] and Hartley Hill Quarry [SO 952 184]. The stratigraphical ranges of these four sections are shown in (Figure 3.39). The whole of the Birdlip Limestone Formation (Lower Inferior Oolite) is exposed in the conjoined Limekiln and Devil's Chimney quarries, which form the type section of the formation. The lowest strata at present (1996) exposed at Limekiln Quarry are rather 'dirty', ferruginous limestones belonging to the Leckhampton Member, of which this exposure forms the type section (Mudge, 1978a,b; Barron *et al.,* 1997).

Details of the unit at Leckhampton Hill are given by Mudge (1995). The sections in the Limekiln and Devil's Chimney quarries also constitute the type section of the Cleeve Cloud Member. The lower marly part of the Scottsquar Member (the Oolite Marl of most previous accounts) is well seen at the top of the Devil's Chimney Quarry where it forms a distinctive banded outcrop in the quarry face. The upper part of the member (the so-called Upper Freestone) is better seen in the Hilltop Quarry. Strata above the Gryphite Grit Member are best seen in the side of the shallow Hartley Hill Quarry, the floor of which is now restored to agriculture. The Notgrove Member is exposed by the path at its northern end [SO 9523 1846]. The Upper Trigonia Grit Member, the basal unit of the succeeding Salperton Limestone Formation (Upper Inferior Oolite), is exposed for several hundred metres along the shallow eastern face of the quarry.

Interpretation

The Leckhampton Member forms the basal unit of the Inferior Oolite Group throughout the mid- and north Cotswolds, and rests with slight unconformity on the underlying Lias Group. The latter is at present not well exposed at Leckhampton Hill, but includes the sands and silts of the Toarcian Bridport [Cotteswold] Sand Formation, the erosion of which probably contributed much of the quartz sand within the Leckhampton Member. The member contains a typical Mid Jurassic shelly fauna which includes sporadic ammonites, notably *Leioceras,* the index genus for the early Aalenian Opalinum Zone. These strata correspond essentially with the former Scissum Beds, named from the ammonite *Tmetoceras scissum* (Benecke), although some workers (e.g. Richardson, 1906) assigned the upper part of this unit at Leckhampton Hill to the succeeding Lower Limestone.

The overlying Crickley Member comprises the Lower Limestone and Pea Grit of previous accounts (approximating to the Crickley Limestone and Crickley Oncolite of Mudge, 1978a,b). Algally accreted pisoids occur throughout much of the succession, but most abundantly in the uppermost part. These pisoids are the characteristic feature of the 'Pea Grit' (see Crickley Hill GCR site report, this volume), and the rather indefinite base of that unit explains the great range of thicknesses that have been attributed to it (e.g. 6.4 m according to Macfadyen (1970), but only *c.* 2.2 m according to Mudge (1978b)). It is for this reason that the 'Lower Limestone' and 'Pea Grit' are now combined into a single lithostratigraphical unit (Barron *et al.,* 1997).

The Cleeve Cloud Member constitutes the Lower Freestone of previous accounts, for which various thicknesses have been quoted, ranging from Ager's (1969) 13.2 m to Arkell's (1933) *c.* 40 m; Richardson's (1906) *c.* 24 m appears to be approximately correct (Mudge, 1978a,b; Barron *et al.,* 1997). Most of the primary cross-bedding features in the massive oolites of the lower part of the member (the Cleeve Hill Oolite of Mudge, 1978a) have been destroyed by pervasive bioturbation. Trace fossils, including narrow sub-vertical tubes, in some cases branching at the base, have been recorded as rootlets in some previous publications (e.g. Ager, 1969) but are more probably worm burrows (cf. *Skolithos* and *Lennea*) suggesting deposition in extremely shallow water. The conspicuous cross-bedding on several scales, with some foresets several metres high in the upper part of the Cleeve Cloud Member (the Devil's Chimney Oolite of Mudge, 1978a), indicates dune formation in a strongly current-swept environment. Foreset azimuths indicate currents flowing predominantly towards the south. About halfway up this unit, there is a planar hardground that forms a prominent surface in the quarry face, and the top is also capped by a hardground, with worm and bivalve borings and encrusting serpulid tubes and oysters. Such hardgrounds indicate stabilization and early lithification of the sea floor.

