# SHILLINGSTONE QUARRY

*OS Grid Reference: ST824098*

## Introduction

Shillingstone is a working quarry on the north-west face of the Chalk escarpment overlooking the Stour River valley to the north (Figure 3.34). Bromley, in unpublished notes (1977), recorded the great scar in the landscape that the former Shillingstone Quarry presented. As currently worked, the exposed faces are scattered and difficult to piece together to make a coherent stratigraphy. Sections measured when more complete faces were available (Mortimore, 1976, in manuscript; Figure 3.35) show the Plenus Marls Member, the Holywell Nodular Chalk and New Pit Chalk formations, and parts of the Lewes Nodular Chalk Formation, in a series of badly faulted benches. The basal Lewes Nodular Chalk Formation includes the Chalk Rock with the Spurious Chalk Rock at its base. This is an expanded section compared with areas to the north, around Warminster (Cley Hill and Beggars Knoll), and Mere (see GCR site report for Charnage Down Chalk Pit, this volume). Despite many attempts to measure and collect the sections, there is still great uncertainty about parts of the stratigraphy.

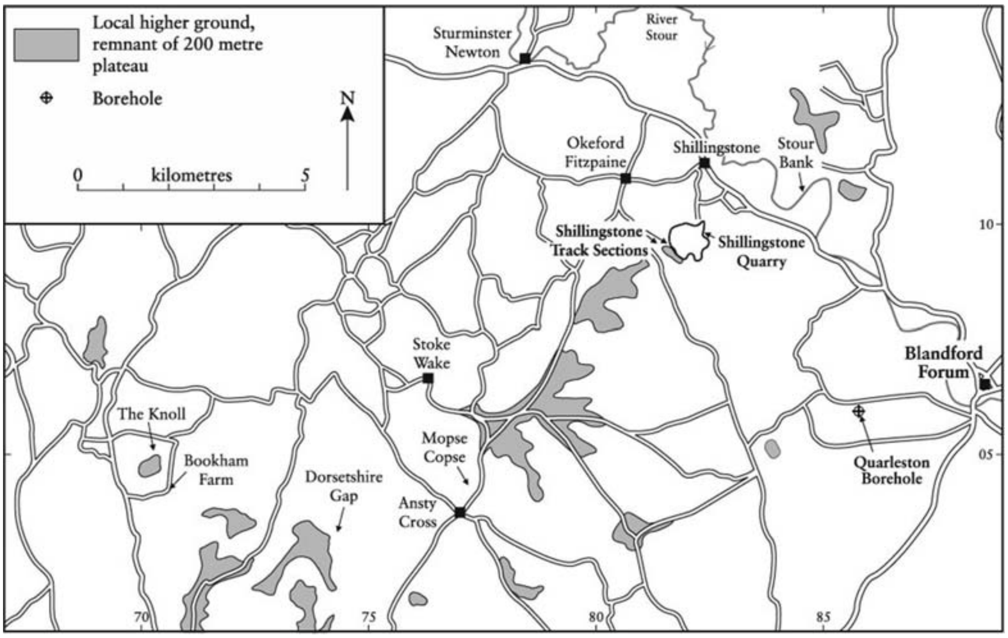


*Figure 3.34: Location of Shillingstone Quarry and Track Sections, other sites mentioned in the text in the Blandford Forum area, Dorset.*

