HACKNESS HEAD

J.K. Wright

OS Grid Reference: SE964905and SE966904

Introduction

The Hackness Head locality is a composite site, comprising two adjacent disused quarries about 100 m apart, and is situated approximately 0.5 km due west of Hackness village (Figure4.16). Costicardia Subzone limestones are preserved here on the southern side of the Hackness Outlier, a large dissected area of Corallian rocks north-east of the main Corallian outcrop and separated from it by the valley of the River Derwent.

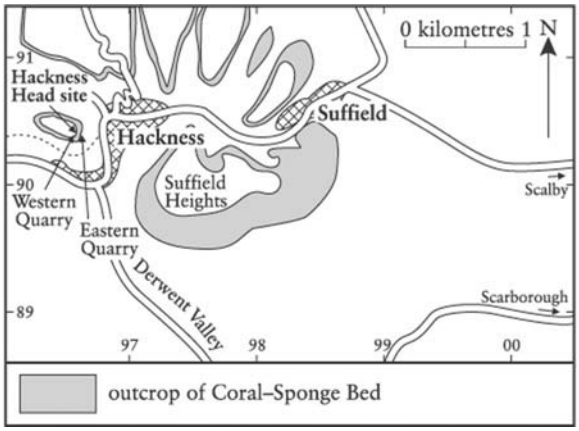

Figure 4.16: Locality map for Hackness Head showing the outcrop of the Coral–Sponge Bed (Subdivision 3). (After Wilson, 1949, fig. 43.)

The Corallian rocks of the Hackness Hills were first studied and mapped by William Smith whilst he was employed on the Hackness Estate (Smith, 1829–1830). Hudleston (1876, 1878) and Blake and Hudleston (1877) gave general accounts, and detailed mapping and a study of the stratigraphy was carried out by Fox-Strangways (1892). Arkell (1933) and Wilson (1934) both based their accounts on Fox-Strangways' work. The rocks of the Hackness Outlier were referred to in general terms by Wright (1972), who gave a revised stratigraphy, and this scheme was adopted by Kent (1980b). Some general conclusions on the depositional environment of the lower Corallian sediments that accumulated in this area were given by Wright (1983).

Wilson (1949) presented the results of a detailed study of the Hackness Coral–Sponge Bed, one of the principal members of the Corallian succession in the Hackness Hills. This is a unique occurrence representing the earliest coral reef in the British Corallian, and it is well exposed at this site. Wright (1992) described the depositional history of the Coral–Sponge Bed.

Description

The rocks exposed in the quarries belong in the lowest Passage Beds Member of the Coralline Oolite Formation. A generalized section of the Coralline Oolite in the Hackness area as described by Wright (1992) is as follows:

	Thickness (m)
Coralline Oolite Formation	
Hambleton Oolite Member, Cordatum Subzone	
(Fine, white oolite	9)
– Bored, erosive junction –	
Passage Beds Member, Costicardia Subzone	
Subdivision 4. Biosparite containing abundant large coral fragments, limestone clasts and '*Pentacrinus*' ossicles in a shelly matrix with much medium-grained quartz sand	0.15–0.20
Subdivision 3. (Coral–Sponge Bed). White, rubbly-weathered micritic limestone with an abundant coral–bivalve–brachiopod–sponge fauna listed below	2–3.5
– Bored, erosive junction –	
Subdivision 2. Shelly, ferruginous, muddy limestone with abundant *Nanogyra* fragments, '*Pentacrinus*' ossicles and oncoids in a limonitic, sandy matrix. The highest bed contains chamosite ooids and a more varied fauna with *Lima* sp. and *Pleurotomaria* sp.	4
Subdivision 1. Loose, medium- grained, moderately well-sorted quartz sand with scattered shell debris	2–3
Lower Calcareous Grit Formation	
Saintoft Member, Bukowskii Subzone	
(Tough, fine, calcareous sandstone	seen to 5)

Figure 4.17 shows a cross-section of the site. The eastern quarry is illustrated in Figure4.18. This quarry reveals 3.7 m of Subdivision 2, a shelly, iron-rich limestone with abundant *Nanogyra nana* (J. Sowerby), and occasional *Chlamys* sp. and sponges. Some coralliferous limestone (Subdivision 3) occurs at the top of this section, but is better exposed in the western quarry, where 2 m of the white, rubbly-weathering Coral–Sponge Bed is seen. The bed is composed of micritic limestone containing numerous rounded colonies of*Fungiastraea* and *Isastraea*. The shelly, micritic limestone in between the coral colonies contains a remarkably rich and diverse reef-dwelling invertebrate assemblage.

