Enthorpe Railway Cutting, Yorkshire Wolds

[SE 906 456]–[SE 914 459]

Introduction

The Enthorpe Railway Cutting GCR site is an abandoned railway cutting trending ENE–WSW some 0.75 km long, with steep, partly degraded sections, up to 15 m high on both sides (Figure 5.15), (Figure 5.16), (Figure 5.17), (Figure 5.18). The cutting is a key section for understanding the lithostratigraphy and biostratigraphy of the lower part of the Burnham Chalk Formation, providing the stratotype section for the Enthorpe Marls and the Enthorpe Oyster Bed. It is one of the most fossiliferous localities in the Chalk of Yorkshire. The unusually soft chalk here has yielded many well-preserved fossils, notably echinoids and inoceramid bivalves, the latter being of critical importance in long-range correlation to contemporaneous successions in Germany and Poland, and even to North America. The section has yielded an undescribed species of the characteristically boreal echinoid genus *Infulaster.* The excellent exposure of the Kiplingcotes Marls is crucial to the interpretation of the Turonian–Coniacian boundary succession in the Northern Province, and its correlation to successions in the Southern Province.

Description

At the Enthorpe Railway Cutting GCR site the strata dip at a low angle to the east, and are displaced by several small faults. The 'Upper Chalk' stratigraphy was first recorded by Jukes-Browne and Hill (1904), but the site was then apparently ignored for many decades until it was exhaustively investigated by the local amateur geologist, Dr Felix Whitham of Willerby. A skeletal lithological log was provided by Whitham (1991, fig. 8), together with extensive biostratigraphical data based on his own bed-by-bed collecting. Whitham (1994) also gave a brief account and a locality map of this and other nearby localities in the Yorkshire Geological Society field guide. Additional biostratigraphical information was given by Wood (1992). The rare earth element mineralogy of the marl seams and their classification into vulcanogenic bentonites (tuffs) and detrital marls was reviewed by Wray and Wood (1998). The lithological log and the lithostratigraphical classification given here is based on hitherto unpublished work carried out by Wood for the British Geological Survey.

Lithostratigraphy

The two sides of the cutting (Figure 5.16) and (Figure 5.17) provide a composite, more or less continuous near-dip section in the lower part of the Burnham Chalk Formation (Figure 5.18), extending from the Ulceby Marl up to the Easthorpe Tabular Flints. Above the highest accessible tabular flints, two continuous, thick (i.e. > 0.30 m) tabular flints (the Barrow Flints) can be observed projecting from the inaccessible highest 3 m of the section near the top of the cutting. The Ulceby Marl itself is not exposed, but it can be revealed by digging into the talus at the base of the western end of the cutting [SE 9138 4594].

This locality is the stratotype section for the Enthorpe Marls, and for the Enthorpe Oyster Bed, which is situated in the interval between Enthorpe Marls 2 and 3. However, the topmost of the four Enthorpe Marls, which is 5 mm thick at the Arras Road Pit [SE 9286 4322], some 2 km to the south (Figure 5.15), is represented here by a bedding plane only. Enthorpe Railway Cutting is also currently one of the best-available sections through the three Kiplingcotes Marls and the immediately overlying Kiplingcote Flints, for which the stratotype section is the abandoned Kiplingcotes Station Quarry, Kiplingcotes Cutting [SE 9322 4376]; (Figure 5.15). The characteristic triple grouping of a basal smooth, lenticular flint, followed by a thick, semicontinuous irregular carious flint and an irregularly shaped 'pappy' flint with protuberances projecting downward from the base, forms a conspicuous feature on the southern side of the cutting. The section provides the only available link between the Ulceby Marl and the Kiplingcotes succession and is indispensible in this respect.

A small chalk pit [SE 9196 4640] adjacent to Enthorpe House (Figure 5.16), and only some 200 m beyond the north-east end of the cutting, exposes a 4.5 m section, which is stratigraphically marginally higher than the Barrow Flints at the top of the cutting. This section extends from *c.* 2 m beneath the distinctive Kirkella Marl with its underlying brown and white carious flint, up to the second of the three Willerby Flints (for stratigraphy see Wood, 1992). These marker horizons are exposed from time to time at Willerby Quarry [TA 0148 3118] in the course of excavation for subsequent landfill, but there are no permanent exposures there, and the former exposure at Little Weighton Quarry [SE 981 333] is now backfilled. This supplementary section is thus of considerable importance.

There are two horizons in which the trace fossil *Zoophycos* is conspicuous (Figure 5.18). the first occurs in a 1.0 m band just below the Kiplingcotes Marl and the second is a broader 2.5 m thick band between flint bands 25 and 30.

Biostratigraphy

The exposed succession extends from the higher part of the *Sternotaxis plana* Zone (Upper Turonian) to the middle of the *Micraster cortestudinarium* Zone (Lower Coniacian) of the traditional zonal scheme. The rich inoceramid faunas, from the level of the Kiplingcotes Marls upwards, here and in correlative localities (Kiplingcotes Station Quarry, Willerby Quarry), allow the succession to be placed within the revised standard northern European Lower Coniacian inoceramid bivalve zonation (Figure 2.9) and (Figure 2.18), (Figure 2.19), (Figure 2.20), (Figure 2.21), Chapter 2; Walaszczyk and Wood, 1999b,c; Appendix, this volume).

The Ulceby Oyster Bed, as elsewhere, is silty and rich in bioclastic debris, particularly small crinoid columnals. It has yielded the usual well-preserved medium-sized pycnodonteine oysters, as well as specimens of the brachiopods *Cretirhynchia cuneiforrnis* Pettitt, *Gibbithyris subrotunda* (J. Sowerby) and *Orbirhynchia* sp.. An undescribed large species of the echinoid *Infulaster* is not uncommon between Enthorpe Marls 1 and 2, and Whitham (1991) recorded the first ocurrence of *Sternotaxis placenta* (Agassiz) at this level. The oysters of the Enthorpe Oyster Bed, which are smaller, sparser and much less conspicuous than those of the Ulceby Oyster Bed, are concentrated near the base of the interval between Enthorpe Marls 2 and 3, but extend up to the top of the interval.

