

COMPTON BAY

OS Grid Reference: SZ350855

Introduction

Compton Bay has formed by the erosion of Cretaceous strata over the Brixton Anticline (pericline) (Figure 3.57) leaving the Late Cretaceous chalks exposed on its northern flanks, dipping steeply northwards. In the core of the exposure is Freshwater Bay, the truncated and drowned headwaters of the River Western Yar, whose tributary streams must have drained the region to the south now occupied by Compton Bay. There are three parts to this site. The first, at beach level, approached via Compton Chine, exposes the Cenomanian Grey Chalk Subgroup, including the Glauconitic Marl, West Melbury Marly Chalk and Zig Zag Chalk formations, overlain by the Plenus Marls Member at the base of the White Chalk Subgroup. The second is a cliff section in Turonian Chalk that ends towards the top of the New Pit Chalk Formation. The third part comprises the Military Road section on Compton Down (Afton Down, Figure 3.58), which expose the Spurious Chalk Rock, the entire Lewes Nodular Chalk Formation and the basal part of the Seaford Chalk Formation. A supplementary fourth section is Freshwater Bay, which has excellent exposures of the lower Lewes Nodular Chalk on the sea stacks on the south-east side of the bay, and Seaford Chalk in the cliffs of the inner bay. There is a sharp angular discordance here between near-vertical Cretaceous strata and near-horizontal Quaternary sediments (cf. Figure 3.62, p. 181).

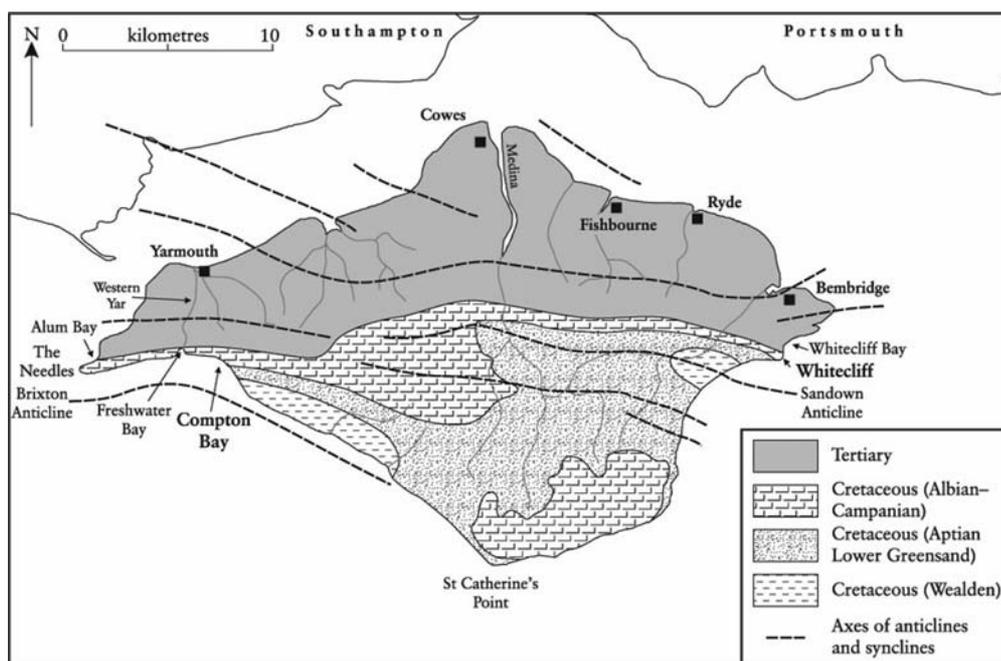


Figure 3.57: Simplified geology of the Isle of Wight, showing the position of the two GCR sites, at Compton Bay and Whitecliff and related sections.

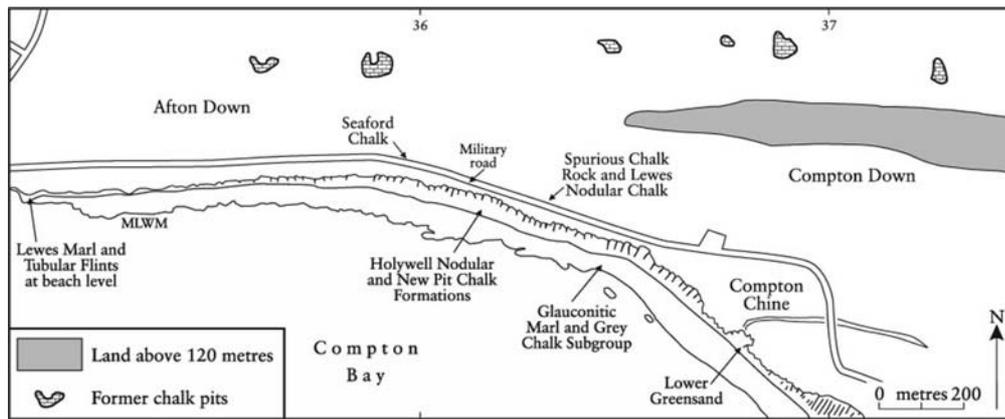


Figure 3.58: Map showing the details of the Compton Bay site. (MLWM = mean low water mark.)