Within the Scottsquar Member, the boundary between the Oolite Marl and Upper Freestone is somewhat arbitrary, and the succession is laterally very variable; thicknesses ranging from 1.8 m to 5.2 m have been quoted for the Oolite Marl. Indeed, the massive peloidal and ooidal packstones and grainstones of the Upper Freestone seen in Hilltop Quarry were included in the Oolite Marl *sensu* Baker, 1981. Regionally, the two units cannot be consistently separated and for this reason are now combined (Mudge, 1978a; Baker, 1981; Barron *et al.,* 1997). The facies and fauna of the Scottsquar Member are discussed in detail by Mudge (1978a, 1995) and Baker (1981). Mudge (1978a,b) recorded a bored and oyster-encrusted hardground at the top of the member (in Devil's Chimney Quarry), and Murray (1968) suggested evidence of sub-aerial exposure from the presence of solution cavities infilled with ferroan calcite at this level in Hilltop Quarry.

Above the Scottsquar Member, a lens of marl currently exposed in Hilltop Quarry has been assigned to the Lower Trigonia Grit Member (Aston Limestone Formation) by some workers (notably Murray, 1968), perhaps because of the non-sequence at the top of the Scottsquar Member (see above). However, following Buckman (1895), it is herein assigned to the Harford Member (incorporating the Harford Sands and Snowshill Clay, etc., of previous authors), the youngest part of the Birdlip Limestone Formation (Lower Inferior Oolite). This exposure represents the westernmost outcrop of the member, which is overstepped by the Aston Limestone Formation immediately to the west of the quarry (see Barron *et al.,* 1997, fig. 4). The distribution and pattern of overstep of the Harford Member beneath the so-called Aalenian denudation' (Buckman, 1901) is similar to that seen at the higher level beneath the Salperton Limestone Formation (the 'Bajocian denudation'), suggesting early development of the gentle 'Cleeve Hill Syncline' and 'Birdlip Anticline' structures as sedimentary trough and high respectively (see Knap House Quarry and Rolling Bank Quarry GCR site reports, this volume, and (Figure 3.2)).

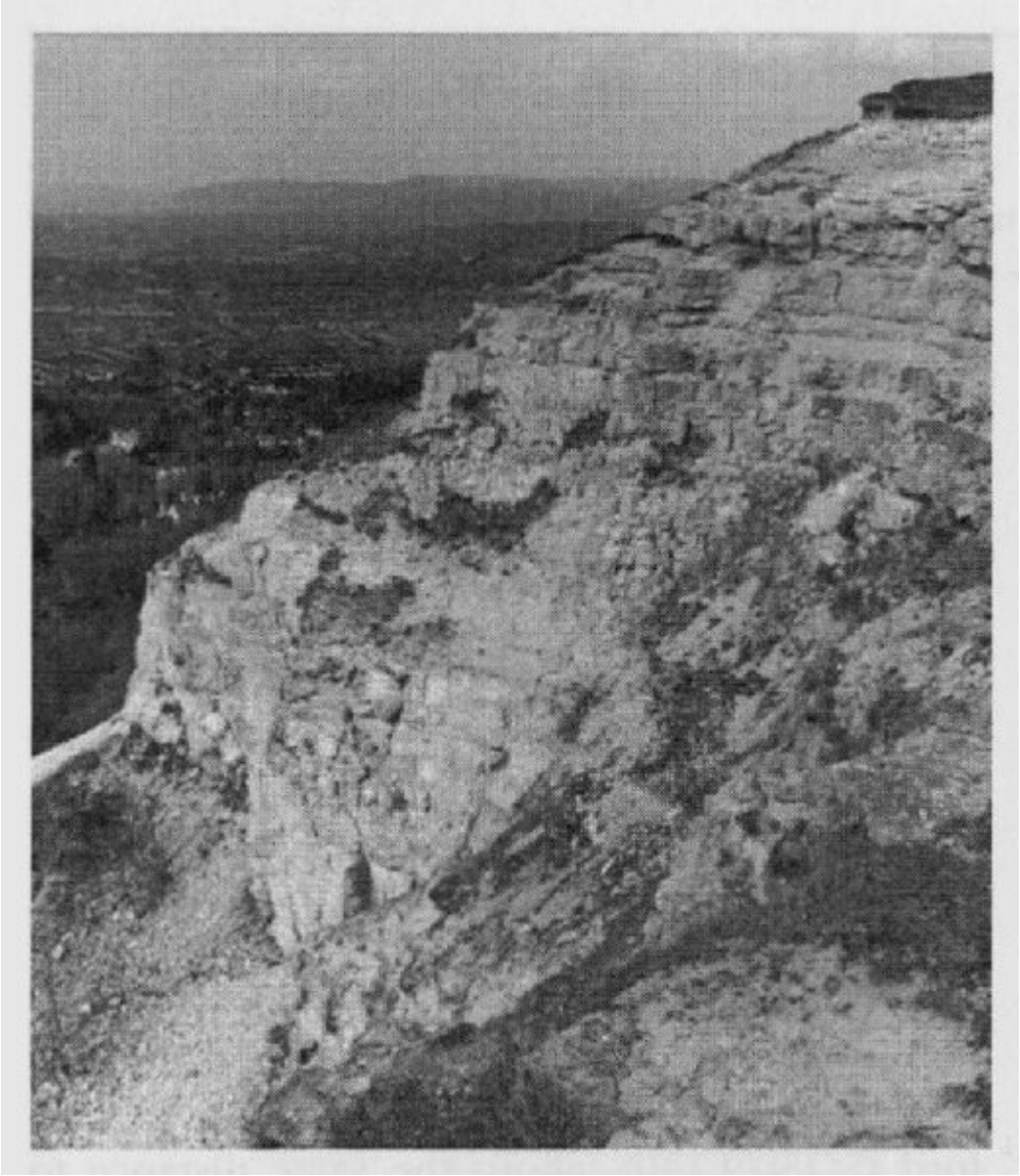
The grey to brown, slightly sandy, rubbly or massive, shelly and shell-debris-rich limestones that are the predominant lithology of the Aston Limestone Formation (Middle Inferior Oolite) are traditionally known as 'grits'. They rest on the Harford Member, or where this is absent, the Scottsquar Member. Richardson (1906) recorded ammonites 'of the *Sonninia fissilobata* type' from the Gryphite Grit Member, the sandier lower part of which (no longer well exposed), with the brachiopod *Lobothyris buckmani,* was previously separated as the Buckmani Grit.

