THE LOWER GREENSAND GROUP (APTIAN—ALBIAN) AT SWANAGE: CORRELATION WITH THE ISLE OF WIGHT TYPE SECTION

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The Lower Greensand Group (Aptian—Albian: Lower Cretaceous) outcropping north of Swanage in Dorset is usually poorly exposed, yet the section is important in the study of the palaeogeography developed during the marine transgressions of the Lower Cretaceous. During Aptian—Albian times the Swanage area lay between open marine conditions of the Channel Basin to the east (Isle of Wight: Figure 1) and non-marine/estuarine conditions to the west. This facies transition is reflected in thickness changes in the Lower Greensand Group: from 100 to 250 m on the Isle of Wight; 90 m at Swanage and 0 m (zero) on the east side of Lulworth Cove (Figure 1).

Fitton (1836) completed some of the early work on the Lower Cretaceous of southern England which included descriptions of the Swanage section. The Lower Greensand at Swanage was described in detail by Judd (1871) and Meyer (1872). Judd suggested that the 'Punfield Beds' (Punfield being a cove in the Swanage cliff section), rested on non-marine Wealden clays, and included a non-marine to marine transition fauna. Meyer refuted this, maintaining that the succession was essentially complete, as on the Isle of Wight. Arkell (1947) built upon Judd's (1871) work by describing the Lower Greensand sediments at Swanage as 'estuarine'. Casey (1961) found support for both Judd and Meyer in suggesting that the faunas of the Punfield Marine Band (a limestone band in the succession) were estuarine, and that the stratigraphy is comparable with the Isle of Wight type-section. The present work suggests a further reconciliation: Judd's (1871) observation of brackish and marine faunas within the Punfield Marine Band has been confirmed by Simpson (1982) and Cleevely *et al.* (1983). Discovery of *Filosina gregaria* Casey, a bivalve of brackish affinities common to the Wealden succession above the Punfield Marine Band, during this study, adds support to the estuarine model.

