FIELDTRIP TO THE CORALLIAN ROCKS OF THE DORSET COAST, WEDNESDAY 3 JANUARY 2007

J.C.W. COPE

Cope, J.C.W. 2007. Fieldtrip to the Corallian rocks of the Dorset coast, Wednesday 3rd January 2007. *Geoscience in south-west England*, **11**, 355-357.

A party of 26 members of the Ussher Society assembled in the car park of the Smugglers' Inn, Osmington Mills, some 5 km east of Weymouth for the preconference fieldtrip on 3 January 2007. The day was grey and overcast with low cloud and rain threatening.

A descent was made to the foreshore and here the view through the mist to the west, over the southern limb of the Weymouth Anticline was explained. At the furthest point south, the northern face of the Isle of Portland was visible. Its base lay on a poorly exposed outcrop of the top of the Kimmeridge Clay Formation, overlain by the Portland Group and the lower part of the Purbeck Group at the top of the escarpment; these were all dipping south at a very low angle. To the north, Portland Harbour and Chesil Beach overlay the submarine outcrop of the Kimmeridge Clay Formation; the higher ground of the southern Weymouth conurbation around Wyke Regis was on the Corallian Group outcrops, whilst Weymouth Esplanade and town centre were on the Oxford Clay Formation. As the Weymouth Anticline plunged eastwards, older formations such as the Frome Clay, Forest Marble and Cornbrash only cropped out on the western side of the anticline. The Oxford Clay Formation was the oldest lithostratigraphical unit to crop out on the eastern side of the Weymouth peninsula (Figure 1). The outcrop of the Corallian Group, on which the party were standing lay to the north of that Oxford Clay outcrop and was consequently on the northern limb of the anticline.

The party then examined the slipped Kimmeridge Clay outcrop, seen at beach level. Fresh material of the clay, here in a small fault-bounded exposure and belonging to the Mutabilis Zone, was readily obtained and it was noted that the bivalves and ammonites were preserved in largely original aragonite, often showing iridescence.

The party then moved eastwards along the shore to examine the succession within the Corallian Group. The field course leader explained that the scale of formations within the Dorset Upper Jurassic rocks varied considerably. The Oxford Clay Formation, below the Corallian Group, was some 150 m thick and was divided into three members, whilst the Kimmeridge Clay Formation, above the Corallian Group, was up to 500 m thick (but probably half that in the Osmington-Ringstead area) and was not divided into members. The Corallian Group, because of its varied and often contrasting lithologies, although only some 60 m thick, had been divided into formations by several workers, with varying results. The latest consensus suggests that four formations should be recognised, each divided into members (Wright and Cox, 2001). The scale of the formations contrasted with the thick clay formations above and below the Corallian Group.

In the vicinity of Osmington Mills, the first sections exposed on traversing eastwards were in the Nothe Grit. Exposure here was not good and the first sections that were well exposed lay eastwards at the top of the Nothe Clay. The uppermost part of the Nothe Clay here exposed was a grey sandy clay; its fauna is principally of bivalves. The overlying Bencliff Grit has a transitional boundary with the clays below and consists of fine-grained sandstones and siltstones with more argillaceous intervals. It contains conspicuous rounded concretions around one metre in diameter ('doggers') that litter the beach. They were formed by localised calcareous cementation of the sands which display striking cross-bedding that can be traced from the poorly cemented sands across the concretions. These structures have been interpreted as swaley cross bedding, indicative of storm deposition, first described by Sun (1989) and by Allen and Underhill (1999). The absence of macrofossils in the sands suggests these rocks are lagoonal; apart from trace-fossils the