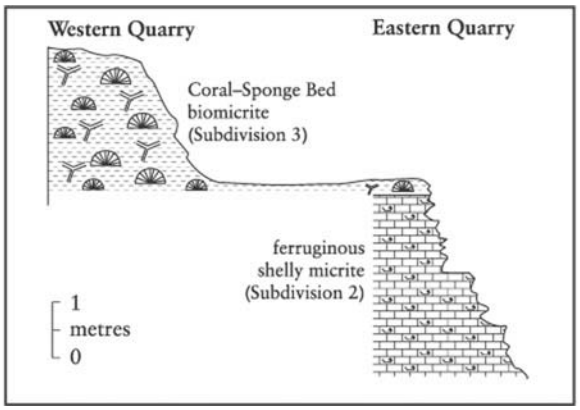

Figure 4.17: Cross-section of Hackness Head showing the two quarry sections, as measured by J.K. Wright in 1991.

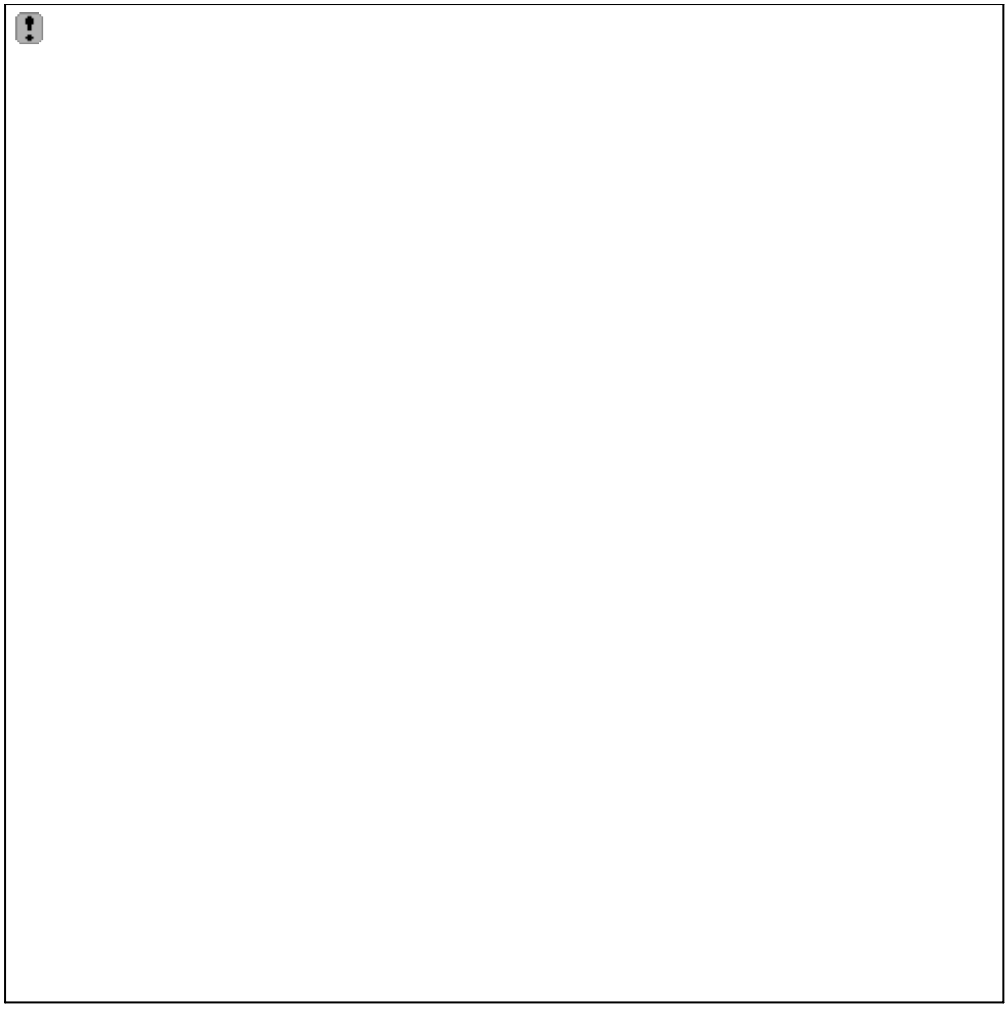

Figure 4.18: View of the eastern quarry at Hackness Head, showing the massive, bioclastic limestones of Subdivision 2 overlain by coral rubble (Subdivision 3) just below the grass at the top. Hammer shaft (mid-left of picture) is 30 cm. (Photo: J.K. Wright.)

Numerous calcareous sponges occur, many species of which are known in Britain only from this and neighbouring quarries. A large number of these sponge species were figured in Hinde's (1887–1912) classic monograph on British fossil sponges. Both Hinde andWilson (1949) gave fossil lists based on collecting over the whole of the Hackness Hills, and thus lists specific to this site are not available. Hinde (1887–1912) initially recorded seven species of calcareous sponge from the Hackness Coral–Sponge Bed. Wilson (1949), who made a collection of over 300 specimens from the Hackness area, amended this to 11 species. The complete list of fossil sponges recorded from the Hackness Outlier is as follows: *Enaulofungia floriceps* (Phillips), *E. polita* (Hinde), *E. bernensis* (Etallon), *E. bella* (Hinde), *E. smithi* (Wilson), *E. hindei* (Wilson), *E. suffieldensis* (Wilson), *Peridonella recta* Hinde, *P. hacknessi* Wilson, *Blastina aspera* Hinde and *Corynella chadwicki* Hinde.

The calcareous sponge assemblage occurring in the Hackness Coral–Sponge Bed is found in association with a coral fauna rich in numbers, and consisting of*Fungiastraea arachnoides* (Parkinson), *Isastraea explanata* (Goldfuss) and *Thamnasteria concinna* (Goldfuss). These occur in lenses, colonies and isolated masses or ‘roundheads', along with numerous often fragmentary branching corals