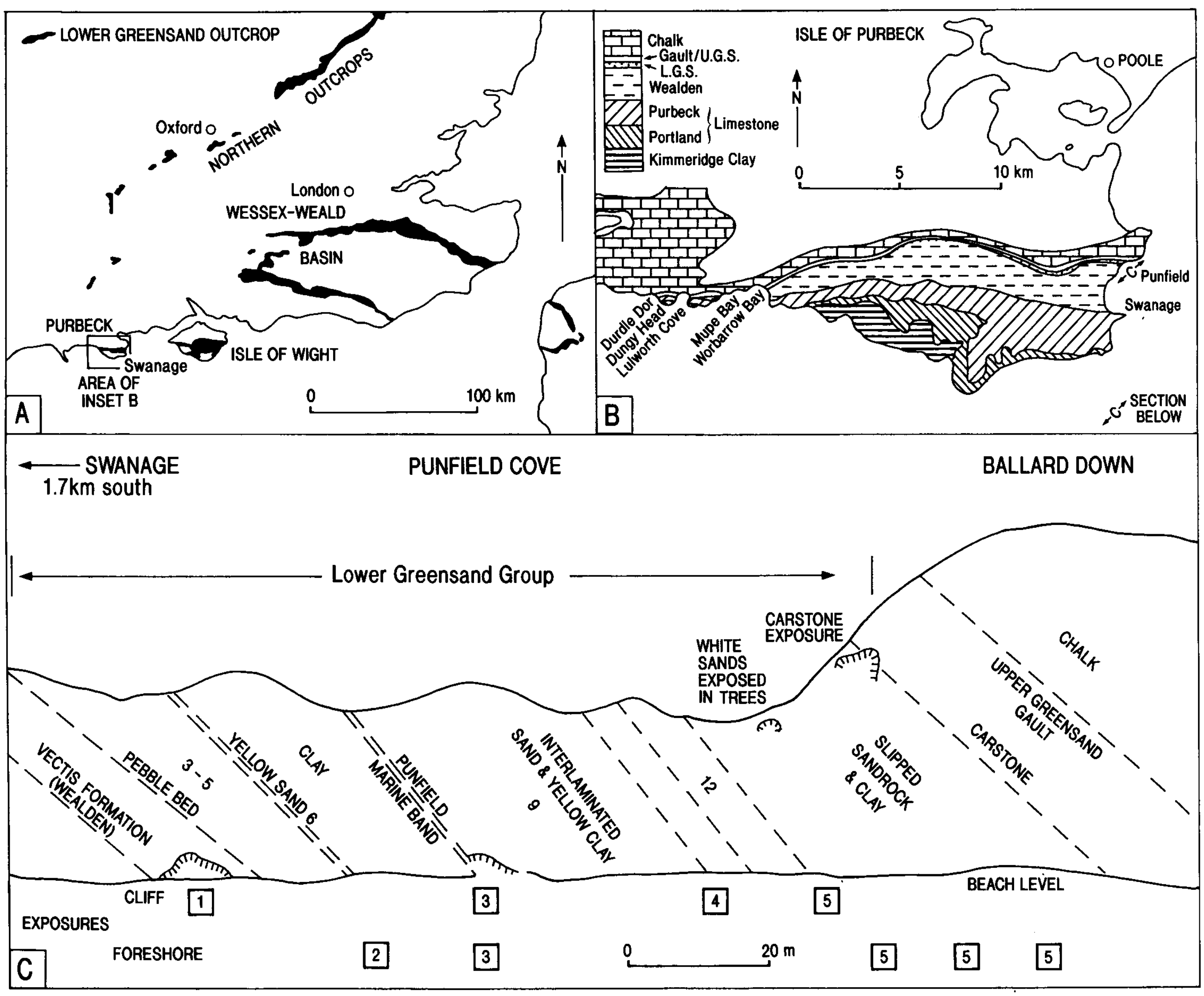

Figure 1: A: Locality map showing relationship of the study area to the Isle of Wight and southern England. B: Geological map of the Isle of Purbeck. C: Outcrop stratigraphy of the Lower Greensand and adjacent strata exposed north of Swanage. Bed numbers assigned by Arkell (1947) are indicated. Numbered boxes relate to Figure 2 and text. Apparent variation in dip is due to cliff profile.