The Turonian–Coniacian boundary falls within the higher part of the Kiplingcotes Marls, but its exact position has not yet been determined. A shell bed, 0.15 m beneath Kiplingcotes Marl 2, here and in the Kiplingcotes Station Quarry and Arras Road Pit sections, containing specimens of *Cremnoceramus waltersdorfensis waltersdorfensis* (Andert) together with the basal Coniacian marker fossil, *C. deformis erectus* (Meek) (formerly referred to as *C. rotundatus* Trager *non* Fiege: see Walaszczyk and Wood, 1999a) and common, but extremely poorly preserved specimens of the thin-shelled bivalve *Didymotis* cf. *costatus* (Fritsch), marks the approximate boundary. *Cremnoceramus deformis erectus* also occurs between the highest two marls. The occurrence of these fossils, in association with conspicuous, well-developed marl seams, finds a parallel in the Navigation Marls group in the Southern Province. The large, thin-tested echinoid *Sternotaxis placenta* and a possible *Tethyoceramus* sp. have been collected above the Kiplingcotes Carious Flint, and *Cremnoceramus waltersdorfensis hannovrensis* (Heinz) is common 0.3 m above the highest Kiplingcotes flint.

The interval between, and immediately underneath the Easthorpe Tabular Flints is exceptionally fossiliferous, and is readily accessible for collecting above the talus on the northern side of the cutting. These beds, which contain conspicuous examples of *Zoophycos,* yield abundant echinoids, including *Echinocorys* cf. *gravesi* Desor, *Infulaster* sp. nov., *Micraster corbovis* Forbes, *M. normanniae* Bucaille and *Sternotaxis* aff. *placenta.* The echinoids are associated with medium-sized inoceramids such as *Cremnoceramus* ex gr. *deformis* and *Cremnoceramus crassus inconstans* (Woods), the zonal index species of the *crassus inconstans* Zone).

The section has yielded specimens of *Inoceramus annulatus* Goldfuss and *Cremnoceramus crassus* Petrascheck (the *C. schloenbachi* (Bohm) of earlier literature) from beneath Willerby Flint 2, placing this highest Enthorpe horizon in the *Cremnoceramus crassusdeformis* Zone of the revised inoceramid scheme (see Walaszczyk and Wood, 1999b,c). The same horizon at Willerby Quarry and at the base of the now backfilled Little Weighton Quarry yielded *Micraster bucaillei sensu* Stokes.

Interpretation

The exceptionally soft nature of the chalk and the concomitant absence of stylolite development in the Enthorpe Railway Cutting in comparison to correlative successions, notably that at Barrow Quarry [TA 071 203] in North Lincolnshire, where the chalk is very hard, is possibly attributable to its position over the Market Weighton Axis. It is noteworthy that, although the Jurassic and Lower Cretaceous strata thin and become condensed over this structure, and may even be cut out altogether, the Turonian–Coniacian succession here is relatively expanded.

As noted earlier, rare earth element analysis of the clay component of the silty, bioclastic Ulceby Marl has shown that it is vulcanogenic (Wray and Wood, 1998). It correlates with the Lewes Marl of the Southern Province, and it, together with the overlying Ulceby Oyster Bed, are inferred to correlate with the key bentonite T_F-Micraster Marl event bundle of northern Germany. Given that the Turonian–Coniacian boundary falls somewhere within the Kiplingcotes Marls, the interval from the Ulceby Marl up to the base of the Kiplingcotes Marls can be inferred to belong to the *Mytiloides scupini* Zone, with the typically thin terminal Upper Turonian *Cremnoceramus waltersdorfensis waltersdorfensis* Zone falling within the basal part of the Kiplingcotes Marls. The occurrence of a possible specimen of *Tethyoceramus* above the Kiplingcotes Carious Flint and of common *C. waltersdorfensis hannovrensis* (Heinz) above the top flint, suggests that the *waltersdorfensis hannovrensis* inoceramid Zone of Walaszczyk and Wood (1999a) begins within or just above the Kiplingcotes flint group. The inoceramid biostratigraphy of the higher part of the succession needs to be re-investigated in the context of the new zonal scheme.

The nearby Kiplingcotes Station Quarry (Figure 5.16) is famous for the preservation, beneath a large ammonite, of an originally aragonite-shelled molluscan fauna (Wright, 1935; Wright and Wright, 1942), comparable with the so-called '*reussianum* fauna' of the Chalk Rock of the type area (see Fognam Quarry and Kensworth Chalk Pit GCR site reports, this volume), albeit at a higher stratigraphical level. The actual horizon was not recorded, but it is likely to have been about the level of the Kiplingcotes Marls, which are situated near the base of the section; support for this interpretation is provided by the occurrence of large ammonites at this horizon in Lincolnshire.

The Enthorpe Railway Cutting section can be geologically linked to the nearby Kiplingcotes Station Quarry and the section at the Arras Road Pit, as well as to the Willerby and Barrow quarries. It also demonstrates the condensation that exists at the stratotype section of the Ulceby Marl and Ulceby Oyster Bed at Vale House Quarry, Ulceby [TA 107 134], in north Lincolnshire, where the interval from the Ulceby Marl to the Enthorpe Oyster Bed is 6 m, as against nearly 9 m at Enthorpe. In contrast to the Barrow and Ashby Hill [TA 2405 0060] quarries, where giant paramoudra flints are developed above the Kiplingcotes Marls (cf. Toynton and Parsons, 1990), no such flints are found at Enthorpe. Enthorpe Railway Cutting provides an indication of the succession that must be present in the inaccessible sea cliffs between North Landing and Breil Head in the Flamborough Head GCR site. Although there is no evidence of channel development at Enthorpe, an extensive shallow channel was seen at the Willerby Quarry to cut down from just above, to the base of, the Willerby Flints (Wood, 1992). This channel development is connected with the Ilsede Phase (Stille, 1924) of Subhercynian tectonism, which was originally identified in northern Germany (see Mortimore *et al.,* 1998).