Fossils are generally rare in the overlying Notgrove Member, which is locally the youngest member of the Aston Limestone Formation, but Richardson (1906) recorded poorly preserved casts of sonniniid ammonites. The member is capped by a well-developed hardground, which marks the 'Bajocian denudation' of Buckman (1901), and an erosional non-sequence that progressively cuts through the Inferior Oolite Group away from the axis of the 'Cleeve Hill Syncline'. The Notgrove Member is overstepped just to the west of this site (see Barron *et al.,* 1997, fig. 4).

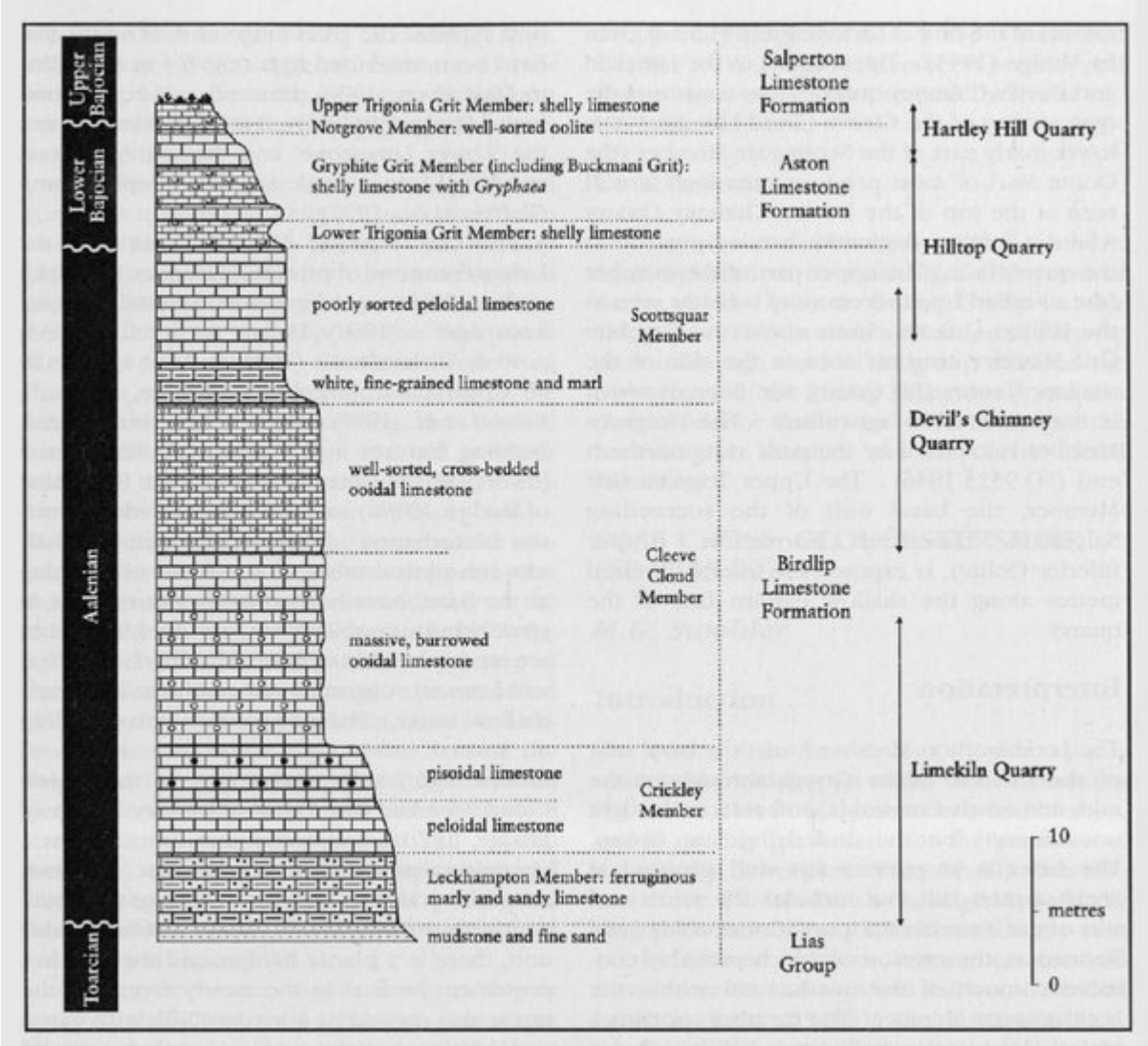
Conclusions

The quarries at Leckhampton Hill have been much referred to in more than 150 years of study of the Inferior Oolite Group in the Cotswolds. They provide a thick and impressive section through much of the group and form the type section of the Birdlip Limestone Formation (Lower Inferior Oolite) and of its basal unit, the Leckhampton Member, and the Cleeve Cloud Member.