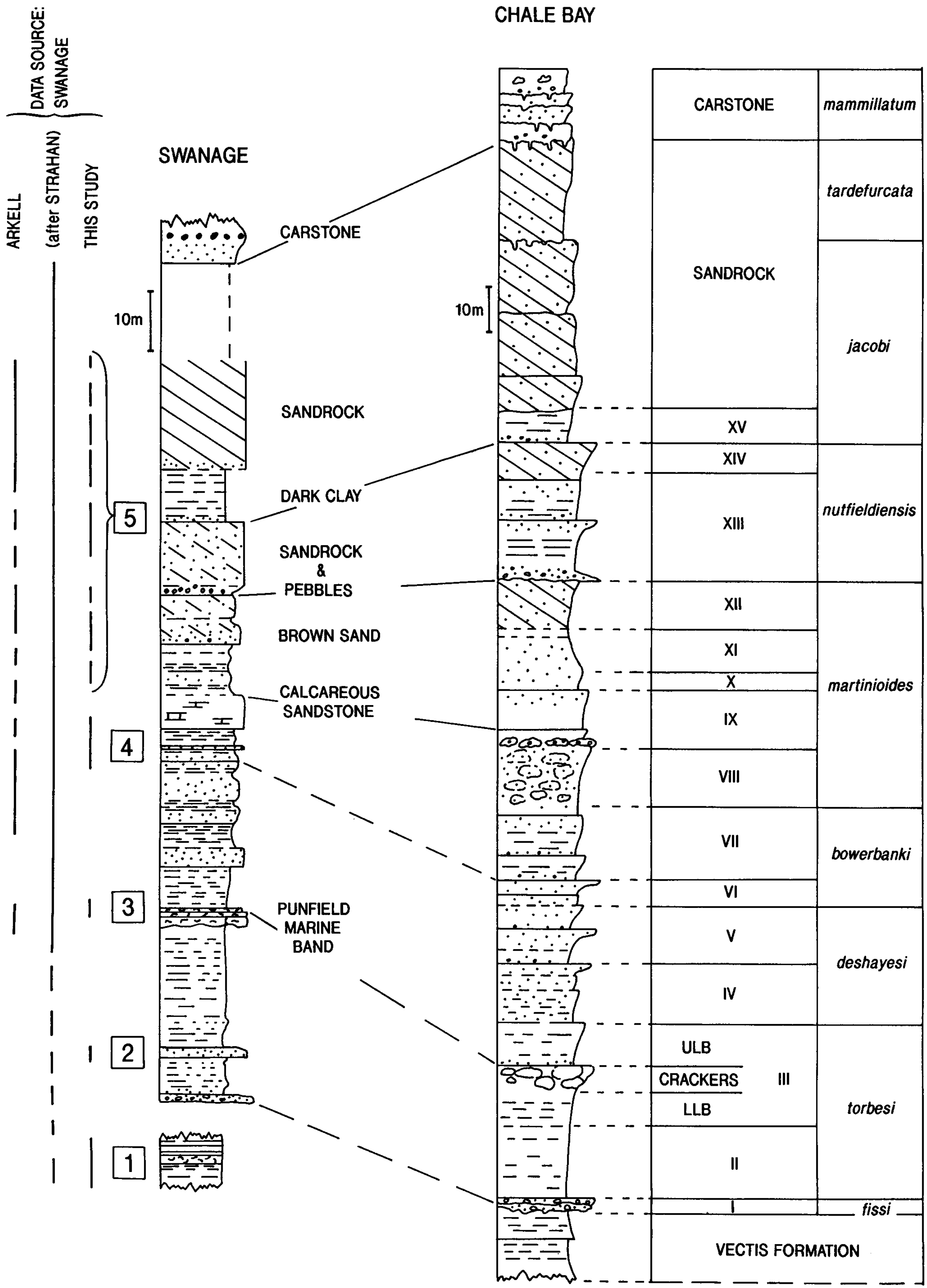

Figure 2: Stratigraphy of the Lower Greensand exposed at Swanage (90 m thick) with sources of data and correlation with the Isle of Wight type section at Chale Bay (250 m thick).

At the present day occasional exposures of the Punfield Marine Band occur in the low cliffs of Punfield Cove [SZ 039 809]. White, uncemented sands higher in the Lower Greensand succession may be observed in the cliffs behind the cove, while the early Albian Carstone (effectively basal Gault) is exposed in the high scarp slope below the Chalk (Figure 1). During the winter of 1988, a number of fresh exposures of Lower Greensand were noted on the foreshore, and in the cliffs north of Swanage. This unusual situation, and the importance of the succession, warranted documentation of all the exposed material.

An isolated exposure of Wealden 'shales' (Exposure 1 of Figures 1 and 2) similar to the Vectis Formation lithofacies of the Isle of Wight *(sensu* Stewart *et al.,* 1991) was noted approximately 25 m below the Punfield Marine Band. Approximately 10 m of well-laminated, dark grey to black mudstones with white silt partings were exposed. A 1 to 2 cm-thick, uncemented shell bed of the bivalve *Unio* was observed at the top of the bed.

Shingle covered approximately 10 m of strata between the Wealden beds of Exposure 1 and the unfossiliferous, massive micaceous grey silty clay of Exposure 2 (Figure 2). Poor definition of physical sedimentary structures in these beds is due to pervasive bioturbation by *Thalassinoides* and *Macronichnus*. This exposure is interpreted to be part of the Atherfield Clay Formation, on account of its stratigraphical position and lithology. Whether it is the Chale Clay Member or Lower Lobster Beds Member of the Isle of Wight type locality (Simpson, 1985) is hard to tell.

The lower contact of the 1.5 m-thick Punfield Marine Band (Exposure 3; Figures 1 and 2) was not observed during this study, while the upper bioclastic limestone beds were found to be enriched in wood fragments. 10 cm of light grey clay separate the Punfield Marine Band and an uncemented shell-bed of *F. gregaria:* a brackish-marine bivalve more common to the Wealden beds below the Lower Greensand Group. The shells were noted to be convex-upward on a single bedding surface. The clay above coarsened-up into a white, medium-grained, cross-bedded sandstone containing rare oysters *(Aeteostreon)* and a patchy calcite cement, drawing comparison with the Crackers Member of the Isle of Wight succession (Simpson, 1985). Overlying the sands were ?slipped brown silty clays. These contained ammonite fragments, one of which was identified by Drs. H. Owen and P. Rawson (pers. comm. 1989) as *Deshayesites punfieldiensis* Spath. This ammonite was recorded from the Punfield location by Arkell (1947), although Casey (1961) thought this to be a mis-identification. This new record indicates correlation with the Upper Lobster Beds of the Isle of Wight (Simpson, 1985).