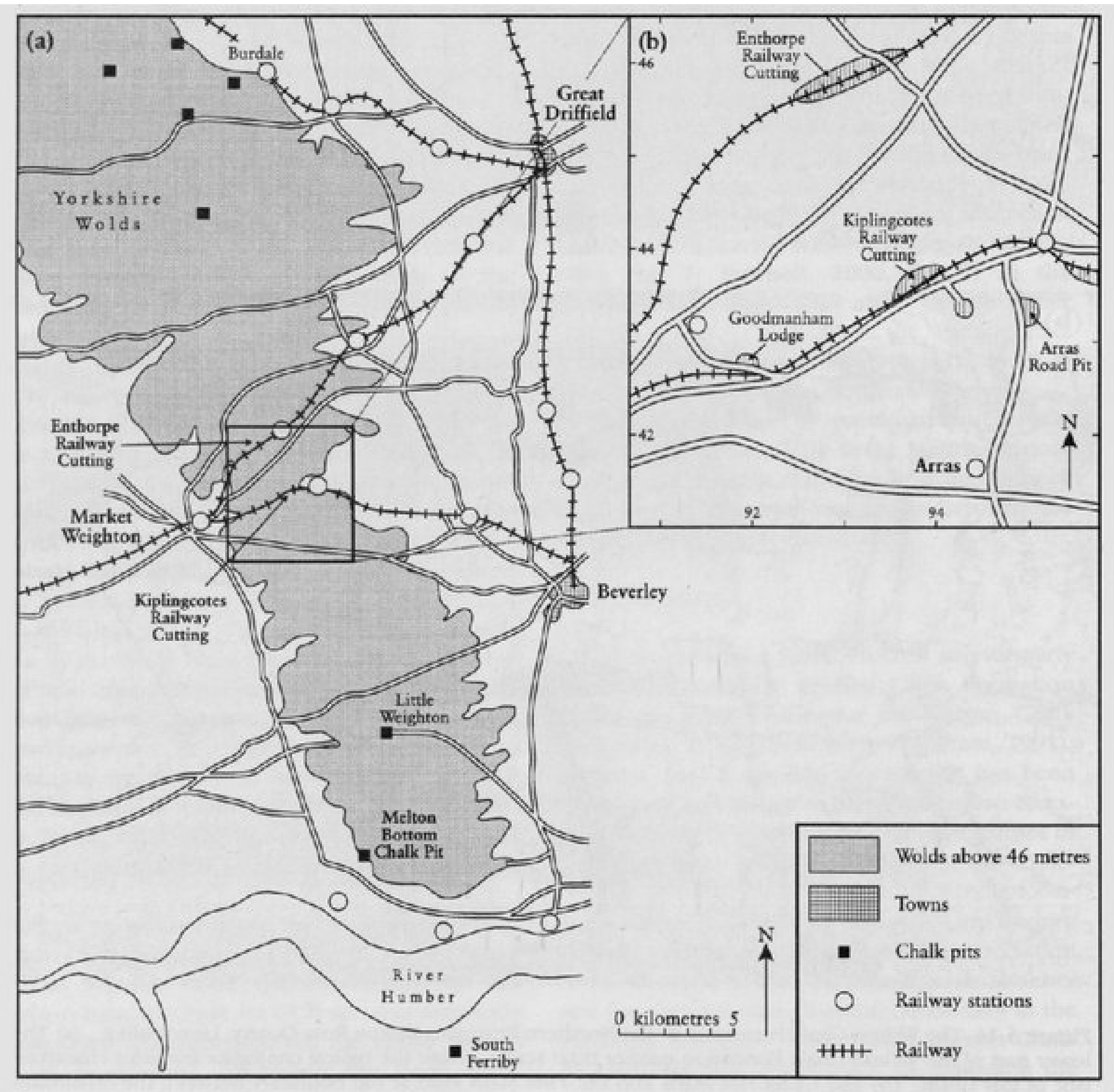
The Willerby Quarry succession provided the Kiplingcotes Marls–Little Weighton Marls interval of the standard composite section (see Wood, 1992, fig. 34). In comparison, the highest horizon of the composite Enthorpe Railway Cutting and quarry succession (Willerby Flint 2) is situated *c.* 12 m beneath the second of the three Little Weighton Marls. These marls mark the equivalent of the base of the *Micraster coranguinum* Zone of southern England. The composite Enthorpe succession, however, from the highest of the Kiplingcotes Marls to the Barrow Flints, is relatively expanded (*c.* 11.7 m) in relation to the Willerby Quarry and Barrow Quarry sections (*c.* 8.5 m). It is possible that this expansion may also apply to the (unexposed) highest part of the *cortestudinarium* Zone to the east of the quarry.

In addition to the biostratigraphical evidence for correlations, and the presence of north-west European-wide marker marl seams, the two conspicuous *Zoophycos* trace fossil horizons correlate with the equivalent Southern Province Cuilfail and Beachy Head Zoophycos ((Figure 5.18); (Figure 2.3), Chapter 2). The Cuilfail Zoophycos are particularly well developed and preserved at the Arras Road Pit and also occur widely across north-west Europe (Mortimore and Pomerol, 1991b).