Figure 3.62: (a) Turonian–Coniacian Lewes Nodular Chalk Formation at the western end of the Compton Bay GCR site, adjacent to Freshwater Bay, Isle of Wight. (b) Base of the Lewes Nodular Chalk Formation in the Compton Down Military Road section in the Compton Bay GCR site, Isle of Wight. (Photos: R.N. Mortimore.)

Description

The first systematic account of the Upper Cretaceous Chalk of the Isle of Wight was given by Barrois (1875). He identified a lower unit comprising Chalk Marl and Grey Chalk with Glauconitic Marl at the base and Plenus Marls at the top. His 'Craie Marneuse' (including the zones of *Inoceramus* (i.e. *Mytiloides*) *labiatus* and *Terebratulina gracilis* (i.e. *lata*) corresponds to the Holywell Nodular Chalk and New Pit Chalk formations. Barrois (1875) recognized the very hard yellowish nodules embedded in a greenish-grey marl at the base of his *I. labiatus* Zone and he later (1876) correlated this level with the Melbourn Rock. Barrois also recognized

the green-coated nodules forming Whitaker's (1865c) Chalk Rock (the Spurious Chalk Rock of Rowe (1908)), towards the top of his *T. gracillis* Zone. These nodules were later taken by the [British] Geological Survey (Reid and Strahan, 1889) as the base of the Upper Chalk. Barrois placed all of the Chalk above the *T. lata* Zone in his 'Craie Blanche' (White Chalk). Barrois (1876) made several corrections to his zonal account of the Chalk of the Isle of Wight, including a revision of the boundary between the *M. cortestudinarium* and *M. coranguinum* zones, and the identification of the *Marsupites* Zone.

The [British] Geological Survey later (Jukes-Browne and Hill, 1904, p. 88, p. 90; White, 1921, pp. 62–63) took the base of the Upper Chalk in the Compton Down Military Road section (Afton Down), on palaeontological evidence (i.e. at the boundary between the *T. lata* and *S. plana* zones). This boundary coincided with a grey marl interpreted to be the Caburn Marl (Figure 3.63, p. 183), found at a level considerably higher than the level of the Spurious Chalk Rock used by Reid and Strahan (1889). Rowe (1908, p. 220) took his boundary at the the second 'grey marl' above the Spurious Chalk Rock (i.e. the presumed Caburn Marl). White (1921) noted, but dismissed, Brydone's (1917) suggestion that the Chalk Rock should be included as the basal beds of the Upper Chalk.

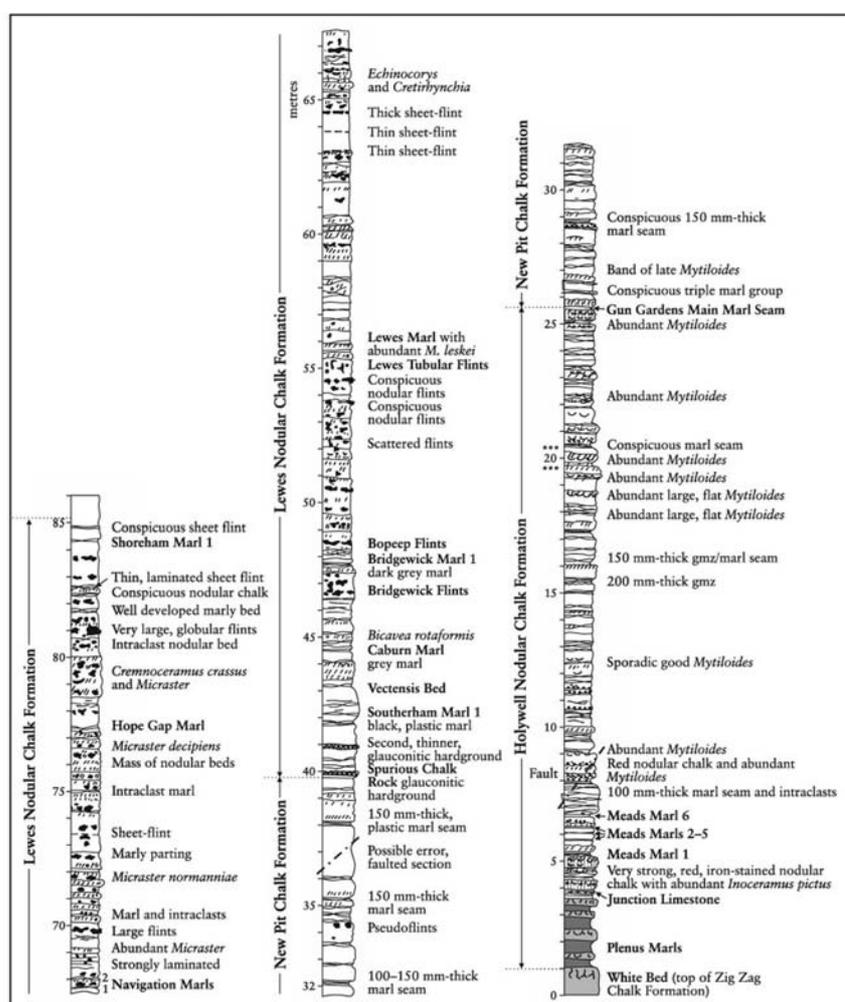


Figure 3.63: The lower part of the White Chalk Subgroup, exposed in Compton Bay and on the north side of Compton Down Military Road section, Isle of Wight. (gmz = griotte (or flaser) marl zone.)