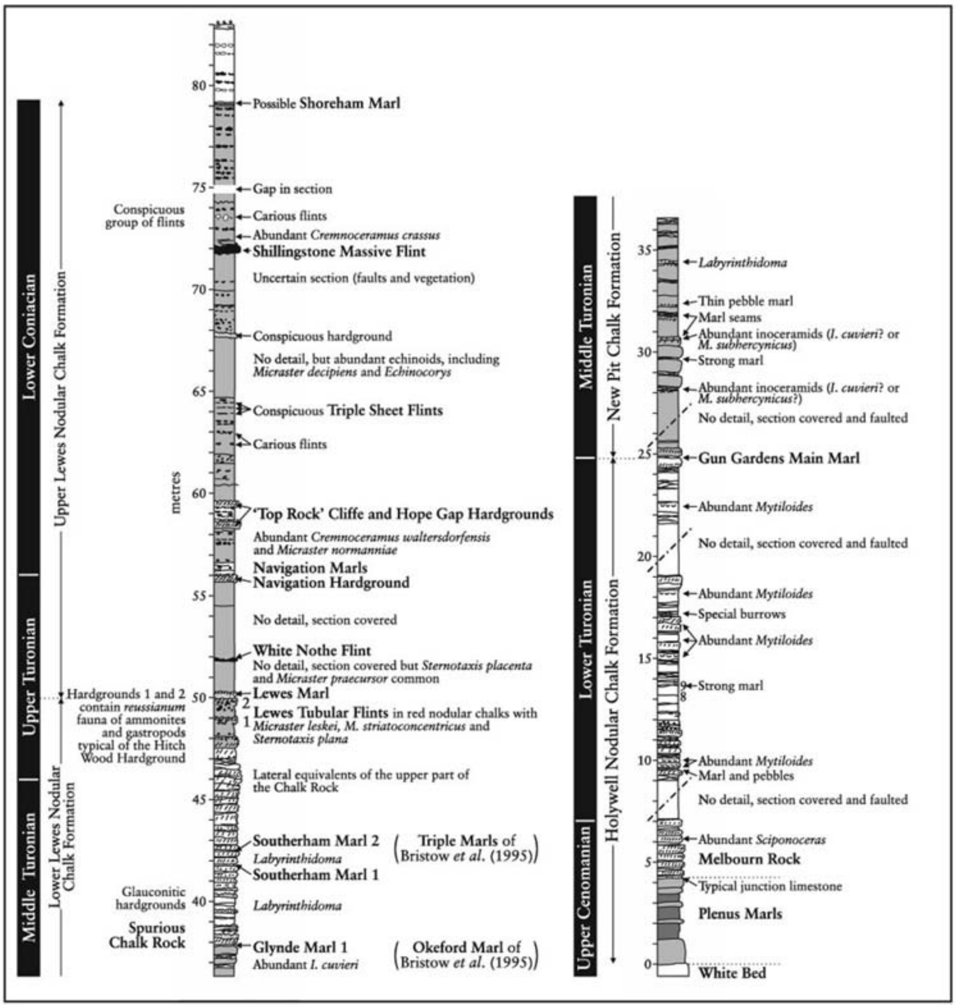


*Figure 3.35: The succession of Upper Cretaceous Chalk at Shillingstone Quarry, Dorset. (After Mortimore and Pomerol, 1987; and Bristow et al., 1995.)*

## Description

Shillingstone is first mentioned by White (1923), and Drummond (1967) visited the quarry during the course of his research (1950s) on the Albian–Cenomanian successions. Carter and Hart (1977a) sampled Shillingstone and published a simplified Cenomanian section for micropalaeontological studies. Mortimore and Pomerol (1987) and the British Geological Survey (Bristow *et al*., 1995) published graphic logs of the Turonian–Coniacian section. One kilometre to the west, on the far side of a possibly structurally controlled valley (Figure 3.34), there are important correlative exposures beside the so-called 'Shillingstone track sections' (ST 815 095) in the woodland.

It was not until the 1970s that systematic work was undertaken on the whole of the exposure (Mortimore, 1976, 1979, 1983, in manuscript; Mortimore and Pomerol, 1987). Bromley and Gale (1982) recorded the Chalk Rock sections as part of their study of the Chalk Rock through the region. Latterly, the British Geological Survey revisited the section and systematically collected the fossils (Bristow *et al*., 1995). On each occasion, a different section had been seen, leading to differences in interpretation. Several controversies remain, including:

(i) the age of the beds underneath the Spurious Chalk Rock;

(ii) correlation of the marls within the Chalk Rock with those of the main basin;

(iii) thicknesses of sediment above the Chalk Rock to the other marker beds in the upper Lewes Nodular Chalk.

### *Lithostratigraphy*

The currently exposed composite 80 m succession (Figure 3.35) extends from the Plenus Marls Member at the base of the Holywell Nodular Chalk Formation to the inferred basal beds of the Seaford Chalk Formation.

