Stratton Audley, Oxfordshire

[SP 601 254], [SP 602 251]

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Introduction

The quarry that constitutes the GCR site known as 'Stratton Audley', is located about 1 km southwest of the village of Stratton Audley, near Bicester, in Oxfordshire (Figure 4.11). Though partly flooded and largely infilled by tipping, it still exposes an Upper Bathonian succession comprising, in ascending order, the White Limestone and Forest Marble formations, and the lower part of the Cornbrash Formation. Middle Bathonian beds, assigned to the Rutland Formation, have also been proved in boreholes drilled from the floor of one of the quarries (Figure 4.12). The main significance of the section recorded here is the evidence of transition between open marine depositional environments to the south-west and restricted, nearshore, brackish-water, lagoonal and salt-marsh environments adjacent to the London Landmass to the east. Of special interest also are hardground beds that display sedimentary structures indicative of emergent, supratidal depositional conditions. Descriptions of the section have been recorded by Palmer (1973, 1979) and Barker (1976). The following account is based mainly on Palmer (1973), although the stratigraphical nomenclature has been modified.

Description

Only the upper two major units (Ardley and Bladon members) of the White Limestone Formation are present in the section described by Palmer (1973). However, two beds of black sand proved in borings below Palmer's (1973) basal limestone bed (numbered 14) are here considered to be decalcified sandy limestone equivalent to the 'Roach Bed' at the base of the Ardley Member and to overlie the Excavata Bed (cf. Sumbler, 1984; see Ardley Cuttings and Quarries GCR site report, this volume). The latter is thus the sole representative of the Shipton Member here. Barker (1976) also identified this limestone as the Excavata Bed; the *c.* 3 m of marl and clay proved in the borings below it are herein assigned to the Rutland Formation (cf. Palmer, 1979).

The *c.* 4.6 m of beds above the 'Roach Bed' comprise finely detrital and pelletal, micritic, commonly bioturbated limestones, which contain the gastropods *Cossmannea bathonica* (Rigaux and Sauvage) and *Eunerinea arduennensis* (Buvignier), the bivalve *Isognomon* and the echinoid *Clypeus.* These limestones are capped by a bed of burrowed limestone (White Limestone Formation Bed 6 of Palmer, 1973; the Ardleyensis Bed) that contains the diagnostic gastropod *Aphanoptyxis ardleyensis* Arkell. In places, the upper surface of this bed is developed as a bored hardground with adherent oysters (*Nanogyra*). The overlying limestones include a clayey oolite yielding *Anisocardia, Astarte* and high-spired gastropods, and a thin marl with current-sorted bivalves at its top, and rootlets. Above a *c.* 1 m-thick shelly, pelletal limestone, the top of the Ardley Member is marked by the Bladonensis Bed (White Limestone Formation Bed 1 of Palmer, 1973), a micritic limestone the lower part of which is clayey and the top of which is capped by a hard-ground. The shelly bed yields the diagnostic gastropod *Aphanoptyxis bladonensis* Arkell, the bivalves *Bakevellia* and *Protocardia?,* fragments of the coral *Isastrea,* and lignite. The Bladonensis Bed displays shrinkage cracks and algal laminae, and is penetrated by rootlets. The total thickness of the Ardley Member is about 8 m.

The lower sediments of the succeeding Bladon Member ('Forest Marble and Blisworth Clay' beds 11 and 12 of Palmer, 1973), together known as the Fimbriata–Waltoni Bed', comprise 0.9 m of brown clay, overlain by even-bedded green and grey clay, 0.10–0.45 m thick, with rootlets in the lower part and shells above, including the bivalves *Bakevellia, Modiolus, Placunopsis* and *Praeexogyra hebridica* (Forbes), the brachiopod *Epithyris* and the echinoid *Acrosalenia.* The Upper Epithyris Bed ('Forest Marble and Blisworth Clay' Bed 10 of Palmer, 1973), which forms the upper part of the Bladon Member, is a shelly micritic limestone, 0.3–1.0 m thick, which contains the bivalve *Modiolus* and high-spired gastropods; it thickens and thins at the expense of beds both above and below. 'Birdseye' vugs have been recorded in this bed (Barker, 1976). The Upper Epithyris Bed was seen at one point to be penetrated by a clay-filled channel lined by imbricated lignitic logs and containing limestone pebbles, probably derived from the Upper Epithyris Bed. The clay also contains abundant shells of the gastropod *Viviparus,* as well as the bivalve '*Corbula*'and charophytes; stratigraphical relationships indicate that it forms the lowest part of the basal green and blue clay-bed of the Forest Marble Formation. The remaining 1.9 m of this formation comprise interbedded, bioturbated, pelletal, micritic limestones and clays. The section is completed by 2.3 m of rubbly limestone assigned to the Lower Cornbrash. The basal 0.3 m yields the brachiopod *Cererithyris intermedia* (J. Sowerby) and the bivalve *Meleagrinella echinata* (Wm Smith).