A particular point emphasized by White (1921, p. 61) is the thinning of the Lower Chalk (Glaucconitic Marl and West Melbury Marly Chalk) and 'Middle Chalk' westwards across the island to Compton Bay.

By far the most comprehensive account of the Chalk of the Isle of Wight, including the present site, was given by Rowe (1908). This includes section measurements, descriptions of

lithologies, superb annotated photographic plates and comprehensive lists of fossils. Early researchers (e.g. Reid and Strahan, 1889, p. 77) had noted strange bands of siliceous nodules in marl seams in the *T. lata* Zone (New Pit Chalk). Rowe (1908, p. 218) describes these as '... grey or fawn coloured on the surface, and very white inside, contrasting strongly when broken with the greyer tint of the surrounding matrix'. Rowe traced these nodules, which he regarded as unique, through the Compton Bay cliff section and the Military Road section as well as in several inland pits. The nodules were shown by Gale (1996, fig. 5) as flints c. 1 m below the Round Down Marl.

Later work concentrated on particular aspects of the Chalk of Compton Bay. Drummond (1967, 1970) investigated the Albian–Cenomanian section. Kennedy (1969) published a detailed log of the Lower Chalk, correlating his marker bands initially recognized in the Folkestone section (see Folkestone to Kingsdown GCR site report, this volume), through Sussex (**Southerham Grey Pit**; see GCR site report, this volume), to the Isle of Wight. Gale (1995, figs 8, 11, 12) illustrated the marl–chalk couplet cyclostratigraphy of parts of the Cenomanian succession and (1996, figs 3, 5) published sections for the Holywell Nodular Chalk and New Pit Chalk formations. The Plenus Marls were investigated by Jefferies (1962, 1963), who allocated his bed numbers to the succession. Graphic logs of parts of the White Chalk Subgroup sections were published by Mortimore (1986b, fig. 3.6), Mortimore and Wood (1986, figs 2.3, 2.4) and Mortimore and Pomerol (1987, figs 8, 9). All of these studies have added increasing precision to correlations and to understanding the lateral variations in the Chalk and their causes.

A steep northerly dip results in an excellent Chalk reference section at Compton Bay, especially in the Cenomanian and Turonian successions. The section forms part of a key network of sections used to establish a cyclostratigraphy and timescale for the Middle Cenomanian strata by Gale (1989, 1990a, 1995). It was at Compton Bay that Rowe (1908) coined the phrase 'Spurious Chalk Rock' for the green-coated nodular chalk surfaces in the Turonian *Terebratulina gracilis* (i.e. *lata*) Zone that had been considered by earlier workers to represent the true Chalk Rock. Rowe also identified the marker bed with the bryozoan *Bicavea rotaformis* Gregory here, which he had previously (Rowe, 1901) found on the Dorset coast.

Grey Chalk Subgroup

The first part of the reference section at Compton Bay, on the beach and in the cliff about 600 m west of Compton Chine, provides an excellent exposure in the Grey Chalk Subgroup (Figures 3.59–3.62), which here is about 47 m thick (Kennedy, 1969). Kennedy (1969) took the base of the Glauconitic Marl and hence the base of the Chalk at the change from fine buff sand at the top of the Upper Greensand to dark, coarse highly glauconitic sand with a thin basal conglomerate of limestone clasts. Both Drummond (1967, pp. 30–31) and Kennedy (1969, p. 518) recognized five bed subdivisions of the Glauconitic Marl and the presence of both phosphatized (*remanié*) and unphosphatized fossils.



Figure 3.59: Marker beds in the Cenomanian Grey Chalk Subgroup at Compton Bay, Isle of Wight. Note the conspicuous cyclostratigraphy picked out by marl–limestone couplets. (Photo: R.N. Mortimore.)

Kennedy (1969) divided the overlying traditional 'Lower Chalk', up to the Plenus Marls Member, into 14 (local) bands, based on assemblages of fossils as well as lithologies, and linked these to his type section at Folkestone, Kent. Of particular importance to lithological correlation is Band 12 containing lenticular laminated structures (i.e. Jukes-Browne Bed 7; see also **Southerham Grey Pit** GCR site report, this volume). Gale (1995), using a cyclostratigraphy based on (inferred precession-driven) marl–chalk couplets, recognized five groups of couplets lettered A to E in the Cenomanian strata. His A division couplets incorporate the Glauconitic Marl and the condensed Lower Cenomanian succession. Gale (1995, p. 183) suggested that the Glauconitic Marl represented the condensation of the lowest 25–30 couplets of more complete successions seen in south-east France. Only the higher couplets (A31–51) of the A division are represented in England, but even these are difficult to identify in the more condensed sections such as Compton Bay.

