

A NEW LOOK AT PORTLANDIAN STRATA EXPOSED AT WARREN FARM, STEWKLEY, BUCKINGHAMSHIRE

J. D. RADLEY

The tract of countryside immediately to the north and north east of Aylesbury is largely underlain by various sands, clays and limestones which were deposited as sediment in a warm sea of fluctuating depth, during the upper part of the Jurassic Period, between about 155 and 135 million years ago.

Approximately 140 million years ago, uplift of land away to the north east of Buckinghamshire caused the long established Jurassic sea to retreat into two basins, the Wessex-Weald Basin in southern England and the Spilsby Basin to the north east, the two basins being effectively separated by the landmass. Marine conditions continued to prevail in the north eastern basin, but in the southern basin retreat of the sea towards the south west resulted in a replacement of open marine conditions, first by a subtidal, and ultimately by tidal-flat and freshwater environments. The nature of this regression meant that sedimentary rock layers, representing successive environmental zones, or "facies" can now be found resting directly on top of one another when seen in the field. (See figures 1 and 2).

The uppermost open marine and subtidal deposits of this regressive phase around Aylesbury consist mainly of sands, limestones and clays, and comprise the rocks of the Portland Beds, broadly equivalent in age to the Portland Beds of Dorset, laid down in the same sea. The tidal-flat and freshwater deposits constitute part of the Purbeck Limestone Formation, and rocks of the same formation in Dorset were laid down at a slightly later stage, partly on tidal flats after the advance of the shoreline from the north east.

The critical rocks are very poorly exposed in Buckinghamshire, practically the only permanent open section now existing appears to be the old stone pit at Warren Farm, near Stewkley. Here the whole of the Creamy Limestones can be seen, overlain by roughly 2 m. of marls and mudstones representing part of the Purbeck Limestone Formation, (see fig. 2). Traces of Lower Cretaceous Whitchurch Sands form the top of the section.

Where not obscured by debris in the pit bottom, the lowest part of the Creamy Limestones overlies mustard-coloured sand known as the Crendon Sand. The boundary is transitional and for a few centimetres the base of the limestone is quite sandy. This, and the next metre of limestone is full of fossils, mainly bivalve molluscs. The majority are preserved as internal and external moulds, their original aragonite shells having been dissolved away. When composed of calcite however, the shells are retained. For this reason well preserved oysters, (*Ostrea expansa* and *Nanogyra nana*) can be found. Other abundant species include *Camptonectes lamellosus*, *Laevitrigonia gibbosa*, *Protocardia dissimilis* and *Pleuromya uniformis*, the latter three being burrowing forms.

The oysters cemented themselves to shells and shell fragments on the sea floor, whilst *Camptonectes lamellosus* is the only common form which might have been capable of swimming. This fauna indicates a stable sea floor, whilst the relatively unbroken and unworn condition of these fossils indicates a non-turbulent environment, probably a short distance offshore. The shells tend to be large which in the past has been taken as an indication of a tropical or sub-tropical climate. Large ammonites (*Kerberites*) have also been found, but the absence of corals, brachiopods and echinoderms indicates abnormal salinity.

The next 30 cms. or so of limestone is similar to that below, but a profound change in fossil content has taken place. The large molluscs appear to be absent, and instead a fauna of small bivalves and gastropods is present. I have provisionally identified some of them as the following:

Gastropods: *Ampullospira ceres*, a possible *Pleurotomaria* and a *Procerithium*.

Bivalves: forms resembling *Cucullaea* and *Eomiodon*.