such as *Thecosmilia annularis* (Fleming) and *Rhabdophyllia phillipsi* Edwards and Haime. Hitchins (1980) found within sheltered pores in corals and sponges small foraminifera belonging to a new genus*Tentilenticulina*. Other foraminifera such as *Placopsilina* occur fixed to coral surfaces.

Large numbers of terebratulid brachiopods along with numerous bivalve, echinoid, serpulid worm and bryozoan species fill other ecological niches in the rich palaeontological community of the Coral–Sponge Bed. The full list of brachiopod, bivalve and echinoid species, based on Wilson (1949) and Kent (1980b), is as follows:

Bivalves:

Lopha gregarea (J. Sowerby)

Nanogyra nana (J. Sowerby) *Lithophaga inclusa* (Phillips)

Liostrea quadrangularis Arkell *Chlamys nattheimensis* (de Loriol)

Chlamys fibrosus (J. Sowerby) *Lima zonata* Arkell

Lima rigida (J. Sowerby) *Astarte ovata* Smith

Camptonectes lens (J. Sowerby) *Pleuromya uniformis* (J. Sowerby)

Ctenostreon proboscideum (J. Sowerby) *Praeconia rhomboidalis* (Phillips)

Ostrea sp. *Velata anglica* Arkell

Gervillella aviculoides (J. Sowerby)

Echinoids:

Hemicidaris intermedia (Fleming)

'Cidaris' smithi Wright

Brachiopods:

'Terebratula' fileyensis Walker *'Terebratula' kingsdownensis* auctt *Zeilleria hudlestoni* Walker *Terebratulina substriata* auctt

Subdivision 1

Wright (1992) deduced that the unit had been laid down as part of a terrigenous sand sheet. The medium grain size and moderate-to-good sorting suggests that the Hackness area was occupied by a barrier sand extending across a predominantly westerly current that was gradually transporting terrigenous sediment from the Market Weighton uplift to the south. Both east and west of Hackness, the equivalent sands are fine grained, offshore marine in nature (see site report for Filey Brigg, this volume).