A key marker bed in the traditional Chalk Marl is the Cast Bed (Price, 1877), originally recognized at Folkestone, which rests here on a well-developed limestone, the Tenuis Limestone, at the boundary between the West Melbury Marly Chalk and the Zig Zag Chalk formations (Bristow *et al.*, 1997). Gale (1995) took this same boundary as the dividing line between his B and C division couplets, and this can be readily identified at Compton Bay (Gale, 1995, fig. 8). The base of the D division couplets is taken at the base of Jukes-Browne Bed 7. Up to 20 couplets were identified by Gale (1995, fig. 12) before they are lost in the lithologically poorly-differentiated White Bed of Jukes-Browne and Hill (1903).

The base of Gale's (1995) E Division couplets is taken at the sub-Plenus erosion surface of Jefferies (1962, 1963), i.e. at the base of the White Chalk Subgroup; the couplets of division E end in the Lower Turonian strata at the top of the Holywell Nodular Chalk Formation.

Gale's work is admirable in demonstrating the potential time frame for the Cenomanian and illustrating the gaps in successions, such as at Compton Bay. The broader division, however, into the West Melbury Marly Chalk and Zig Zag Chalk formations, divided at the Tenuis Limestone, and their subdivisions into units such as the Glauconitic Marl (Member), Jukes-Browne Bed 7, the White Bed and Plenus Marls (Member), is simpler to apply. The White Bed at Compton Bay contains numerous bands of wispy marls (Kennedy, 1969) and in this respect differs markedly from the correlative interval at Folkestone but is similar to Beachy Head. The lithological log of the Grey Chalk Subgroup (Figure 3.60), is a synthesis of previous

observations, our own measurements and details kindly provided by Professor A.S. Gale.

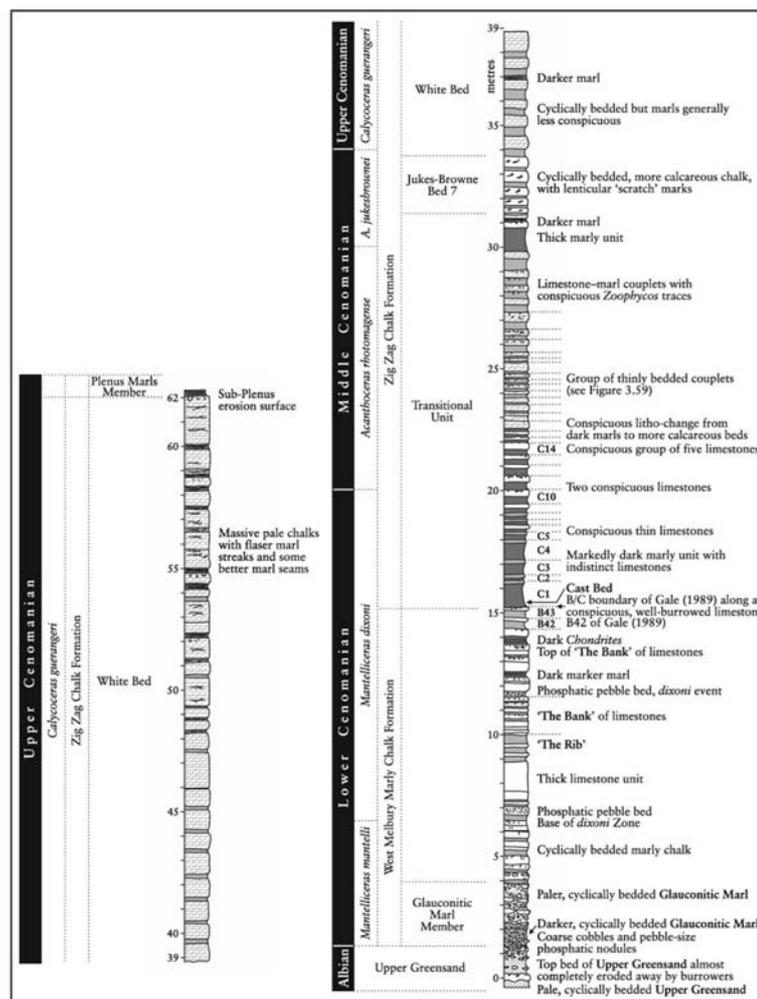


Figure 3.60: The Grey Chalk Subgroup succession, exposed at Compton Bay, Isle of Wight.