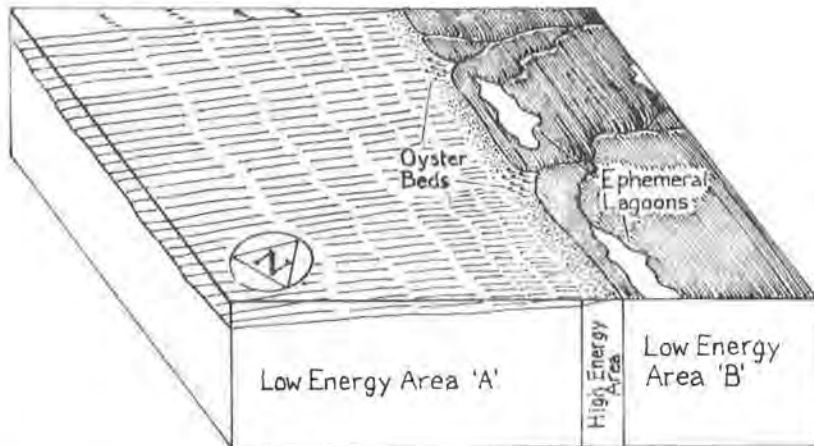


Fig. 1 Environmental Model

	Low energy area 'A'	High energy area	Low energy area 'B'
Stratigraphic division	Crendon Sands and Creamy Limestones	Uppermost Creamy Limestones	Purbeck Limestone Formation
Lithology	Sands and massive limestones	Broken-shell limestones and clays	Fine-grained marls and mudstones
Environment	Shallow open marine	Sub-tidal	Tidal flats dissected by creeks
Faunal Diversity	Moderate	Moderate (low where oysters thrive in brackish environment)	Low
Faunal Density	High*	Moderate to high	Moderate

* Crendon Sands are generally non-fossiliferous, owing to post-depositional solution.

A small regular echinoid plate was also found. In this layer the shells have not been dissolved away, and their unabraded state once again appears to bear testament to calm conditions.

The overlying bed consists of about 15 cms. of brown laminated clay, rich in comminuted shell debris, and large specimens of *Ostrea expansa*, often broken. These have been bored and encrusted by a variety of small organisms. The abundance of broken shell debris indicates high-energy current or wave action, possibly in a shallow embayment flanking the encroaching shoreline. The abundance of oysters and lack of other bivalves might indicate a slightly brackish environment, probably influenced by coastal river discharge. (See fig. 1).

The next 15 cms. of rock consists of a hard grey broken-shell limestone, quite crystalline in places, containing abundant disarticulated valves of *Laevitrigonia gibbosa*, replaced by calcite, with less abundant *Camptonectes*, *Protocardia*, a possible *Modiolus* and *Eomiodon*, rare oyster fragments, and a flat chip of bone, probably from a turtle carapace. This limestone seems to indicate deposition in a subtidal environment, where constant wave action would produce the washed shell-sand which constitutes this limestone. This is overlain by 15 cms. of oyster-rich clay, identical to that below the underlying limestone.

Beds 7 to 10 (see fig. 2) represent basal parts of the Purbeck Limestone Formation, and were deposited mainly on tidal flats which advanced over the underlying strata, towards Dorset from the north east.

The lowest bed above the second shelly clay consists of soft, finely laminated cream and brown marl, containing numerous ostracods. These small water-fleas swarmed in the shallow water which frequently covered the flats, leaving thin laminae of ostracod debris. This marl grades up into about 30 cms. of fine-grained white marl, sometimes indurated into a crumbly calcareous mudstone. Fossils are fairly abundant, and consist of small mussels, (a smooth *Modiolus* and a ribbed form) together with ostracods, fish remains, rare serpulids and *Laevitrigonia gibbosa*. The water which covered the flats at this time was probably occasionally brackish. Succeeding this, a 10 cm. oyster-rich clay is exposed, and might represent a slight re-advance of the sea.

The remaining sediments of the Purbeck Limestone Formation consist of crumbly marls and mudstones, sometimes containing brackish-marine ostracods. One mudstone band, a short distance below the top of the Purbeck Limestone sequence, yielded a single small *Valvata*, together with a few badly preserved *Hydrobia*, thus establishing the first record of gastropods belonging to these genera from the Purbeck Limestone of Buckinghamshire. Some oolites are present within this layer, possibly introduced during storms into the shallow ephemeral lagoons which occurred on the tidal flats at this time.