Drummond (1967, 1970) suggested a thickness of 140 ft (*c*. 45 m) for the Lower Chalk at Shillingstone, comprising some 60 ft (18 m) of Chalk Marl (West Melbury Marly Chalk Formation) with perhaps 10–20 ft (3–6 m) of Lower Cenomanian deposits (Figure 3.36). Currently, the Grey Chalk Subgroup is only very scrappily exposed along track sections 1 km west of the the quarry. There are no detailed logs and no prospect of obtaining any at the present time. However, the British Geological Survey Quarleston Borehole, to the east (Figure 3.34), provides a geophysical log showing the thickness of the Grey Chalk as 63 m (Bristow *et al*., 1995, fig. 49). The borehole gamma-log illustrates a marly lower part and a more calcareous upper part with a well-defined Plenus Marls Member. A conspicuous spike on the borehole log marks the Tenuis Limestone at the boundary between the West Melbury Marly Chalk Formation below and the Zig Zag Chalk Formation above. The stratigraphy and thicknesses compare closely with the sparse records from Shillingstone Quarry.

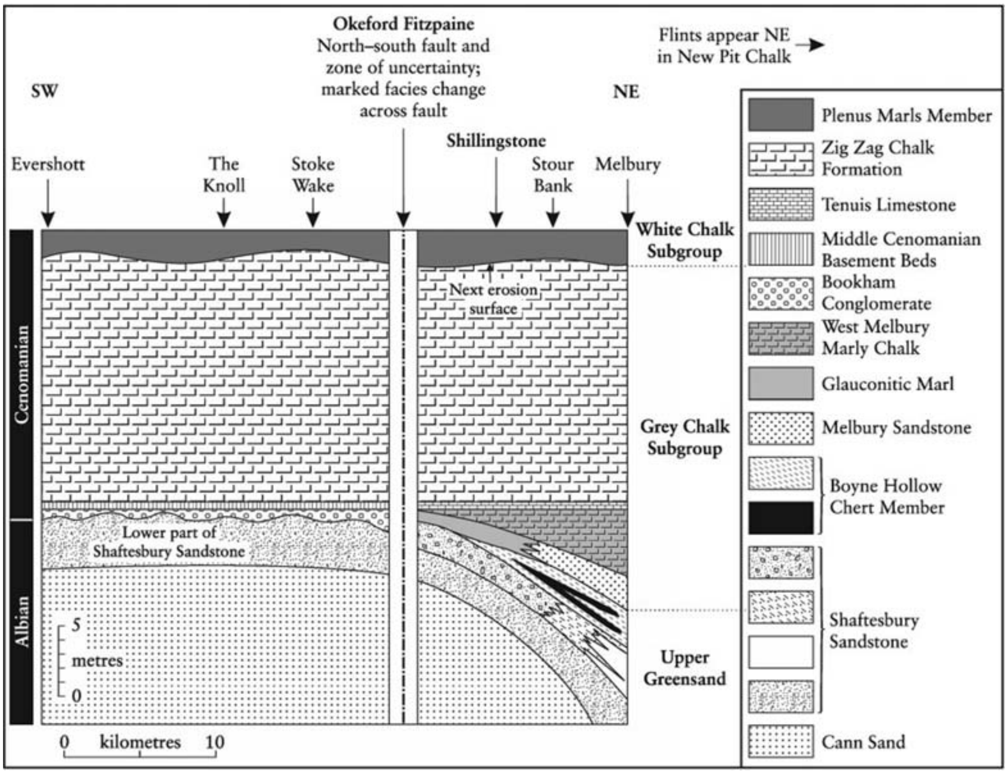


*Figure 3.36: Schematic section showing the position of Shillingstone close to the sedimentary hinge line where facies and thickness changes occur in the Albian–Cenomanian interval across the Mid-Dorset Swell. The effects of this hinge line continue into Late Cenomanian and Turonian times. (After Drummond, 1967, 1970; and Bristow et al., 1995.)*

During the 1970s the lowest exposures included the White Bed at the top of the Grey Chalk Subgroup and the overlying Plenus Marls Member. The Plenus Marls are about 4 m thick (compared with 5 m in the Quarleston Borehole), comprising three prominent marly units separating paler limestones. As is typical, the uppermost beds of the Plenus Marls form a complex of very thin marls and limestones. Jefferies' (1962, 1963) bed numbers for the standard Plenus Marls succession can be applied. The overlying Melbourn Rock begins with a hard, relatively smooth, limestone (Junction Limestone, Mortimore, 1986a), succeeded by much more nodular hard limestones with interbedded marl seams. These marl seams and intervening nodular chalks in the Melbourn Rock can be correlated with the standard stratigraphy at Beachy Head, Sussex (Mortimore, 1986a; Mortimore and Pomerol, 1987, 1996).