White Chalk Subgroup

The basal unit of the White Chalk Subgroup, the Plenus Marls Member, was divided by Jefferies (1963, pp.14–15; and Figure 3.63) into his eight beds at Compton Bay. Above the Plenus Marls it is possible to scramble over most of the Holywell Nodular Chalk and New Pit Chalk formations on the steeply dipping cliff section. The total section is only c. 36–37 m thick, with the greatest loss of section apparently in the New Pit Chalk. Barrois (1875, 1876) recognized the hard, nodular Melbourn Rock lithology at the base of the Middle Chalk and the presence, some distance above, of layers of rich, shell-detrital chalks. This is comparable with the Sussex definition of the Melbourn Rock (Mortimore, 1986a), which was applied to the Compton Bay section (Mortimore and Pomerol, 1987, fig. 8). The Meads Marls are well developed above the Melbourn Rock (Figure 3.63; Mortimore and Pomerol, 1987; Gale, 1996) and the overlying part of the Holywell Nodular Chalk Formation contains many beds of abundant inoceramid bivalves (*Mytiloides*). In contrast, the New Pit Chalk Formation above, about 14 m thick, is more massive and smoother, and contains several conspicuous marl seams weathering out as grooves (Figure 3.63).

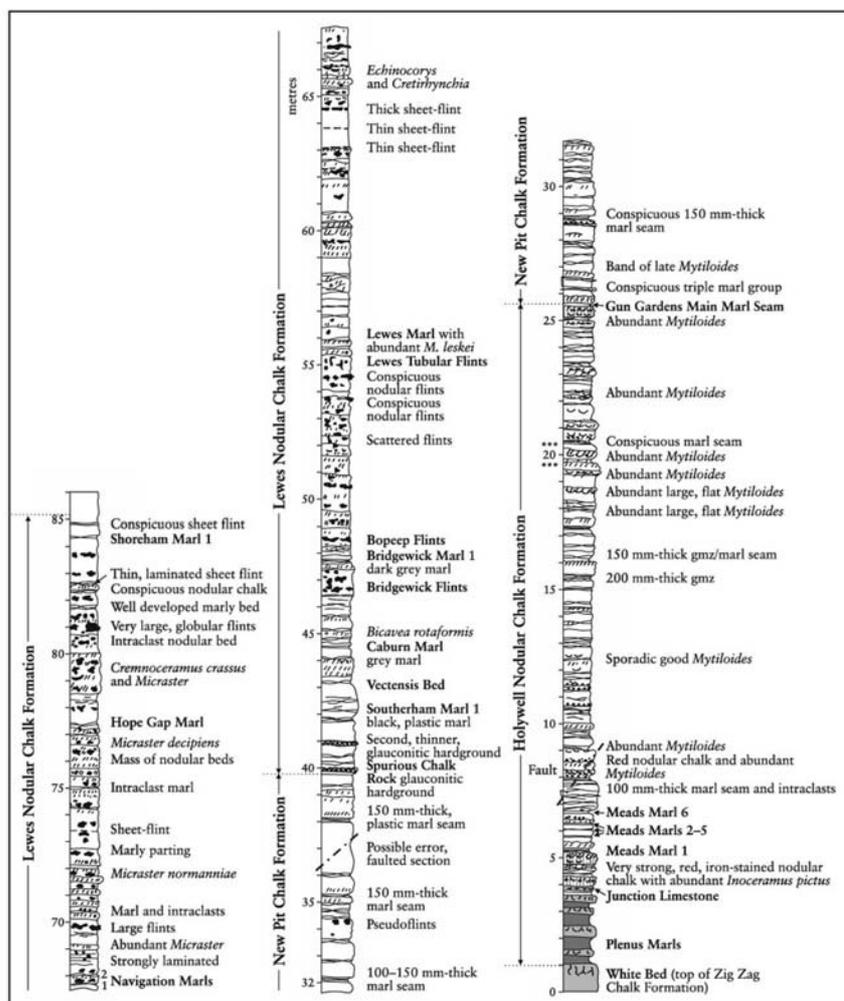


Figure 3.63: The lower part of the White Chalk Subgroup, exposed in Compton Bay and on the north side of Compton Down Military Road section, Isle of Wight. (gmz = griotte (or flaser) marl zone.)

Lewes Nodular Chalk Formation and Seaford Chalk Formation: The Lewes Nodular Chalk is best studied in the Military Road section on Afton Down (Figure 3.58). The base is taken at the base of the Spurious Chalk Rock, the lower of the two green-coated, yellow nodular beds (Figure 3.63) recognized by Whitaker (1865c), Barrois (1875), Rowe (1908) and the [British] Geological Survey (Reid and Strahan, 1889; Jukes-Browne and Hill, 1904; White, 1921). This bed is presumed to correlate with the Ogbourne Hardground (at Ogbourne Maizey, Wiltshire; Bromley and Gale, 1982; Gale, 1996; see **Charnage Down Chalk Pit** GCR site report, and Figure 3.42). It is underlain by beds containing inoceramid bivalves, which are questionably *Inoceramus cuvieri* J. Sowerby, rather than *Mytiloides*. The overlying 'Black Marl' has been correlated with the Southerham Marl 1 (Mortimore, 1986a,b; Mortimore and Wood, 1986). The other key marker marl seams of the Upper Turonian framework (Figure 2.9, Chapter 2) have been identified here, including the Caburn, Bridgewick and Lewes marls (Figure 3.63). Features of the remainder of the Lewes Nodular Chalk include the conspicuous Lewes Tubular Flints and overlying Lewes Marl, which here is packed with crinoid debris (*Isocrinus granulosis* (Valette)), as well as *Micraster leskei* (Desmoulin); and the rough, nodular intraclast beds in the succession above. In the upper Lewes Nodular Chalk (Figure 3.63), the Navigation and Shoreham marls are well developed. Another feature of these beds is the presence of numerous, well-developed sheet-flints closely following the bedding.