Other molluscs appear to be absent in this part of the sequence, apart from poorly preserved *Modiolus*, which sporadically occurs in a weathered grey clay beneath the Lower Cretaceous Whitchurch Sands.

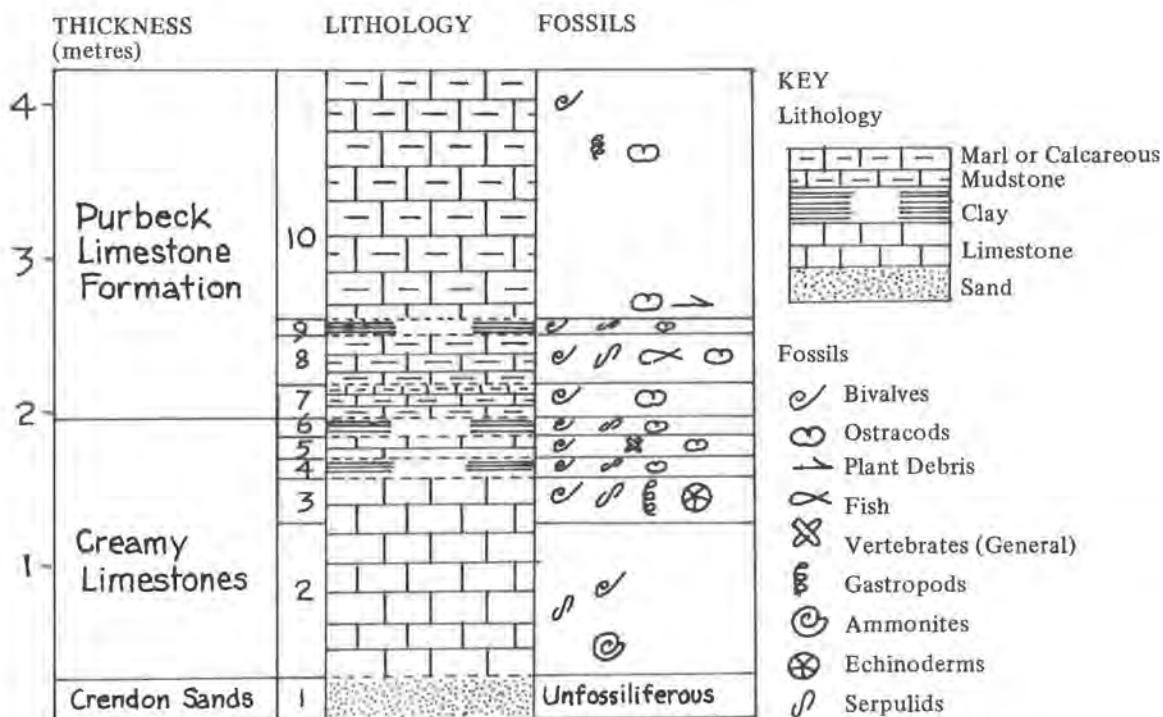


Fig. 2 Portlandian Strata exposed at Warren Farm, Stewkley, Buckinghamshire.

The author adds the following note:

Anyone wishing to visit this exposure should seek prior permission from the farm owner. If collecting is necessary, it should preferably from the numerous fallen blocks, and not the weathered face.

A permanent exposure like the pit at Warren Farm is unique, but exposures of underlying rock may be seen around Aylesbury in trenches for gas, electricity or water mains or on building sites. Important new discoveries are being made all the time, nearly all from such works; indeed fossils can frequently be carried away by the hundredweight, as many people will testify, and expert knowledge is by no means a prerequisite for finding specimens of scientific interest.

Anyone who has recently noticed anything interesting, or collected from exposures of this nature, is asked to contact the author (J. Radley, Spinney End, Marriotts Avenue, South Heath, Great Missenden, Bucks) or the Buckinghamshire County Museum.