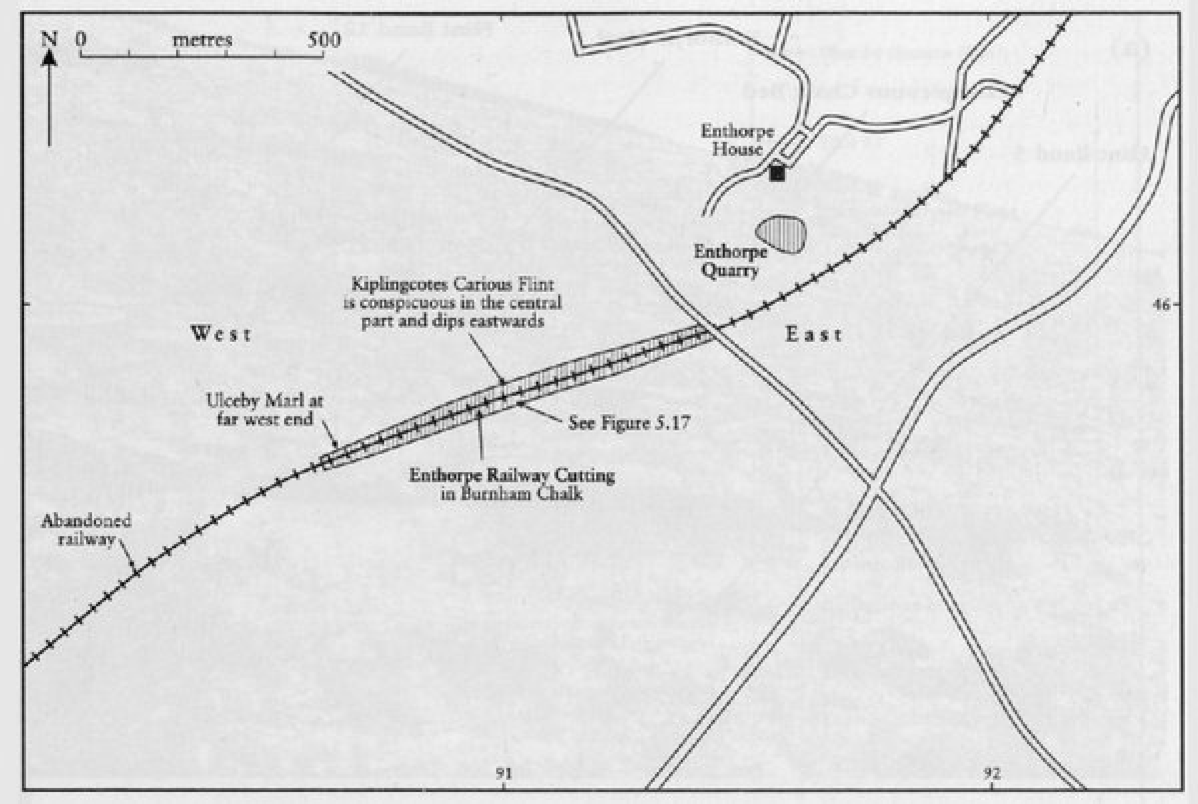
Conclusions

The abandoned Enthorpe Railway Cutting, located close to the Market Weighton Axis, is one of the few exposures of unusually soft chalk in Yorkshire. These soft chalks yield many well-preserved and some unique fossils. This exposure is also the only link in the Northern Province succession in the Upper Turonian–Lower Coniacian strata between the Ulceby Marl and the beds at Kiplingcotes. The Upper Turonian–Lower Coniacian inoceramid bivalve collections in particular are crucial to correlations with Europe and the establishment of the Turonian–Coniacian boundary in English Chalk successions.

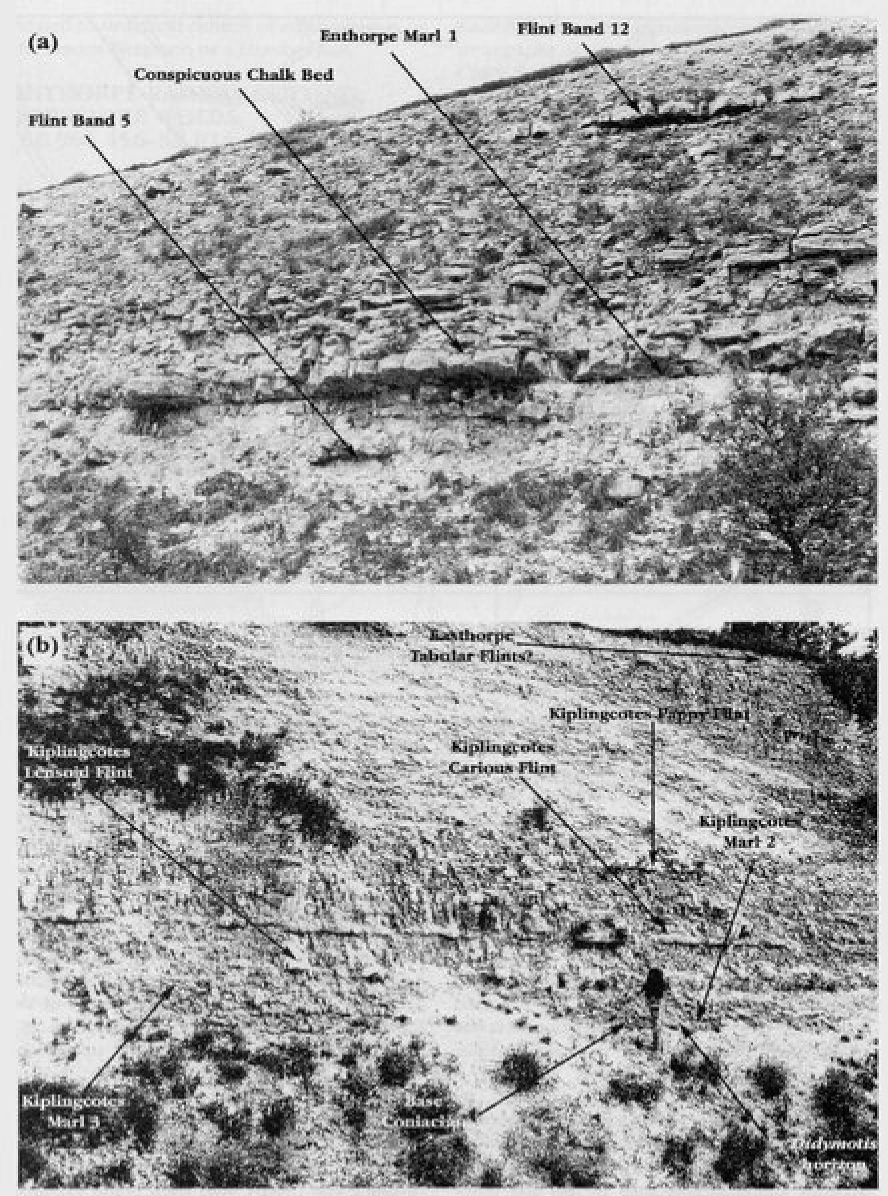
[References](#)