Interpretation

Marls and clays beneath the White Limestone Formation, proved in boreholes at Stratton Audley, were formerly assigned to the Hampen Formation but are now more appropriately classified as Rutland Formation (Horton *et al.,* 1995). They were probably deposited in a near-shore, brackish-water, lagoonal environment (Palmer, 1979). They correspond to the lower and greater part of the Shipton Member of the White Limestone Formation as exposed at Ardley Cuttings and Quarries (see GCR site report, this volume), about 6 km to the WNW, i.e. the lower part of the Shipton Member passes laterally (shorewards) in this area into the upper part of the Rutland Formation. An implication of this is the likely equivalence of the Excavata Bed (uppermost Shipton Member) in Oxfordshire and the Sharpi Beds (lowermost White Limestone Formation) in Northamptonshire, both of which are considered to form part of the same regionally correlatable rhythmic, depositional unit (Cripps, 1986).

The detrital and micritic limestones of the White Limestone Formation accumulated in a low-energy, shallow-water, protected carbonate lagoon, in which burrowing bivalves were largely responsible for the common bioturbation. Sporadic clay and marl beds indicate intermittent influxes of terrigenous sediment. The hardgrounds (Ardleyensis and Bladonensis beds) reflect episodes of low sea-level terminating upward-shallowing, regressive units, accompanied by minimal sedimentation and lithifica-tion of sea-floor sediment. The adherent oysters and borings associated with the Ardleyensis Bed affirm penecontemporaneous cementation of the substrate. The 'birdseye' vugs, shrinkage cracks and algal laminae that characterize the Bladonensis and Upper Epithyris beds indicate periods of emergence as supratidal mudflats (Palmer and Jenkyns, 1975). The clays of the Fimbriata–Waltoni Bed represent a major influx of terrigenous mud, presumably from the London Landmass that lay to the east and southeast. The occurrence in them of both marine and brackish-water organisms, and of rootlet horizons, suggests rapid changes between open marine, restricted lagoonal and nearshore salt-marsh environments.