CRETACEOUS	
Chalk Group	150 m
Upper Greensand Formation	
Cherty Beds Member	20 m
Foxmould Member	27 m
Gault Formation	12 m
Late Cimmerian unconformity	
(Gault rests on horizons down to Oxford Clay)	
Wealden Group	?110 m
Purbeck Group	
(most of Lulworth Fm. + Durlston Fm.)	50 m
JURASSIC	
Purbeck Group (lowest part Lulworth Fm.)	10 m
Portland Group	
Portland Stone Fm.	30 m
Portland Sand Fm.	30 m
Kimmeridge Clay Fm.	350 m
Corallian Group	60 m
Oxford Clay Fm.	150 m
Cornbrash Fm.	10 m
Forest Marble Fm.	28 m
(Boueti Bed at base)	0·3 m
Frome Clay Fm.	30 m
(Wattonensis Beds at base)	3 m

Figure 1. *The succession of Jurassic and Cretaceous rocks in the area around Weymouth.*

sands have yielded foraminiferans and ostracods tolerant of fresh water together with abundant spores and pollen. The party noted that the lower part of the sands locally exudes sweet oil; its source is from the Lower Jurassic Charmouth Mudstone Formation, here probably not buried deeply enough for maturity, but migrating across faults to the north where it is more deeply buried.

The Osmington Oolite Formation rests with sharp contact on the Bencliff Grit; the boundary is a non-sequence and the top of the Bencliff Grit was seen to be bored. The basal beds were transgressive sandy bioclastic limestones of the Upton Member that pass up into deeper water clays and then cross-bedded oolites of the Shortlake Member (Figure 2). Towards Bran Point spectacular U-shaped burrows of the trace fossil *Diplocraterion* were examined in a level-bedded oolite.

At Bran Point the party walked seawards along a ledge exposed by the low tide that was separated from the cliffs and foreshore to the immediate north by the Bran Point Fault (Arkell, 1947). The latter runs virtually parallel to the coast and has a small northerly downthrow. The ledge gave views eastwards towards White Nothe. At the point of White Nothe itself the junction of the Upper Greensand and Chalk was clearly visible just above sea-level and seen to be dipping gently south at about 10°. This boundary could then be projected visually north-westwards and picked up again some 600-700 m to the north-west high up in the cliff. The junction between the Upper Greensand and the Gault was covered by talus from the Chalk and Upper Greensand and by vegetation, but at the far side of Ringstead Bay the dark cliff of Kimmeridge Clay could be seen at the base of the cliff, where it is overlain by the (hidden) Gault. Northwards the Kimmeridge Clay could be seen to be succeeded by the Portland and Purbeck groups dipping northwards at some 30° below Holworth House. This is the famous Holworth House unconformity. The pre-Gault folding is of Late Cimmerian age and in this region can be closely constrained temporally since, to the immediate north of the Chalk ridge to the north of Ringstead Bay, the Wealden Group crops out in the Upton Syncline, immediately below the Gault. Part of the Wealden is probably missing there, but the only formation entirely missing is the Aptian Lower Greensand.

The party then continued on eastwards, examining first the Nodular Rubble Member of the Osmington Oolite Formation, that succeeds the Shortlake Member with a break (Figure 2). The rubbly appearance of this member could be seen to be due to calcareous infillings of the branched crustacean burrow *Thalassinoides* separated by clays. Several specimens of the turreted gastropod *Pseudomelania headingtonensis* were collected along with a species of *Pholadomya* and the echinoid *Nucleolites scutatus*.

Above followed a major non-sequence encompassing more than two ammonite subzones (Figure 2) and the party then examined the succeeding Clavellata Formation. The shell banks of the eponymous trigoniid *Myophorella clavellata* were seen on the foreshore and the cliffs. The base of the succeeding Sandsfoot Clay was noted, but beyond this exposure became poor.