repeated on either side of Freshwater Bay, where it is highly disturbed by Quaternary weathering on the margins of the former Western Yar River channel. Beds containing the Belle Tout Marls and the Seven Sisters Flint Band can just be discerned in the now degraded Military Road section. Many conspicuous flint bands are present.

Biostratigraphy

Compton Bay, like the **Handfast Point to Ballard Point** (Punfield Cove) and **White Nothe** sites (see GCR site reports, this volume), provides evidence for east to west condensation of the Lower Cenomanian strata. The basal bed of glauconitic sand in the Glauconitic Marl (Bed 1b of Kennedy, 1969) contains phosphatized *Mariella* and ?*Ostlingoceras*. The derived, phosphatized *remanié* fossils in Kennedy's Bed 1d represent a *Neostlingoceras carcitanense* Subzone ammonite assemblage, including *Mantelliceras cantianum* Spath, *M. aff. mantelli* (J. Sowerby) and heteromorphs. Unphosphatized ammonites of the same species are also present (Kennedy, 1969, p. 520). As Gale (1995), has indicated, there is a large hiatus at the base of the Cenomanian Stage in England, represented by the Glauconitic Marl. Kennedy's Band 4 contains higher Lower Cenomanian *M. saxbii* assemblage ammonites. The Cast Bed, at the base of Gale's C Division couplets, marks the entry of a group of limestones in the Middle Cenomanian *Acanthoceras rhotomagense* Zone containing the uncoiled, straight ammonite *Sciponoceras baculoides* (Mantell) as well as *Scaphites* spp., *Turrilites costatus* Lamarck and *Acanthoceras rhotomagense* (Brongniart). The common occurrence of the rhynchonellid brachiopod *Orbirhynchia mantelliana* (J. de C. Sowerby) in Kennedy's Band 3 is also a good guide to this level.

At the base of Jukes-Browne Bed 7 (Kennedy Band 12) and Gale's D Division couplets there is a band containing large individuals of the zonal index *Acanthoceras jukesbrownei* (Spath). Upper Cenomanian ammonites (*Calycoceras guerangeri* Zone) enter in couplet D14, low in the interval between the top of Jukes-Browne Bed 7 and the Plenus Marls Member.

In the Cenomanian–Turonian boundary transition the change in inoceramid bivalve assemblages from *Inoceramus pictus* J. de C. Sowerby and related forms, below Meads Marl 4, to *Mytiloides* spp. above the same marl, is conspicuous. Above this level, a standard Turonian biostratigraphical succession is present. The Lower Turonian Holywell Nodular Chalk Formation contains abundant *Mytiloides* shell beds with *Orbirhynchia cuvieri* (d'Orbigny). The change to brachiopod-dominated rather than *Mytiloides*-dominated assemblages coincides with the base of the Middle Turonian Substage, just above the Gun Gardens Main Marl, though the index ammonite, *Collignonoceras woollgari* (Mantell), has not been collected here.

There is no clear indication of the base of the Upper Turonian strata in this section, which, by extrapolation from **Fognam Quarry** (see GCR site report, this volume), extrapolates to the Spurious Chalk Rock. In the nodular chalk layers immediately above the Caburn Marl, Rowe (1908, p. 220) identified his marker bed with the bryozoan *Bicavea rotaformis*, which he had previously recognized at Mupe Bay, Dorset (Rowe, 1901). This same marker bed was also located in the Caburn Pit, Lewes, Sussex (Mortimore, 1986a) at the same horizon above the Caburn Marl. The recognition of this bryozoan band in Sussex established the correlation of the Caburn Marl with the second, or 'Grey', marl above the Spurious Chalk Rock in the Isle of Wight (Mortimore and Wood, 1986, fig. 2.3). Higher in the Upper Turonian succession, *Micraster leskei* Desmoulin is abundant in and above the Lewes Marl. *Echinocorys*, *Sternotaxis placenta* (Agassiz), *Micraster praecursor sensu Drummond–normanniae* Bucaille are common, and occur in the same stratigraphical order as in Sussex.