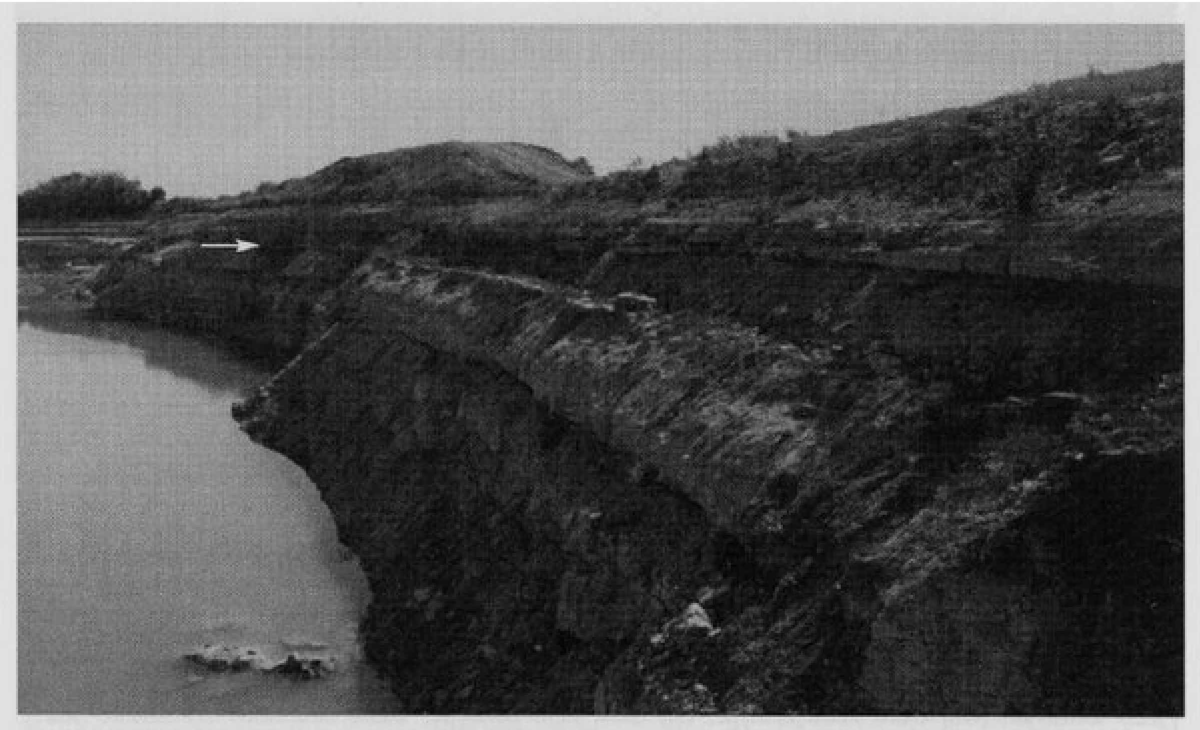
The abundance of freshwater shells and microfossils in the channel-fill deposit at the base of the Forest Marble Formation (not the Bladon Member as interpreted by Palmer (1979)) indicates the temporary establishment of a freshwater shoreline lagoon fed by streams draining the London Landmass. Such streams would have transported the abundance of plant debris found in the channel-fill. The limestone pebbles in the channel suggest the occasional influence of stronger currents, perhaps induced by storms. The interbedded micritic limestones and clays that form the bulk of the Forest Marble Formation serve as witness to changing patterns of quiet-water lagoonal environments, which were at times characterized by terrigenous mud deposition, and at other times by carbonate mud sedimentation. This low-energy, lagoonal region marginal to the London Landmass was transitional to the higher-energy, open marine area to the south-west, where shell-fragmental, ooidal limestones form a substantial part of the formation.

No fossil of biostratigraphical significance has been found in the quarries at Stratton Audley and so dating of the succession must rely on comparison with other sections yielding diagnostic faunal evidence, aided by correlation of regionally persistent rhythmic, depositional units (Cripps, 1986; Wyatt, 1996a,b). *Tulites glabretus* (S.S. Buckman), diagnostic of the Subcontractus Zone, which has been found about 5 km west of Stratton Audley (see Ardley Cuttings and Quarries GCR site report, this volume) came from very near the base of the White Limestone Formation (Shipton Member). Thus, assuming no non-sequence, the upper part of the Rutland Formation recorded in bore-holes at Stratton Audley may be assigned to the Subcontractus Zone and the overlying Morrisi Zone, since the Excavata Bed throughout the Cotswolds is known to occur in the uppermost part of the latter zone. The Ardley and Bladon members are inferred to belong to the Bremeri and lower Retrocostatum zones, the Forest Marble Formation to the Hollandi Subzone of the Discus Zone, and the Lower Cornbrash to the Discus Zone and Subzone.