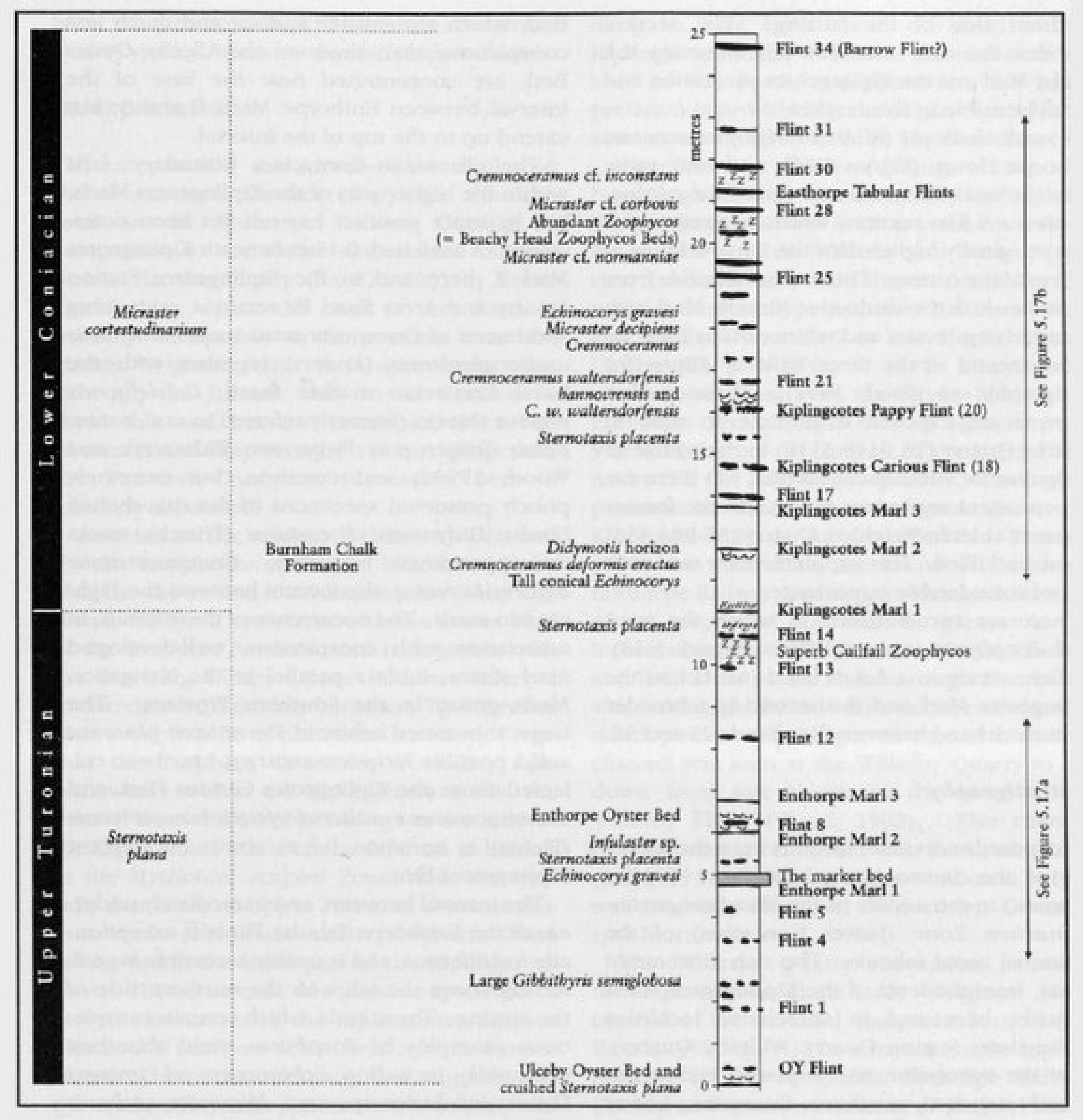
(Figure 5.15) The location of Enthorpe Railway Cutting and other field sections in the Yorkshire Wolds.



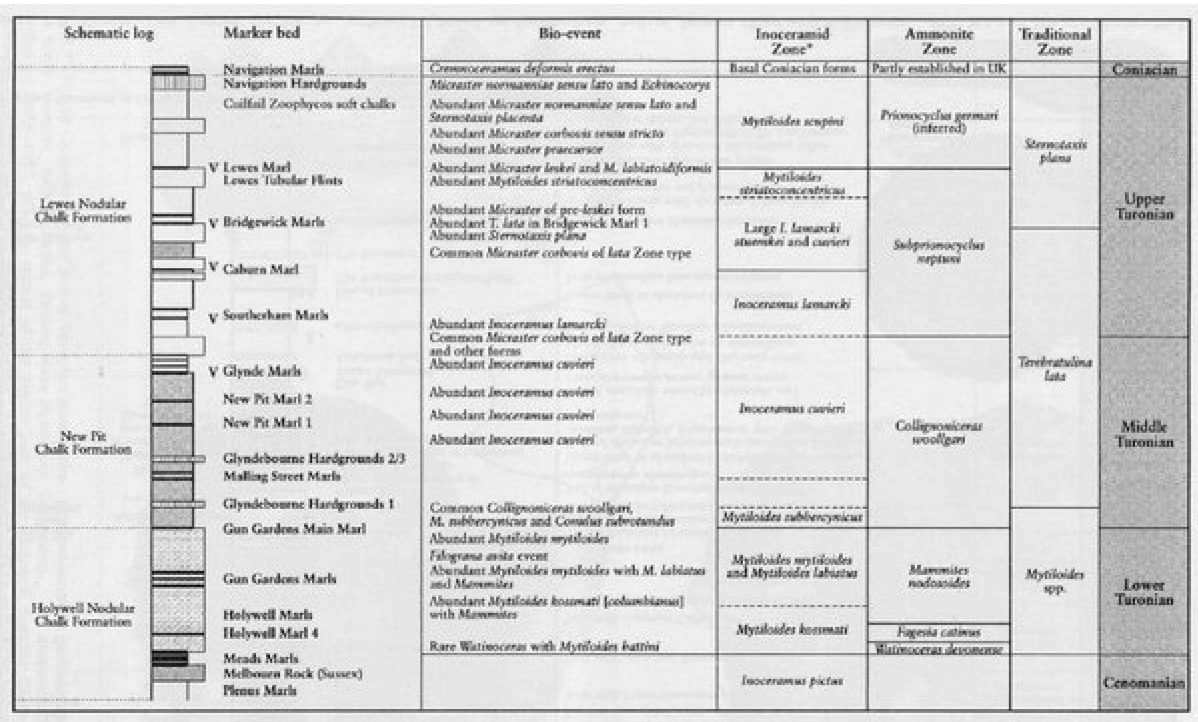
(Figure 5.16) The Enthorpe Railway Cutting GCR Site, exposing the Burnham Chalk Formation from just above the Ulceby Marl to a level above the Easthorpe Tabular Flints in the Beachy Head Zoophycos Beds.