Typical gritty, shell-detrital, nodular chalks enter about 5 m above the top of the Plenus Marls in a faulted section. There are about 10–12 m of shell-detrital chalks (section measured across several faults) followed by about 6 m of beds with few shells of *Mytiloides*, ending in a strong marl seam between two nodular chalk beds. On present evidence, this marl seam is correlated with the Gun Gardens Main Marl of the standard succession at Beachy Head, Sussex. If this correlation is correct, the boundary between the Holywell Nodular Chalk and New Pit Chalk formations is present (but see information about track sections below).

Faulting between benches in the quarry makes detailed and accurate logging of sections in the New Pit Chalk and the overlying Chalk Rock exceedingly difficult. Bromley and Gale (1982) provide a detailed section of the Chalk Rock interval at the base of the Lewes Nodular Chalk. Particularly useful lithological markers include the Southerham Marls (named the 'Triple Marls' by the British Geological Survey (Bristow *et al.*, 1995), but see Mortimore and Pomerol, 1987) and the Lewes Tubular Flints.

A conspicuous tabular flint is present in beds between the Lewes and Navigation marl seams (Figure 3.35). The British Geological Survey (Bristow *et al.*, 1995) named this the 'Shillingstone Tabular Flint', but it clearly correlates with the White Nothe Flint (Mortimore and Pomerol, 1987) of the **White Nothe** GCR site. The beds comprising the Navigation Marls and the remaining upper Lewes Nodular Chalk Formation are exposed in a series of discontinuous sections behind the main quarry, and thicknesses are uncertain. A marl seam resting on a poorly developed hardground near the base of the highest section may correlate with one of the Shoreham Marls, in which case the highest beds would fall within the Seaford Chalk Formation.

### *Cenomanian Stage*

Little information is available on the Cenomanian faunas. The belemnite *Praeactinocamax plenus* (Blainville) occurs in Jefferies' Bed 4 of the Plenus Marls Member in the Shillingstone track section, and some of the other beds of this unit contain the inoceramid bivalve *Inoceramus pictus* J. de C. Sowerby. The basal beds of the overlying Melbourn Rock, in both the quarry and track section contain abundant specimens of the heteromorph ammonite *Sciponoceras bohemicum anterius* Wright and Kennedy, and *Euomphaloceras septemseriatum* (Cragin) was collected from the track. These ammonites are indicative of the terminal Cenomanian *Neocardioceras juddii* Zone (Figure 2.8, Chapter 2).

