Catton Grove Chalk Pit, Norwich, Norfolk

[TG 229 109]

Introduction

Catton Grove Chalk Pit (also known as 'Campling's Pit') is a small quarry surrounded by a housing estate, situated to the east of the Sprowston Road, in the Catton area of Norwich (Figure 4.24). Access is by a track from the Sprowston Road. The site provides a section across the boundary between the Weybourne Chalk and Beeston Chalk formations of the Upper Campanian Chalk of Norfolk. It is also the stratotype for the Catton Sponge Bed, which is a hardground within a complex of hardgrounds that straddles this boundary The succession here, and that at the stratigraphically higher Caistor St Edmund Chalk Pit GCR site, represents higher Campanian Chalk than is preserved in the Whitecliff, Isle of Wight and Handfast Point to Ballard Point, Dorset GCR sites. Catton Grove Chalk Pit and the nearby Attoe's Pit [TG 231 111], also now backfilled, were the source of many fossils, including ammonites, in museum collections; these came mostly from the Catton Sponge Bed and the immediately overlying beds, which are particularly fossiliferous.

The Catton Sponge Bed marks the boundary between two of the zones of the northern European Upper Campanian belemnite zonal scheme that now replaces the traditional *Belemnitella mucronata* Zone. It is a level of major macrofaunal change, which particularly affects the brachiopods, molluscs and echinoids. It marks the entry of certain benthic foraminiferal species that range up to and, in some cases, above the Campanian–Maastrichtian boundary, and is tfius of particular relevance to the interpretation of the microfaunal biostratigraphy of the Chalk successions in the southern North Sea Basin. It reflects a European-wide regressive phase, which elsewhere is expressed either by a hardground or by a change in lithofacies to shallow-water sponge-rich siliceous marls with a high-diversity macrofauna.

Description

The previously exposed section at Catton Grove Chalk Pit has been backfilled, but the Catton Sponge Bed and the overlying basal Beeston Chalk, at the top of the pit, have been deliberately covered by soil and turfed within a semi-circular retaining wall of gabions, in order to preserve it.

Lithostratigraphy

In the 1960s, this pit exposed *c.* 10 m of the highest part of the Weybourne Chalk Formation, terminating in the Catton Sponge Bed; and overlain by the basal 1.8 m of the Beeston Chalk (Peake and Hancock, 1961, fig. 6). Those workers recorded six flint bands below the Caton Sponge Bed, and one band of huge flints up to 0.45 m thick above it. They noted that an additional 22 ft (6.7 m) of section had previously been visible down to a flint that formed the floor of the pit. When this flint, probably the thick semi-tabular flint T of the stratotype Weybourne Chalk succession (Peake and Hancock, 1961, fig. 5), was broken through, the lower part of the pit rapidly flooded and had to be backfilled. Wood (1988, fig. 7) recognized some additional flints, and published a revised log. (Figure 4.26) is based on the two accounts quoted above.

The Caton Sponge Bed was named by Peake and Hancock (1961) to describe the 'hard yellow bed'or 'sponge bed' of the earlier literature that had been recorded in the chalk pits at Caxton, and which Rowe (in manuscript) and Brydone (1938) regarded as marking a level of significant faunal change in the Chalk of Norfolk. Peake and Hancock's Canon Sponge Bed comprises two closely spaced beds of iron-stained, indurated chalk capped by hardgrounds (cf. Wood, 1988, p. 62, fig. 7), rather than the single hardground recorded by them. The two hardgrounds were designated hardgrounds I and II by Wood (1988, fig. 7), the higher (the Catton Sponge Bed proper of previous workers) being taken as the boundary between his topmost (Weybourne$_3$) subdivision of the Weybourne Chalk and the succeeding Beeston Chalk. Hardground I is patchily and relatively poorly indurated, but is capped by a well-defined, planar erosion surface. The Canon Sponge Bed (Hardground II) contains a rich assemblage of hexactinellid sponges, in limonitic preservation, together with moulds of originally aragonite-shelled bivalves and gastropods reminiscent of the *reussianum* fauna from the Hitch Wood

Hardground of the Upper Turonian Chalk Rock. It is locally strongly indurated, and also terminates in a clearly defined erosion surface. This is overlain by soft glauconitized chalk pebbles and a concentration of large, reworked belemnites, which forms an excellent example of a so-called 'belemnite battlefield'. The Sponge Bed is penetrated by an extensive *Thalassinoides* burrow system, which in places contains belemnites 'piped down' from the overlying concentration. The huge flint A of the Peake and Hancock notation in the basal part of the Beeston Chalk is a section through a giant ring flint; it is underlain by chalk containing large pieces of shell of inoceramid bivalves, and is followed by weakly indurated chalk without an obvious erosion surface, which was designated by Wood (1988) as Hardground III.

Biostratigraphy

The section falls within the traditional *Belemnitella mucronata* macrofossil Zone, which covers the entire Upper Campanian Substage ((Figure 1.5), Chapter 1; (Figure 2.13), Chapter 2; (Figure 4.5)). There is a significant change in the belemnites, with *Belemnitella woodi* Christensen becoming extinct just below the Catton Sponge Bed, to be replaced by *B. minor I* Christensen in and above the Sponge Bed (Christensen 1995, fig. 6). The Sponge Bed marks the boundary between the *Belemnitella woodi* and *Belemnitella minor I* belemnite zones (Christensen, 1995, fig. 2; (Figure 4.5)). These zones, originally established as local zones in Norfolk, succeed the restricted *B. mucronata* Zone ((Figure 2.13), Chapter 2; (Figure 4.5)), and have now been recognized in Belgium, the Netherlands and Germany (Christensen, 1999). The belemnites in the 'belemnite battlefield' on top of the Sponge Bed, and in the basal part of the Beeston Chalk, are exclusively *Belemnitella minor* I (Christensen, 1995, fig. 6). The absence of *B. 'langei*', which is present at the base of the Caistor St Edmund Chalk Pit, places the Beeston Chalk at Canon Grove in the lowest of the three local subzones (Christensen, 1995) of the *B. minor* I Zone.