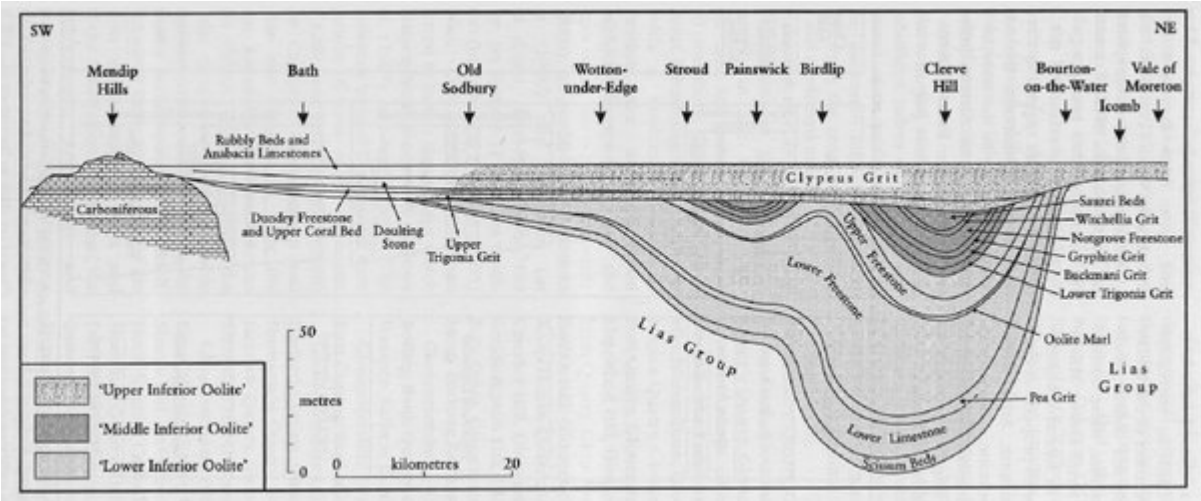
References



(Figure 3.38) Birdlip Limestone Formation in the main face of Devil's Chimney Quarry (at the Leckhampton Hill GCR site) showing the Scottsquar Member ('Upper Freestone' and 'Oolite Marl') overlying the Cleeve Cloud Member. (Photo: M.G. Sumbler.))



(Figure 3.39) Graphic section of the succession at Leckhampton Hill. (After Ager, 1969, fig. B15; and Sumbler and Barron, 1996.) For details of lithologies, see text.)



(Figure 3.2) Diagrammatic cross-section through the Inferior Oolite Group showing the Painswick and Cleeve Hill 'synclines', and the intervening 'Birdlip Anticline'. (After Akell, 1933, fig. 35; see also Barron et al. (1997, fig. 5) which shows a similar section through the 'synclines' based on more recent data and with revised lithostratigraphy.))