Subdivision 2

Conditions do not seem to have been favourable for life, with the exception of*Nanogyra*. This was almost certainly a shallow, tidal, lagoonal area prone to the influx of ferruginous mud from a nearby landmass to the north. In the deeper parts of the lagoon, *Pentacrinus*' thickets flourished, along with thin-shelled bivalves and*Nanogyra*, in conditions sheltered from wave action. Around the margins of the lagoon, freshly broken bivalve shells provided an abundant supply of nucleii for oncoids to grow in the intertidal zone.

The highest bed in this ferruginous sequence, a chamosite oolite crowded with green ooids, is also the most varied as far as the fossil content is concerned. Conditions for the formation of this iron silicate mineral, initially as berthierine (see site report forWestbury, this volume), cannot have been toxic to living organisms, and the berthierine almost certainly formed diagenetically within the sediment (Donaldson *et al*., 1999).

Subdivision 3

Wilson (1949) described the Coral–Sponge Bed at the Hackness site as a heterogeneous mass of lenses of compound corals, calcareous sponges and a host of other fossils in a matrix of calcilutite and detrital reef carbonate. He regarded the corals, sponges and other organisms as having lived in shallow, warm, fully marine waters that were agitated and current swept, and in which little deposition was taking place.

Growth banding shows that the average growth rate for the Hackness corals was only 2 mm per year, as against an average of 10 mm for corals growing in the Bahamas today. Britain in the Late Jurassic Epoch was at a similar latitude to that of the Bahamas, and initially, this slow growth rate seems puzzling. Such rates of growth of 1.5–3 mm per year are in fact quite typical throughout the British Corallian, and the explanation is simply that Jurassic corals grew at a slower rate than do modern ones (Ali, 1984), and had much denser skeletons.

Insalaco (1996) has noted that there is a marked difference in growth rates between Jurassic corals from the Yorkshire reefs and corals of a similar age from central Europe. In Yorkshire the growth rate was on average 1.5 mm per year less than that in central Europe. The climate in both areas seems to have been equable and similarly suited to coral growth. Insalaco proposed that the reduction in growth of the Yorkshire corals was due to the lesser amount of solar radiation reaching these northerly latitudes (39°N at this time).

The massive corals from Hackness are quite small (*c.* 150 mm) compared with the large coral masses occurring at other horizons in the Yorkshire Corallian (see site report forBetton Farm, this volume), and some special factor appears to have inhibited their growth. One possibility is an influx of clay washed in from the low-lying landmass to the north (Rawson and Wright, 2000). Equally likely, Hackness was situated in a lagoonal area away from the reef front (Figure 4.19), and growth of coral here would be inhibited by a reduced food supply.

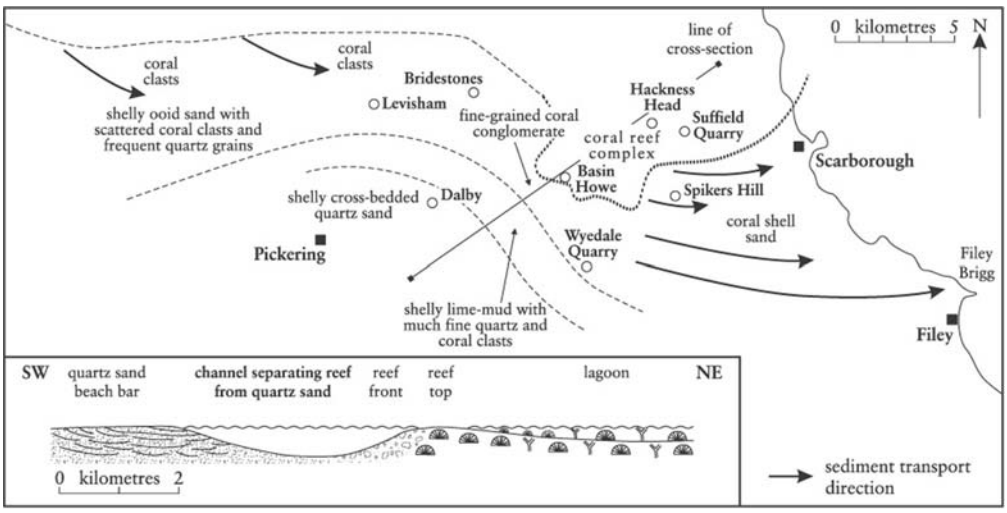

Figure 4.19: Facies distribution across the central and eastern parts of the Cleveland Basin during deposition of the Hackness Coral–Sponge Bed (after Wright, 1992, fig. 10).