The overlying Sandsfoot Formation is separated from the Clavellata Formation by a break encompassing more than two ammonite zones (Figure 2); this break is widespread over southern England. The party then crossed an area of beach devoid of exposures to see the overlying beds towards Ringstead Bay. In the low slipped exposures at the foot of the cliff the coral–bearing Osmington Mills Ironstone (formerly here known as the Ringstead Coral Bed) was intermittently exposed and yielded several pieces of coral and bivalves. This is the only level in the Dorset Corallian to regularly yield reef corals; in this respect it differs from the Corallian of the south Midlands or Yorkshire where *in situ* coral reefs occur. Several species of coral have been recorded here, but all are broken and often bored; they were clearly derived from a reef in the vicinity, but in what direction it lay is unknown. The overlying basal Kimmeridge Clay was replete with the large triangular oyster *Deltoideum delta*, but the characteristic asymmetrical

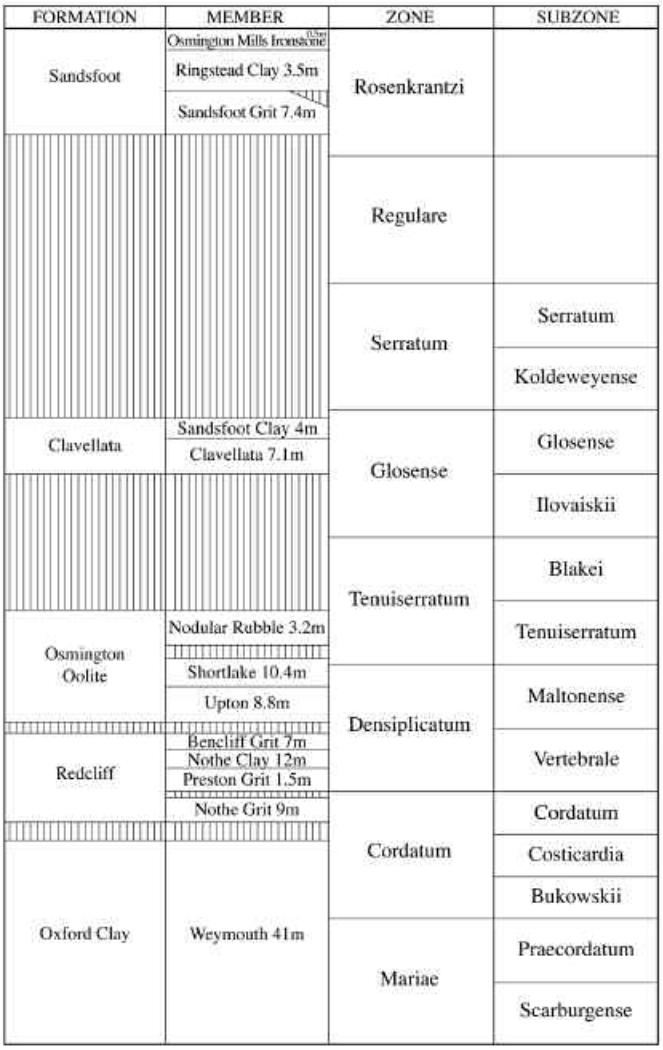

Figure 2. *The Oxfordian succession of the Dorset coast (modified after Wright and Cox, 2001).*

brachiopod of these basal clays, *Torquirhynchia inconstans*, was not found, but this marker fossil occurs at this horizon right along the Kimmeridge Clay outcrop, as far north as Yorkshire (Callomon and Cope, 1995). The return back to Osmington Mills and the Smugglers' Inn for lunch was made over the clifftop path.

When the day was originally planned it was expected to spend the afternoon along the Abbotsbury-Ridgeway Fault Zone to the north to examine the inliers of Middle Jurassic rocks of the area (for details see House, 1989) and look at the topographical expression of the folds and faults along this area. However, the light had deteriorated considerably over lunchtime and the party were consulted as to whether they might prefer to examine the coastal exposures of the Corallian Group to the west of Osmington Mills, where the higher beds were better exposed than the sections seen to the east, and where the light might be better than inland. This was unanimously agreed.

Immediately to the west of the point where the descent to the beach was made, it was noticed that the foreshore had been swept clear of shingle, so that there was an admirably clear succession of the top part of the Sandsfoot Formation, with the Ringstead Clay, with its characteristic limonite-coated concretions, particularly well-exposed.