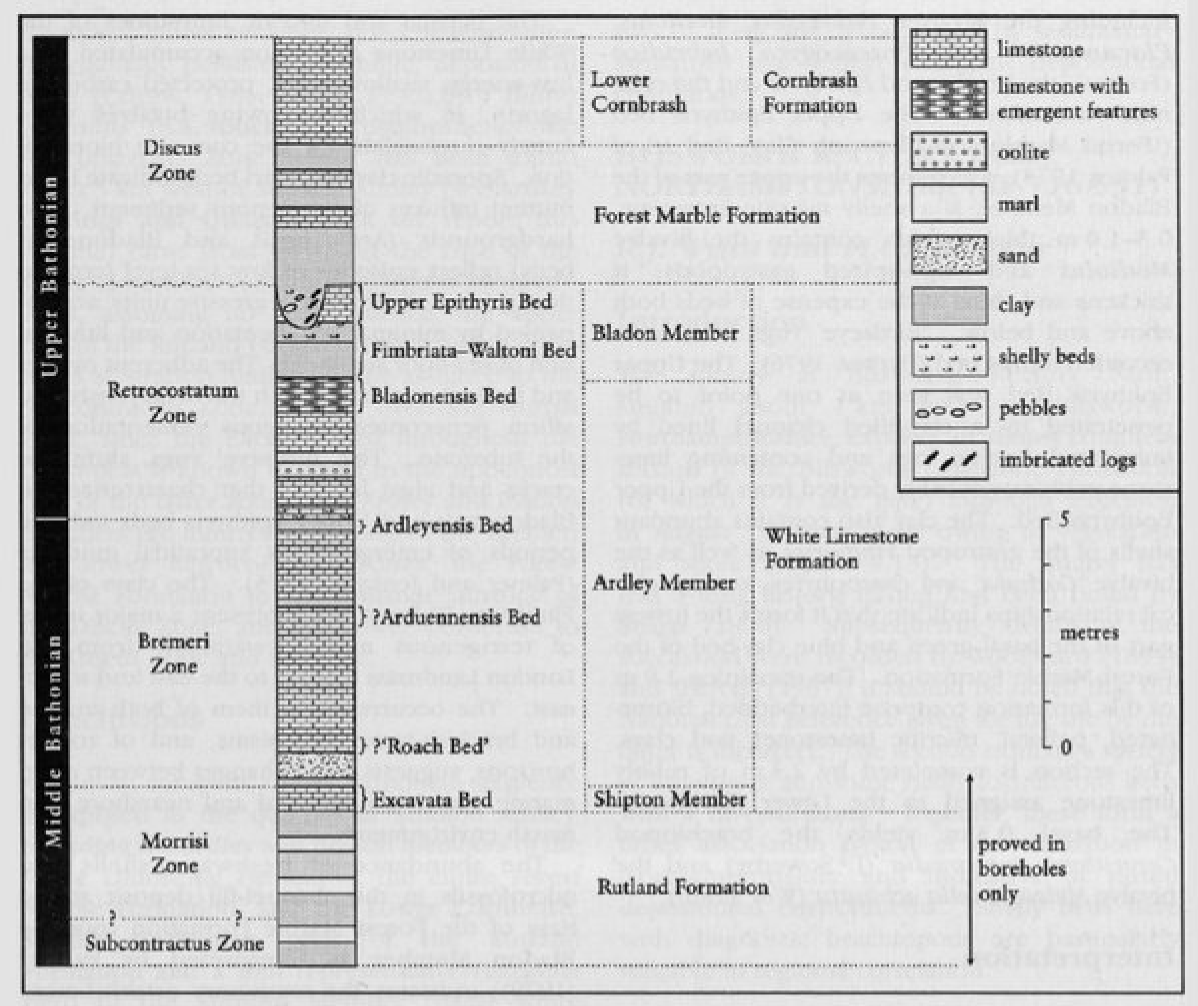
Conclusions

An almost complete Upper Bathonian sequence is exposed in the quarries at Stratton Audley, including the Ardley and Bladon members of the White Limestone Formation, the entire Forest Marble Formation, and the Lower Cornbrash. Middle Bathonian beds of the Rutland Formation and a thin representative (Excavata Bed) of the Shipton Member (basal White Limestone Formation) have also been proved in boreholes to lie beneath the exposed section. The section is of special significance in the study of lithological and faunal facies changes that occur between open marine depositional environments to the south-west, and restricted brackish-water and intermittent freshwater environments to the east, marginal to the London Landmass. Thus, the fine-grained micritic limestones of the Forest Marble Formation, deposited in quiet-water lagoons here, contrast with the more typical coarse-grained ooidal and shell-fragmental limestones of open marine environments to the west. Also, beds equivalent to the micritic limestones of the White Limestone Formation (Shipton Member) to the west are here mainly represented in a clay–marl facies transitional to the freshwater deposits of the Rutland Formation to the east. Hardground beds in the White Limestone Formation indicate temporary breaks in sedimentation, accompanied by lithification of the substrate; two of them are characterized by sedimentary structures that reflect emergent depositional conditions.

References



(Figure 4.11) The southern face of the partly flooded quarry at Stratton Audley showing the White Limestone Formation overlain by the Forest Marble Formation. The formational boundary is marked by the white arrow. (Photo: M.G. Sumbler.))



(Figure 4.12) Graphic section of the Bathonian succession at the Stratton Audley GCR site.)