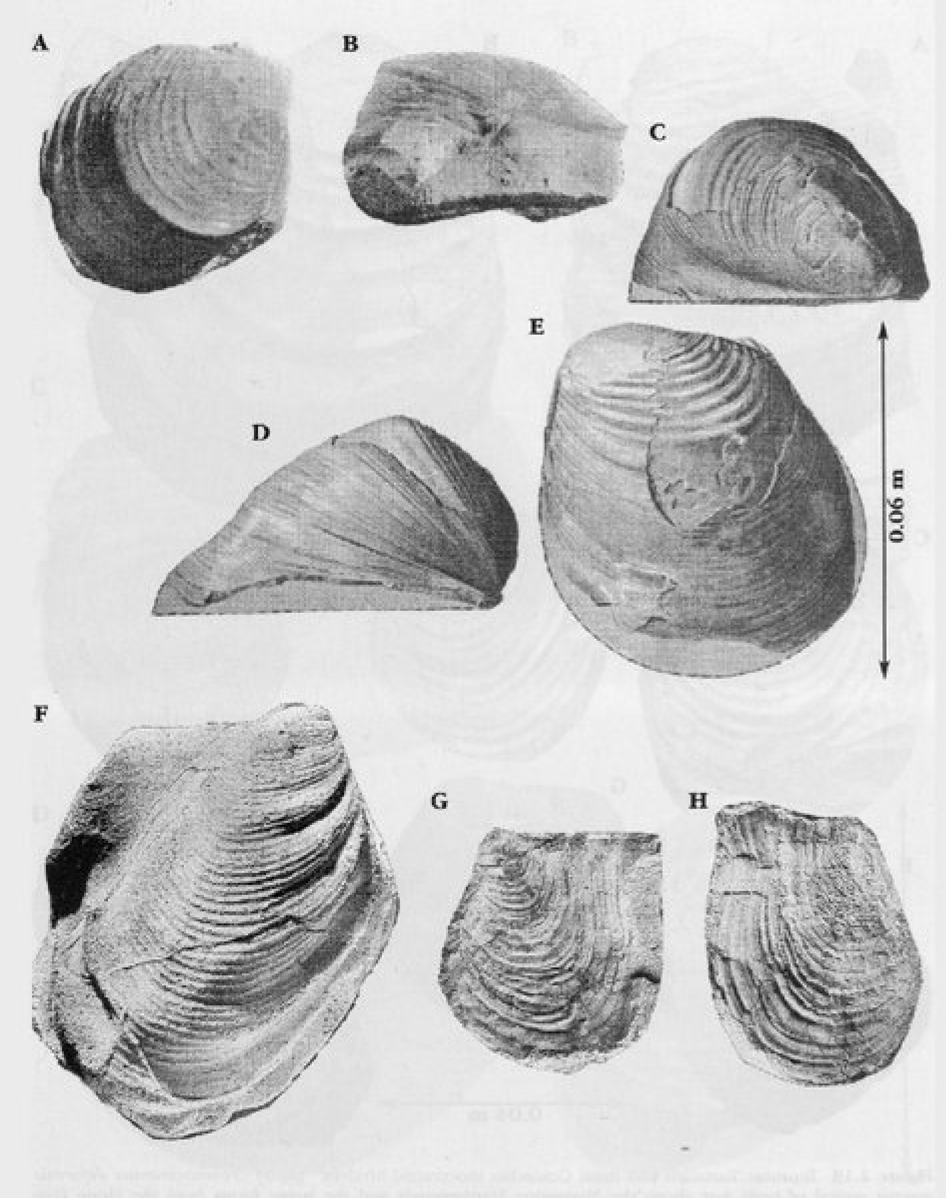
(Figure 5.17) Enthorpe Railway Cutting in the highest Turonian and Lower Coniacian Burnham Chalk Formation. (a) North side of cutting looking NNW (b) South side of cutting looking south-east. (Photos: C.J. Wood.)



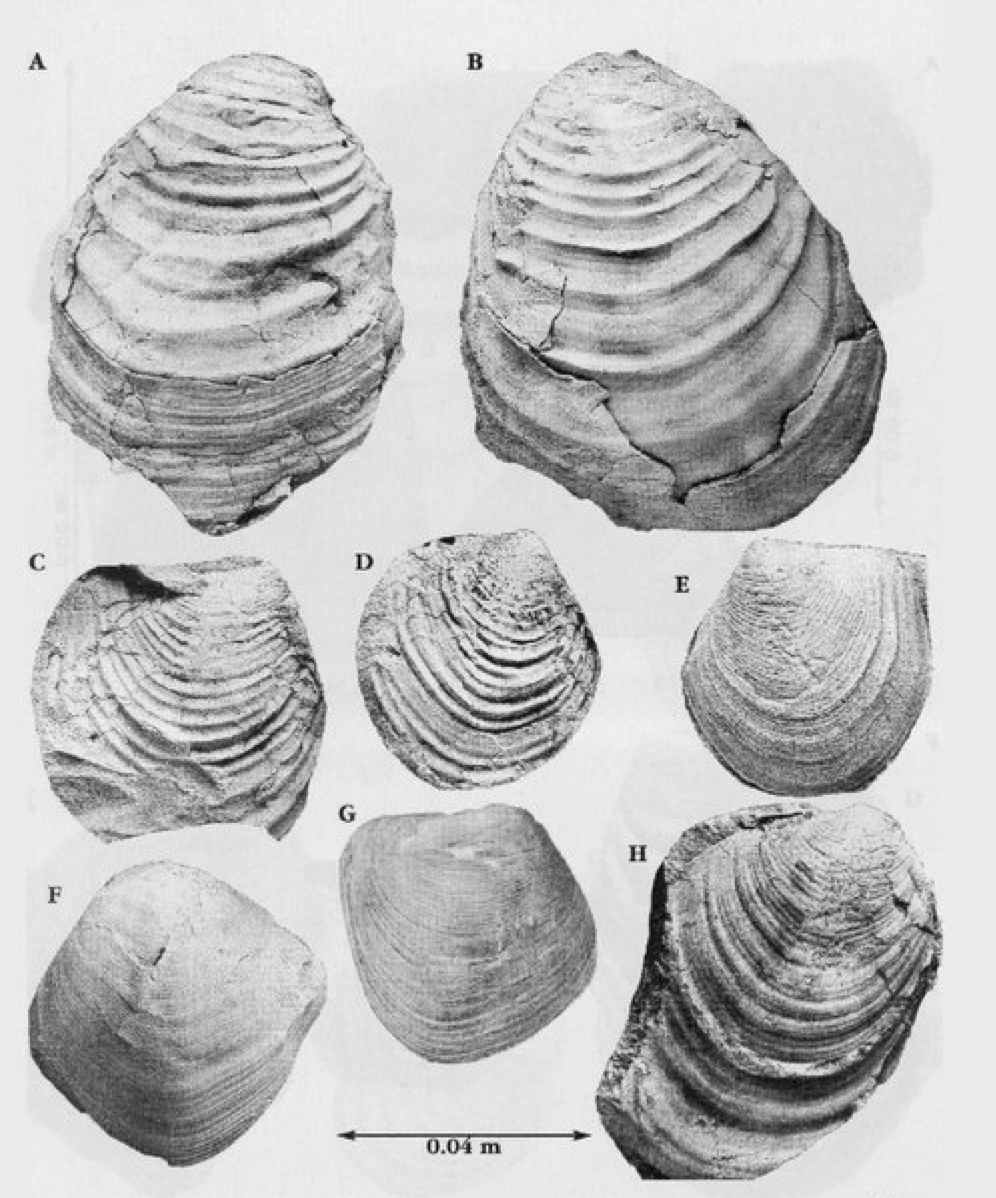
(Figure 5.18) The Burnham Chalk Formation section exposed in the abandoned Enthorpe Railway Cutting, Yorkshire Wolds.