The view westwards towards the headland of Redcliff Point was clearly visible some 2.5 km away. Redcliff Point itself consists of the Weymouth Member of the Oxford Clay, but this formation is truncated only a few metres to the north where the Corallian Group is downfaulted. A good view was obtained

over the Ham Cliff Anticline, a small flexure in the northern limb of the Weymouth Anticline that exposes the Weymouth Member and topmost Stewartby Member of the Oxford Clay in its core. This is a potential GSSP candidate for the Callovian-Oxfordian boundary. The Corallian beds of the northern limb of the Ham Cliff Anticline could be traced continuously to the promontory of Black Head and this would be the focus of the afternoon's fieldwork.

Traversing westwards the first thing to note was the major mudflow onto the foreshore from beneath Goggin's Barrow. Theses mudlflows behave much the same way as glaciers and were first described in a paper by Arkell (1951). The principal material was the grey Kimmeridge Clay and included large septarian concretions that are derived principally from the Eudoxus Zone. Occasionally these concretions yield finely preserved ammonites and other fossils. On the scar below the cliff top a fine section in the Gault could be observed, its brownish grey colour contrasting with the dark grey of the Kimmeridge Clay on which it rested directly. Ammonites and other fossils from the Gault were incorporated into the mudflows and occasionally fine specimens could be recovered at beach level; these were principally hoplitids of the lower part of the Middle Albian. It was far too hazardous to try to access the Gault directly here.

Farther along the beach the party crossed a rough stretch of ground littered with rounded boulders of the Upper Greensand that had been washed out of other mudflows. Most of the material was a hard calcareous glauconitic sandstone and fossils were seen in several boulders including serpulid worms, abundant examples of the bivalve *Amphidonte obliquatum* and large examples of the ammonite *Mortoniceras* signifying the Upper Albian Inflatum Zone.

Beneath Black Head the Corallian section was gained and some time was spent examining the Sandsfoot Formation, here better exposed than on the Bran Point – Ringstead coast, and its junction with the Kimmeridge Clay. The Clavellata Formation was also better exposed, with the trigoniids shell banks proving several fine specimens of *Myophorella clavellata*, some with both valves preserved. The shell beds here also contain a species of the ribbed *Trigonia (Trigonia)*.

The Osmington Formation was well displayed on the foreshore and the party examined the fine white even-grained oolites of the Shortlake Member and the pisolite band towards the top of the underlying Upton Member. The latter is of algal origin and individual pisoliths average 10 mm in diameter. The pisolite here lies closer to the base of the Shortlake Member than at Bran Point probably due to erosion of the top of the Upton Member, before deposition of the Shortlake Member commenced.

Failing light drew the fieldtrip to a close shortly before 4.00 pm. To everyone's surprise, apart from a five minute shower in the late morning, the rain had held off and although the day had been very grey the weather had not spoilt an enjoyable day in the field.

REFERENCES

ALLEN, P.A. and UNDERHILL, J.R. 1999. Swaley cross-stratification produced by unidirectional flows, Bencliff Grit, (Upper Jurassic), Dorset, UK. *Journal of the Geological Society, London*, **156**, 241-252.

ARKELL, W.J. 1947. *The geology of the country around Weymouth, Swanage, Corfe and Lulworth*. Memoir of the Geological Survey of Great Britain.

ARKELL, W.J. 1951. The structure of the Spring Bottom Ridge, and the origin of the mud-slides, Osmington, Dorset. *Proceedings of the Geologists' Association*, **62**, 21-30.

CALLOMON, J.H. and COPE, J.C.W. 1995. The Jurassic geology of Dorset. In: TAYLOR, P. D. (Ed.), *Field geology of the British Jurassic*. Geological Society, London, 51-103.

HOUSE, M.R. 1989. *Geology of the Dorset Coast*. Geologists' Association Guide.

SUN, S.Q. 1989. A new interpretation of the Corallian (Upper Jurassic) cycles of the Dorset coast, southern England. *Geological Journal*, **24**, 139-158.

WRIGHT, J.K. and COX, B.M. 2001. British Upper Jurassic stratigraphy (Oxfordian – Kimmeridgian). *Geological Conservation Review Series,* **21**.