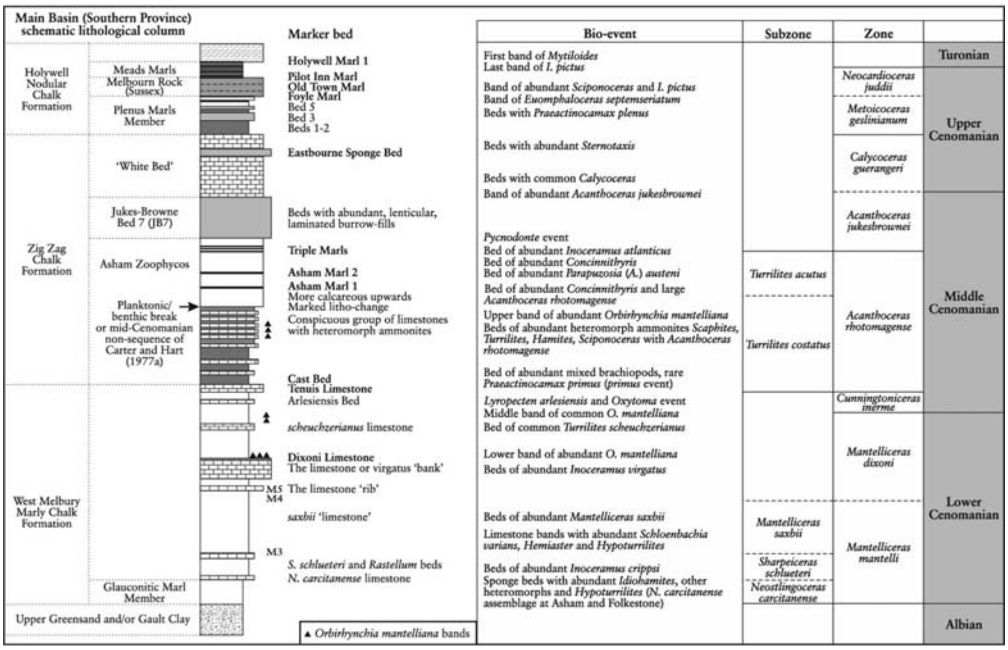


*Figure 2.8: Cenomanian stratigraphy for the onshore UK based on Southerham, Asham, Beachy Head and Folkestone. M2, M4 and M5 are Marker Beds of Gale (1995).*

### *Turonian Stage*

A typically abundant, relatively low-diversity Lower Turonian fauna, dominated by shells of the inoceramid bivalve *Mytiloides* (*M. labiatus* (Schlotheim) and *M. mytiloides* (Mantell)) is found here in the Holywell Nodular Chalk Formation (Figure 3.35), associated with bands of the rhynchonellid brachiopod *Orbirhynchia cuvieri* (d'Orbigny). The special forms of trace fossil common in this interval, and identified at Glyndebourne Pit, Sussex (Mortimore and Pomerol, 1991b) are also common. The change from these *Mytiloides*-rich shell beds to the Middle Turonian New Pit Chalk Formation, with sparse, relatively poorly preserved *Mytiloides,* including *M. subhercynicus* (Seitz), and beds with greater numbers of brachiopods and *Conulus subrotundus* Mantell*,* is conspicuous in this section. The highest beds of the New Pit Chalk Formation also contain abundant *Inoceramus cuvieri* J. Sowerby. The British Geological Survey recorded the Middle Turonian zonal index ammonite *Collignoniceras woollgari* (Mantell) 1 m beneath the Spurious Chalk Rock from the Shillingstone track section to the west of the quarry (Bristow *et al*., 1995).

A feature of the higher beds of the Middle Turonian Substage is the presence of the giant deep-water foraminifer *Labyrinthidoma southerhamensis* Hart (*Coskinophragma* in the earlier literature – see Hart, 1993) (Figure 3.35), which provides a guide to the Glynde and Southerham marls across the Southern Province (Mortimore, 1986a; Mortimore and Pomerol, 1987).

Bromley and Gale (1982) recognized a different fauna in each of the hardgrounds forming the Chalk Rock complex. The lowest hardground (Spurious Chalk Rock = Ogbourne Hardground; see **Charnage Down Chalk Pit** GCR site report, this volume) is, as usual, particularly barren of diagnostic fossils, but it is underlain by inoceramid shell-rich beds (Figure 3.35). Towards the upper part of the Chalk Rock, typical *Micraster leskei* Desmoulins are associated with the Lewes Tubular Flints. *Micraster* sp., *Echinocorys* sp. and *Sternotaxis placenta* (Agassiz) occur in beds between the Lewes Marl and Navigation Hardgrounds, confirming the stratigraphical position of the highest Turonian beds and their correlation with the standard stratigraphy at **Southerham Pit**, Lewes, Sussex (see GCR site report, this volume).

### *Coniacian Stage*

The occurrence of common, well-preserved specimens of inoceramid bivalves belonging to the *Cremnoceramus waltersdorfensis* (Andert) group in a bed just above the Navigation Marls marks the base of the Lower Coniacian strata. Higher, in disconnected sections, beds with abundant *Cremnoceramus crassus (*Petrascheck) (formerly *C. schloenbachi* (Böhm)) indicate the upper Lower Coniacian *C. crassus–deformis* inoceramid Zone (Walaszczyk and Wood, 1999b) and enable correlation with the higher part of the conventional *Micraster cortestudinarium* Zone. There is no faunal evidence for Middle Coniacian (i.e. basal *Micraster coranguinum* Zone) faunas, in the highest, poorly exposed sections, even though the existence of basal Seaford Chalk is inferred from other evidence.