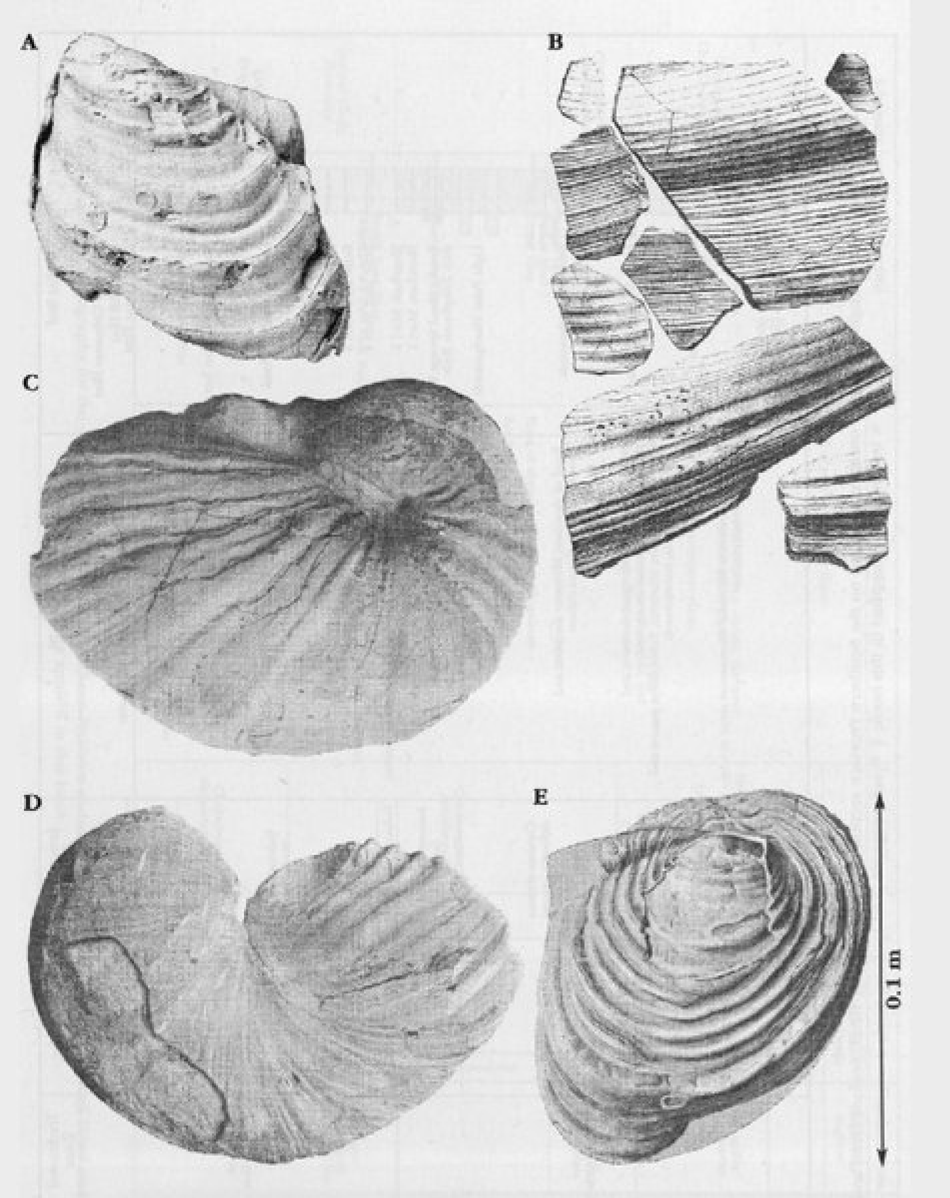
(Figure 2.9) Turonian stratigraphy for the onshore UK based on Lewes Pits and Beachy Head, Southern Province. V = marl derived from volcanic ash. (* = The inoceramid zones used are transferred from the current scheme used in Northern Europe and are under review.)



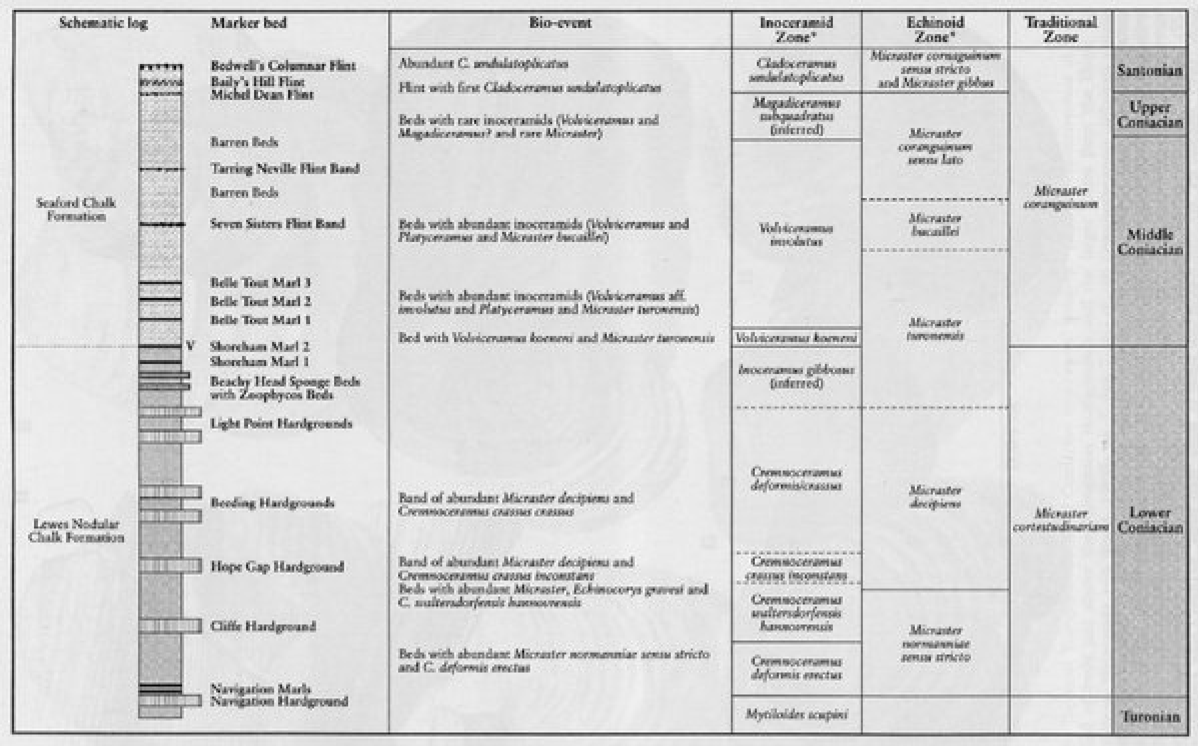
(Figure 2.18) Upper Turonian and Lower Coniacian inoceramid bivalves. (A–E) Cremnoceramus crassus inconstans; (A, B) the lectotype, the original of Inoceramus sp., Mantell, 1822 (from Woods, 1912, text-fig. 42); (C–E) from Woods, 1912, text-fig. 43. (F) Inoceramus lusatiae, holotype: typical of the Navigation Hardgrounds (from Walaszczyk and Wood, 1999b, pl. 2, fig. 4). (G, H) Mytiloides herbichi, probably typical of the beds around the Cuilfail Zoophycos (from Walaszczyk and Wood, 1999b, p1. 1, fig. 5). Scale bar applies to all specimens.