As in Kent and Sussex, the base of the Coniacian Stage in Compton Bay is presumed to be located in or just above the Navigation Marls, but neither of the key index fossils, the inoceramid bivalves *Cremnoceramus deformis erectus* (Meek) or *C. waltersdorfensis* (Andert) has been found. *Micraster* is abundant in the beds above, including *M. normanniae* up to and including the Cliffe Hardground, and there are two bands of extremely abundant *M. decipiens* (Bayle) (Figure 3.63). Large specimens of *Cremnoceramus crassus crassus* (Petrascheck) are common in the higher beds of the Lewes Nodular Chalk Formation (Figure 3.63).

The basal (Belle Tout) beds of the Seaford Chalk Formation (*Micraster coranguinum* Zone), in the highest sections in the Military Road section and in Freshwater Bay, contain abundant

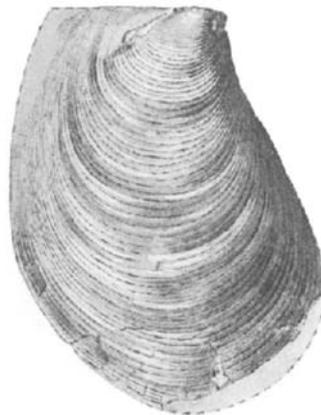
specimens of the inoceramid bivalve genera *Platyceramus* and *Volvicceramus*, indicative of the Middle Coniacian Substage.

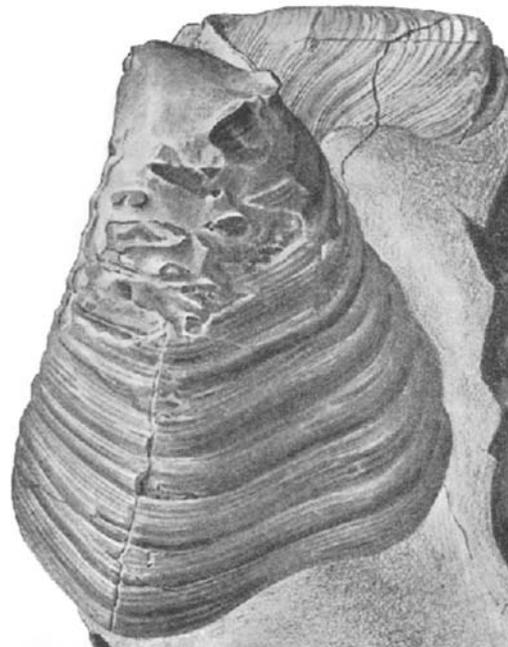
Interpretation

Compton Bay is a pivotal section linking the thicker basinal sections of Sussex and Kent to the marginal sections in Dorset. The Cenomanian succession is totally different from that at Punfield Cove 30 km to the west, adjacent to the **Handfast Point to Ballard Point** GCR site, where the West Melbury Marly Formation is missing and (Middle Cenomanian) Glauconitic Marl, overlain by Zig Zag Chalk Formation, rests non-sequentially on (Upper Albian) Upper Greensand. Drummond (1967, fig. 2-2, p. 32) illustrated the thinning of the Lower Cenomanian marly chalk from Culver Cliff through Rocken End to Compton Bay. Kennedy (1969, fig. 15, p. 524), using more sections around Rocken End and Ventnor, demonstrated the lateral change in a short distance at the base of the Chalk: the basal glauconitic sand bed of the Glauconitic Marl and several rhythms in the Chalk Marl seen at Compton Bay are occluded at Gore Cliff. At the latter locality, the phosphate-rich part of the Glauconitic Marl rests directly on the basal conglomerate and is overlain by the *saxbii* phosphates. Gale (1995), using cyclostratigraphy, has demonstrated that much of the Lower Cenomanian succession, in particular, is probably missing at Compton Bay, compared with more complete sections to the east and in south-east France.

Thinning of the 'Middle Chalk' towards Compton Bay was noted by the [British] Geological Survey (Reid and Strahan, 1889; Jukes-Browne and Hill, 1904) and by Rowe (1908), particularly in the *T. lata* Zone. The *T. lata* Zone broadly corresponds to the New Pit Chalk Formation; this unit progressively thins towards the Isle of Wight from Sussex, and then condenses further in Dorset (see White Nothe GCR site report, this volume). At Compton Bay many of the New Pit marl seams are still present, but these are lost farther west.