## Interpretation

Drummond (1967, 1970) illustrated the critical position of Shillingstone, in that it provides evidence for thickening and thinning of Albian–Cenomanian sediments in Wessex as a result of structural control related to a Mid-Dorset swell (Figure 3.36). North from Shillingstone towards Melbury, the Grey Chalk Subgroup thickens into a Wessex Trough; to the south and west thinning occurs towards Okeford Fitzpaine and Stoke Wake. Today no useful exposures exist of this part of the succession.

Shillingstone Quarry is, however, one of the few exposures of the lower part of the White Chalk Subgroup on the western margin of the Chalk outcrop, and provides a vital link between the major south coast sections and sections in the Transitional Province. It is critical to an understanding of condensation in the Turonian Stage, notably the development of the ‘Spurious Chalk Rock' and Chalk Rock, and the interpretation of the Turonian marl seam correlation framework. There is uncertainty regarding the total thicknesses of units, and recent work by the British Geological Survey (Bristow *et al*., 1995) has cast doubt on the ‘Middle Chalk' section of Mortimore and Pomerol (1987). This is because of the record of *Mytiloides subhercynicus* not far below the base of the Spurious Chalk Rock in the Shillingstone track section. This section is one kilometre to the west (Figure 3.34), across a valley which may be structurally controlled. In the same direction at Okeford Fitzpaine, Drummond (1967, 1970) recorded thinning of the Albian and Cenomanian deposits compared with Shillingstone. In contrast to the track section, the record of *Inoceramus cuvieri* and the giant foraminifer *Labyrinthidoma southerhamensis* below the Spurious Chalk Rock at Shillingstone Quarry (Mortimore and Pomerol, 1987), places the basal contact of the Spurious Chalk Rock higher in the Turonian succession there than in the track section. These apparent differences between the two localities may result from the exceptionally common faulting in the quarry, or there may be a genuine lateral change in the erosion base below the Spurious Chalk Rock.

Shillingstone is located close to a sedimentary hinge line, with sediments thickening north-eastwards and thinning dramatically south-westwards. To account for the thinning, Drummond (1967, 1970) introduced a structural element termed the Mid-Dorset Swell, this interpretation and terminology being later adopted by Kennedy (1970) and the British Geological Survey (Bristow *et al*., 1995). For the Albian–Cenomanian strata, Drummond (1967, 1970), Kennedy (1970) and the British Geological Survey (Bristow *et al*., 1995) have all produced schematic diagrams to illustrate the changes in sediments, linked to correlative sections nearby. Each differs in detail, particularly in the interpretation of erosion surfaces, which has a great bearing on correlation into more basinal sections and the recognition of sequence boundaries. An attempt to summarize the geology in the Albian–Cenomanian succession (Figure 3.36) shows the importance of sections related to Shillingstone at Melbury, Stour Bank, Okeford Fitzpaine, Bookham Farm and Evershott. The GCR sites at **Dead Maid Quarry** (Mere), and **White Nothe** (Dorset coast) are also critical to the interpretation. Although the locus of thinning has been identified as the Mid-Dorset Swell, recent seismic evidence has identified a Cranbourne–Fordingbridge High (e.g. Bristow *et al*., 1995) and it is across the northern flank of this structure that Shillingstone is located.

Immediately west of Shillingstone, at Okeford Fitzpaine, the West Melbury Marly Chalk Formation thins to virtually nothing, in contrast to some 20 m of silty marly poorly differentiated chalk at Shillingstone and, to the south-east, in the Quarleston Borehole (Figure 3.34). Locally, thin patches of this unit are present at Mopse Copse. Okeford Fitzpaine is a key locality where all lithologies thin and change westwards and south-westwards. It is not clear how each of the units correlate in detail from north-east to south-west, the change taking place either side of a north–south fault that may have been active during sedimentation of Late Cretaceous deposits.