The succeeding 20 m of strata were obscured by shingle until a grey-green bioturbated and argillaceous sand was reached (Exposure 4 of Figures 1 and 2). This exposure was 9 m-thick with two 30 to 60 cm-thick beds of iron-cemented silty sand (iron pan') in its upper parts, separated by a bright green siltstone. At the base of the upper iron-cemented bed, the moulds of bivalves and the ammonite *Tropaeum bowerbanki* Sowerby (H. Owen, pers. comm. 1989) were found. The 12 to 15 metres of strata above were poorly exposed, consisting of soft, brown, coarse sands with the clay-lined burrows of *Thalassinoides* and *Diplocraterion*. The lithology of these beds is very similar to the Ferruginous Sands Formation of the Lower Greensand Group exposed at Redcliff and Compton Bay on the Isle of Wight.

The upper beds of the Lower Greensand Group were exposed some 15 m above Exposure 4. The low cliffs north of Punfield Cove exposed slipped micaceous grey mudstones abruptly overlain by white sands typical of the Sandrock Formation of the Isle of Wight (Casey, 1961). These beds are very similar to those more permanently exposed in the cliffs behind Punfield Cove itself: both have tabular cross-stratification, similar lithology and are on-strike. Rotated palaeocurrent vectors suggest that flow was towards the south-east. Resting with an undulatory erosion surface on this white sand was an iron-cemented pebble-bed containing well-rounded quartzite clasts, phosphatic nodules and fragments of derived Upper Jurassic debris such as Portland Sandstone, silicified wood and reworked pavloviid ammonites. Amongst this material were some iron oxide nodules of around 5 cm diameter, crowded with Shelly debris. The shells included bivalves, brachiopods, and three immature specimens of *Parahoplites spp.* Although the fauna is intact within the nodules, and is obviously of Aptian age, the nodules themselves are abraded and may have been reworked from a previously underlying unit to the pebble-bed, as distinct from the associated Upper Jurassic clasts. The existence of the red nodules with *Parahoplites* explains Arkell's (1947) record of this ammonite from the Punfield section, although Arkell thought the specimens were from the Punfield Marine Band itself (four ammonite zones older than the pebble-bed).

Exposed intermittently for 15 m above the pebble-bed (still part of Exposure 5: Figure 2), dark bioturbated silts coarsen-up into white 'Sandrock'-type sands. Above these beds pebbly silts beneath a second Sandrock unit in the cliff, correspond to the locality and description of beds noted by Strahan (1898), which he considered to be a correlative of Fitton's (1847) Group XV, described from Blackgang Chine (Isle of Wight).

The basal pebble bed of the Atherfield Clay Formation at Swanage (Strahan's Bed 1; 1898), was not observed during this work. This bed was correlated with the Perna Bed on the Isle of Wight by Arkell (1947). The Punfield Marine Band (Strahan's Bed 8; 1898) has been correlated with the Crackers Member of the Isle of Wight (Casey, 1961; Simpson, 1985) by virtue of similarities in faunal content. However, the ammonites are not absolutely diagnostic, the *callidiscus* subzone encompassing both the Crackers and Upper Lobster Beds Members of Simpson (1985). On the Isle of Wight, the Crackers comprise cemented nodules within a 3 to 6 m thick coarsening-up sand body, the topmost surface of which may record the same shallow-water phase recorded in the *Filosina* bed above the Punfield Marine Band in this study. Strahan (1898) recorded sands above the Punfield Marine Band; these may be the cemented white sands with oysters observed during this work. The preservation of *bowerbanki* and *nutfieldiensis* zone ammonites in the marginal Lower Greensand at Swanage may indicate that during these periods marine conditions encroached upon the Purbeck estuary (Arkell, 1947; Casey, 1961). Transgressive deposits of *bowerbanki* and *nutfieldiensis* zone age are known from many locations around the Weald and Channel basins (Ruffell and Wach, 1991). Similarly, the dark, silty clays of Strahan's (1898) Bed 14 are in a similar stratigraphic position to transgressive sediments of the *Jacobi* zone found throughout southern England and Germany (Casey, 1961).

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