A still partly unresolved issue is the identification and correlation of the Middle and Upper Turonian marker marl seams in the New Pit and lower Lewes Nodular Chalk Formations at Compton Bay. This issue is crucial to dating the 'Spurious Chalk Rock' at its type locality, Compton Bay, which Gale (1996) correlated with the Ogbourne Hardground at the base of the Chalk Rock of the Wiltshire–Berkshire Downs (see above). Mortimore (1979, 1983, 1986a; Mortimore and Pomerol, 1987) identified the Southerham Marl (black marl), Caburn Marl (grey marl), Bridgewick Marl (grey marl) and Lewes Marl (grey marl) in the Military Road section on Afton Down overlying the Spurious Chalk Rock and these correlations have been confirmed subsequently. Mortimore and Pomerol (1987, fig. 9) also identified a second 'black' plastic marl beneath the Spurious Chalk Rock, which they correlated with the Glynde Marl 1, a marker in the topmost New Pit Chalk Formation (see description of New Pit in the Southerham Pit GCR site report, this volume). This was because in Sussex, at their type localities in the Glynde, Caburn and Southerham pits, both the Glynde and Southerham marls are black, plastic marls and the Glynde Marls interval is associated with bands of abundant *Inoceramus cuvieri* (Figure 2.16, Chapter 2). They considered the inoceramids beneath the Spurious Chalk Rock to be *I. cuvieri*, and on that basis, the Spurious Chalk Rock to correlate with the basal nodular chalks of the Lewes Nodular Chalk Formation. Gale's (1996) work suggests, on the contrary, that the marl beneath the Spurious Chalk Rock is much lower down in the New Pit Chalk Formation because he identified *Mytiloides subhercynicus* in this interval rather than *I. cuvieri*. Gale argues that the Ogbourne Hardground–Spurious Chalk Rock represents an erosion surface within the New Pit Chalk Formation.





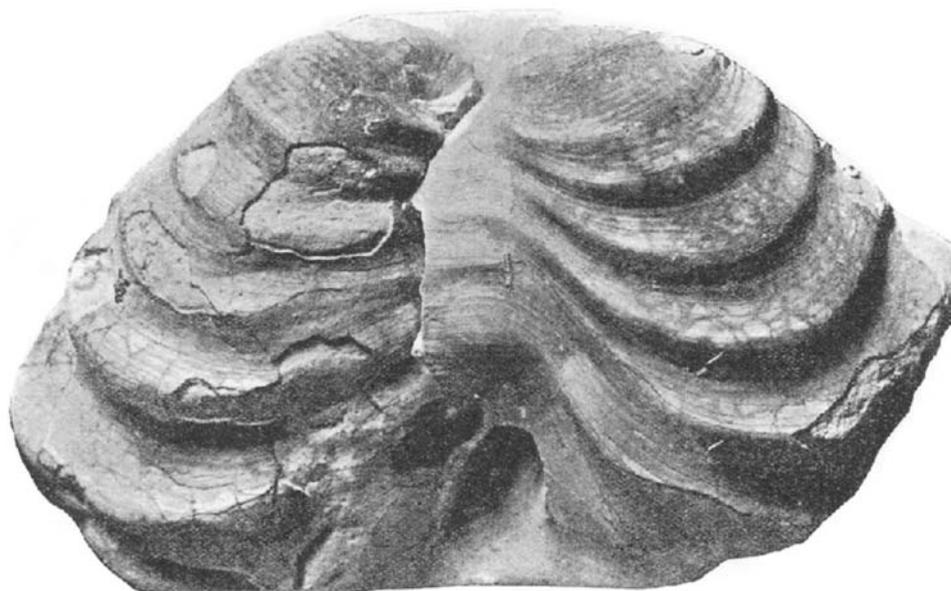


Figure 2.16: Middle Turonian inoceramid bivalves. (A, B) *Mytiloides subhercynicus*, typical of the lowest New Pit Chalk (from Seitz, 1934, pl. 40). (C) *Inoceramus apicalis* (lectotype, from Woods, 1912, pl. 53, fig. 4a), Holywell Nodular Chalk, Hitchin. (D, E) *Inoceramus cuvieri*; (D) typical of *cuvieri* (from Woods, 1912, pl. 53, fig. 7), New Pit Chalk, Royston; (E) the holotype of *cuvieri* (from Woods, 1912, holotype, text-fig. 73), New Pit Chalk, Royston. (F, G) *Inoceramus lamarcki*; (F) the holotype of *lamarcki* from the Glynde Marls–Southerham Marls interval, Dover (Woods, 1912, text-fig. 63); (G) form typical of mid-New Pit Chalk around Lewes (Woods, 1912, text-fig. 69). Scale bar applies to all specimens.

The dating of the interval containing the Spurious Chalk Rock has wide implications for Turonian correlations across the Southern and Transitional Provinces and for the sedimentological models proposed (see also Shillingstone Quarry, Charnage Down Chalk Pit, Fognam Quarry and Kensworth Chalk Pit GCR site reports, this volume). The same marl seams are exposed at other sites on the Isle of Wight, particularly the Carisbrook Castle Quarry (Bristow, 1889, p. 86; White, 1921, p. 64) where the 'black', 'grey' or 'plastic' character of individual marl seams is retained.

Conclusions

Compton Bay provides an excellent section in the Grey Chalk Subgroup and in the lower part of the White Chalk Subgroup at a key point in the palaeogeography of the Chalk sea, between the main basin in Sussex and Kent, and the south-western margin in Dorset and Devon. Most of the major marker beds used in the correlation framework can still be identified here. Compton Bay forms part of a key network of sections used to establish a cyclostratigraphy and timescale for the Middle Cenomanian strata. It is also at Compton Bay where the phrase 'Spurious Chalk Rock' was first used and the Upper Turonian section here is vital for the interpretation of the stratigraphy and for correlating the basal hardgrounds of the Chalk Rock.

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