Localities around Shillingstone (Figure 3.34) such as Stour Bank, Dorsetshire Gap, Bookham Farm, the Knoll and Evershott have provided a diverse range of well-preserved ammonite and inoceramid bivalve faunas, which were described by Kennedy (1970), Wright and Kennedy (1984) and Bristow *et al*. (1995). Because of the complex nature of the condensed sections at, for example Bookham Farm, the stratigraphy has been evaluated in centimetres with some boulders in the conglomerates containing fossils not present in the enclosing sediment.

In the Turonian Stage, Shillingstone provides a contrasting section with Beggars Knoll, Wiltshire (Figure 3.37), illustrating lateral variation, particularly in the Chalk Rock.

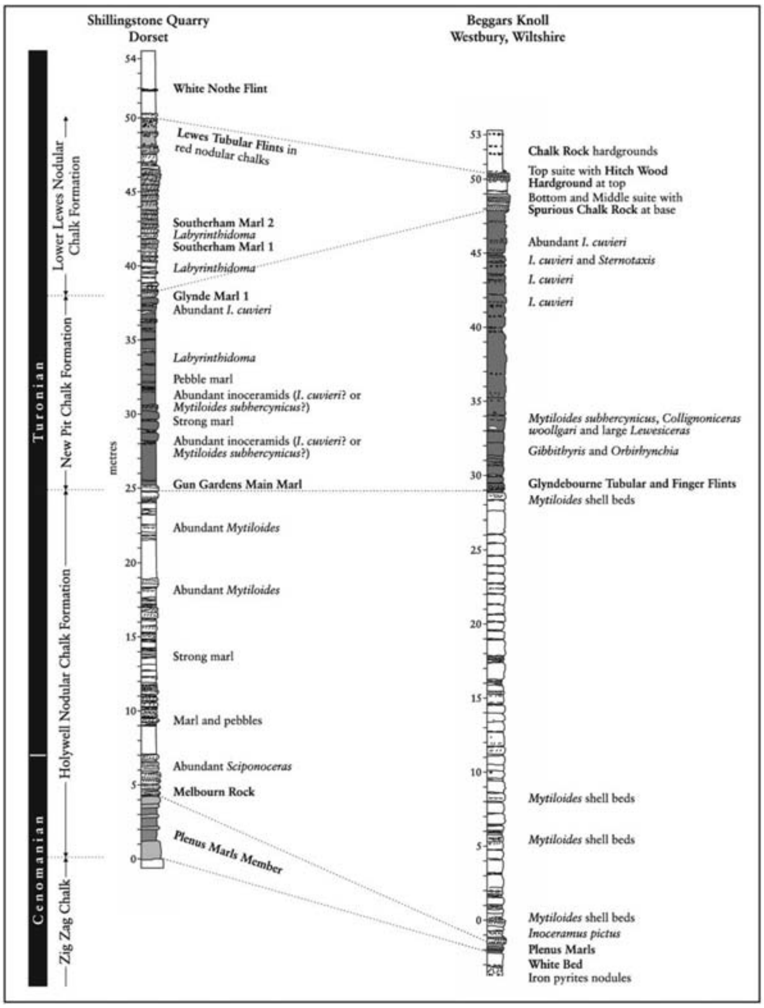


*Figure 3.37: Highest Cenomanian and Turonian successions at Shillingstone Quarry (Dorset) compared with Beggars Knoll (Westbury, Wilts), 40 km to the north.*

## Conclusions

Despite the uncertainties in the stratigraphy, Shillingstone Quarry and the surrounding track exposures provide rare and invaluable Albian–Cenomanian to Coniacian records. These records confirm the presence of regional marker beds in the Plenus Marls Member, the Holywell Nodular Chalk, the New Pit Chalk and the Lewes Nodular Chalk formations. The age of the Spurious Chalk Rock remains controversial, but the presence of*Labyrinthidoma* below it suggests that the Glynde and Southerham marls are present below and above the Spurious Chalk Rock respectively. The continuity of the Lewes Tubular Flints and the Navigation Marls is confirmed, while two conspicuous flint bands take their name from this locality.

Shillingstone Quarry is a vital link between basinal sections to the north and east and the condensed sections of Mid-Dorset and south-east Devon in the Albian, Cenomanian and Turonian stages. Shillingstone is one of only two complete Turonian sections in the western outcrop of the Southern Province (the other being Beggars Knoll, Wiltshire).

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