Thus, with its abundance of lime mud and only slightly broken and abraded shell debris, the Hackness area appears to have been a quiet, lagoonal area in the centre of a reef complex. There was prolific growth of the delicate, branching*Rhabdophyllia*, and the more sporadic growth of massive corals. The abundance of robust globate terebratulids and the presence of sponges support the view that these deposits were formed near land and in shallow water. Palmer and Fürsich (1981) studied a Bathonian sponge reef in Normandy and suggested a similar shallow, protected, low-energy environment.

Studied as a whole, the coraliferous sequences within the Yorkshire Passage Beds fulfil many of the criteria of a coral reef complex (Figure 4.19). To the south-west of Hackness, at Basin Howe, coralliferous micrite with large coral masses reaching 250 mm in diameter occurs (Wright, 1992). The larger size of the corals, plus the abundance of broken coral and the coarser matrix, suggests that this area was close to the nutrient-supplying currents. As the coral reef built up here into the surf zone, coral growth was at its maximum, but erosion was equally at a maximum. Thus, in all directions to west, south and east of Basin Howe, the Coral–Sponge Bed passes laterally into a coral–shell bed consisting of a chaotic jumble of abraded coral fragments, sponges, echinoids and bivalves.

Slightly further west, south and east (i.e. to the south atSpikers Hill, see site report, this

volume), the coral fragments are more rounded and fragments of reef rock more numerous. As the clasts were transported longer distances they became more and more abraded, and those in the long tail of coral–shell sand extending towards Filey consist almost entirely of 2–3 mm fragments of *Thamnasteria* and *Fungiastraea* (see site report for Filey Brigg, this volume).

It is clear that in the area south of Hackness the Coral–Sponge Bed formed a solid reef front that was attacked by wave action and the coral fragments broken off and incorporated into the surrounding sediments. An irregular reef margin is indicated in Figure4.19, based on detailed mapping of clast sizes. Coral conglomerate with clasts 5–10 mm in diameter formed in a narrow zone close to the reef. Coral fragments averaging 2–3 mm are scattered through the fringing sediments away from the reef, and can be prolific (see site report forSpikers Hill, this volume). The long tail of coral–shell sand extending eastwards to Filey demonstrates the west–east transport direction. The lessening in the energy of transport of this finer-grained sediment is shown by the occurrence of large, complete bivalves in life position, i.e.*Gervillella aviculoides* (J. Sowerby) at Filey Brigg. This is the dominant bivalve of a community that seems to have thrived in a relatively high-energy environment.

The conditions suitable for the association of corals and sponges at Hackness were unique in Britain, and were not repeated in later Corallian times. During the main episode of coral reef development in the Coral Rag of Yorkshire, Cambridgeshire, Oxfordshire and Wiltshire there is a virtual absence of calcareous sponges and terebratulids. The Hackness Coral–Sponge Bed formed relatively soon after the end of the sandy conditions of the Lower Calcareous Grit and early Passage Beds, and it appears that the continued influx of very fine clastic sediment affected the palaeoenvironment, encouraging the growth of sponges, and slightly inhibiting that of corals.

Subdivision 4 – the Pentacrinus biosparite

This thin, oobioclastic limestone rests erosively on the coral reef throughout the Hackness area. It is not exposed at the Hackness Head site, but it is seen particularly well at Spikers Hill. The conditions of deposition will thus be dealt with below in the Spikers Hill GCR site report.

Conclusions

Hackness Head is a key stratigraphical and palaeontological site for Upper Jurassic British rocks. The locality shows two metres of coral–sponge bed belonging to the Passage Beds Member at the base of the Coralline Oolite Formation. This accumulation of colonial corals of both massive and phaceloid forms is the earliest known in the British Oxfordian record, and its association with a wide variety of fossil sponges is unique.

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