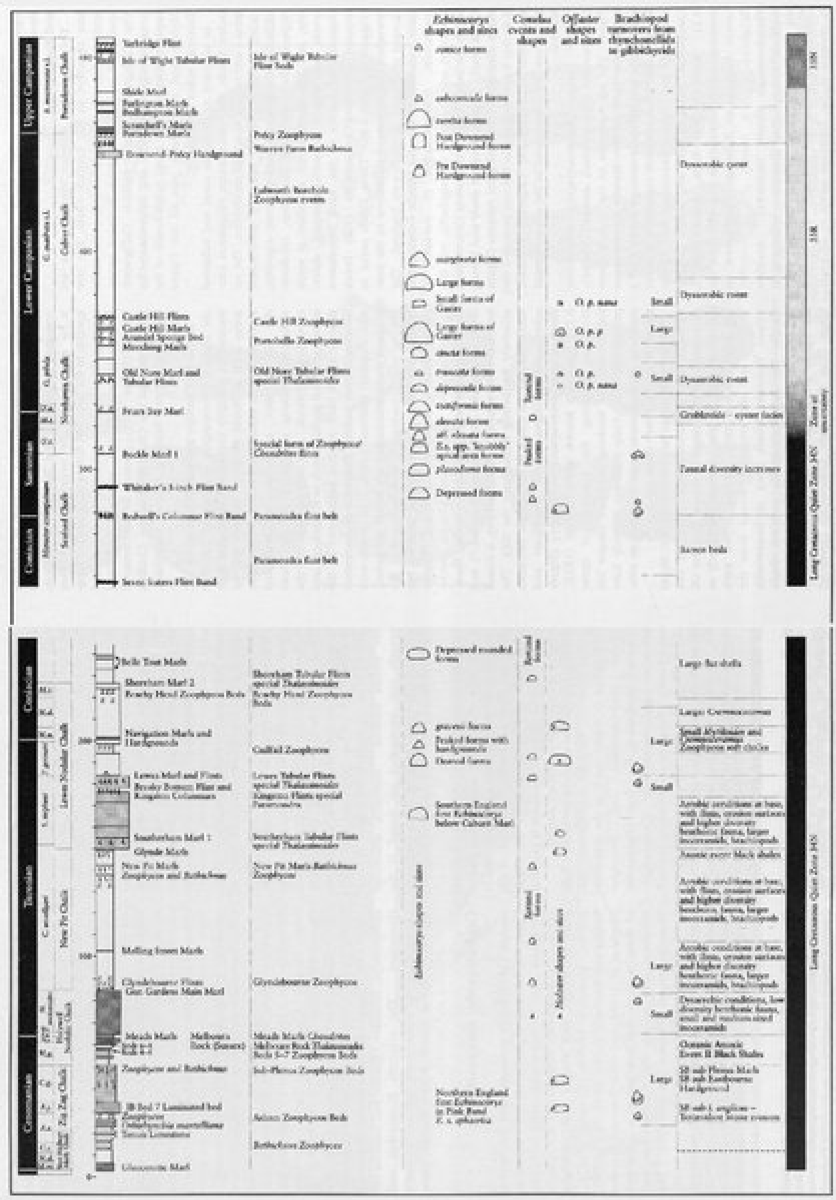
(Figure 2.19) Topmost Turonian and basal Coniacian inoceramid bivalves. (A, B) Cremnoceramus deformis erectus typical of beds just above the Navigation Hardgrounds and the larger forms from the Hope Gap Hardground (from Walaszczyk and Wood, 1999b, pl. 7, figs 7, 8). (C, D) Cremnoceramus deformis erectus, typical of Navigation Marls, (from Walaszczyk and Wood, 1999b, p1. 7, figs 1, 2). (E-G) Cremnoceramus waltersdorfensis waltersdorfensi; (E) typical of the Southern Province (from Walaszczyk and Wood, 1999b, pl. 15, fig. 2); (F) typical of beds below the Navigation hardgrounds (from Walaszczyk and Wood, 1999b, pl. 17, fig. 3); (G) typical of beds between Navigation and Cliffe hardgrounds in the Southern Province (from Woods, 1912, pl. 52, fig. 1). (H) Cremnoceramus waltersdorfensis hannovrerzsis typical of beds between Cliffe and Hope Gap hardgrounds (from Walaszczyk and Wood, 1999b, pl. 11, fig. 2). Scale bar applies to all specimens.



(Figure 2.20) Lower and Middle Coniacian inoceramid bivalves. (A) Cremnoceramus crassus crassus typical of Beeding to Light Point beds, Lewes Nodular Chalk (from Walaszczyk and Wood, 1999b, pl. 17, fig. 2). (B) Fragments of Platyceramus sp. shell typical of the Belle Tout Beds, Seaford Chalk Formation (from De Mercy, 1877). (C–E) Volviceramus aff. involutus; (C, D) typical of Belle Tout Beds, Seaford Chalk Formation (from Woods, 1912, text-figs 93, 90); (E) typical cap valve in Belle Tout Beds, Seaford Chalk Formation, common 1.8–2 m below the Seven Sisters Flint Band (from Woods, 1912, text-fig. 94). Scale bar applies to all specimens.



(Figure 2.21) Coniacian stratigraphy for the onshore UK based on the Southern Province sections at Lewes, Beachy Head, Seaford Head and Dover. (= informal zones applied in this book; V = vulcanogenic marl.)*



(Figure 2.3) Integration of trace fossil events with shape and size changes in some key benthic fossils, and the magnetostratigraphy for the Upper Cretaceous succession in southern England. See (Figure 1.5), Chapter 1, for full details of zonal fossils.