Records of ammonites (*Nostoceras (Bostrychoceras) polyplocum* (Roemer), *Baculites* sp. and *Menuites portlocki* (Sharpe)) can safely be inferred to have come from the Sponge Bed. However, other ammonites from the 'Norwich Chalk' in museum collections, particularly those preserved as glauconitized composite moulds, probably came from less well indurated ammonite-bearing horizons in the Beeston and Paramoudra Chalk. The non-ammonite molluscan fauna is largely undescribed, but includes species of the gastropod genera *Periaulax* and *Planolateralus.* The rich hexactinellid sponge fauna (details in Reid, 1968) is dominated by *Leptophragma striatopunctata* (Schrammen) with, in addition to another five species, *Aphrocallistes cylindrodactylus* Schrammen and *Lepidospongia rugosa* Schlüter. The latter two species also occur in the coeval strata in Northern Ireland.

There is a major macrofaunal change at the Sponge Bed, which especially affects the brachiopods, bivalves and echinoids. This was first noted by Rowe (in manuscript) and independently confirmed by Brydone (1922, 1938) (see review by Wood, 1988, pp. 19–39). Both workers compared this faunal change in the inland sections with the difference in faunal content between the (Weybourne) and (Beeston) Chalk successions to the west and east of Sheringham respectively. The rhynchonellid brachiopod *Cretirhynchia woodwardi* Pettitt, characteristic of the Weybourne Chalk, disappears abruptly at the top of the Sponge Bed, while the terebratulid *Carneithyris carnea* (J. Sowerby) and the rhynchonellids *Cretirhynchia arcuata* Pettitt and *C. norvicensis* Pettitt, all of which occur sporadically in the Weybourne Chalk, become abundant and represented by large-sized individuals in the Beeston Chalk. The large limacean bivalve *Plagiostoma marrotianum* (d'Orbigny) and the pectinacean *Mimachlamys mantelliana* (d'Orbigny) are apparently restricted to the pre-Sponge Bed succession. There is a striking change in the echinoids across the Weybourne Chalk–Beeston Chalk boundary, from an assemblage characterized by *Cardiotaxis heberti* Cotteau, *Micraster glyphus* Schltiter and *M. stolleyi* Lambert (the '*Epiaster*' of both Rowe and Brydone) to one characterized by *Cardiaster cordiformis* (S. Woodward) ('*Cardiaster ananchytis*') and *Galerites roemeri* (Desor), with only extremely rare *Micraster.*

There is an important change in the microfauna (ostracods and foraminifera) across the same boundary. Two very long-ranging species of the ostracod genus *Cytherelloidea cut* out a short distance above the Sponge Bed, with other taxa entering at this level and continuing into the Maastrichtian strata (I. Slipper, pers. comm., 1998). Swiecicki (1980) recorded the extinction of some long-ranging benthic foraminiferal taxa, notably *Globorotalites micheliana* (d'Orbigny) at the Sponge Bed, and noted the abrupt entry of *Bolivina incrassata* Reuss, *Eponides beisseli* Schijfsma, *Globorotalites hiltermanni* Kaever, *Neoflabellina praereticulata* Hiltermann and *Reussella szajnochae szajnochae* (Grzybowski). These are species that range up to and, in some cases, above the Campanian–Maastrichtian boundary. There is also a significant drop in the planktonic foraminiferal content, in both numbers and diversity, at this level. The turnover in the benthic foraminifera constitutes a significant bio-event, potentially applicable to the interpretation of offshore wells, near the top of the UKB18 or *Bolivinoides decoratus* Interval Zone (cf. Hart *et al.,* 1989, p. 314, figs 7.16, 7.25). This higher part of the UKB18 Zone, given a separate subzonal status (B3iv) by Swiecicki (1980) ((Figure 1.5), Chapter 1), is also recognized at the stratigraphically higher Caistor St Edmund Chalk Pit, and in the backfilled Frettenham Pit [TG 246 173], even higher in the Beeston Chalk. Its top is marked by the entry of *Bolivinoides miliaris* Hiltermann and Koch and *B. sidestrandensis* Barr at, or just below, the base of the Paramoudra Chalk Member in the section at West Runton confusingly labelled 'Sheringham' in the *Stratigraphical Index of Fossil Foraminifera* (Hart *et al., 1989*, fig. 7.16).

Interpretation

South of Norwich, Hardground I and the Canon Sponge Bed were revealed in a trench in the now degraded Halfway House Chalk Pit [TG 2330 0268]. The Sponge Bed was also exposed in a trench at or near the base of the now backfilled Stoke Holy Cross Chalk Pit [TG 2536 0140] (see (Figure 4.26)). The section at the latter locality, some 9.5 km to the south along the strike from the present site, extends the succession upwards by another 2 m. In this section an additional thin, weakly indurated chalk bed and a bed of large nodular flints occur just below a weakly developed softground (Wood, 1988, fig. 7). Hardground III in the Beeston Chalk is better developed here than at Catton Grove, with a well-defined erosion surface strewn with flattened glauconitized chalk pebbles. The relationship between the composite Catton Grove–Stoke Holy Cross succession and the basal beds of the Caistor St Edmund Chalk Pit remains unclear, but it is likely that only a very small thickness of chalk separates them.

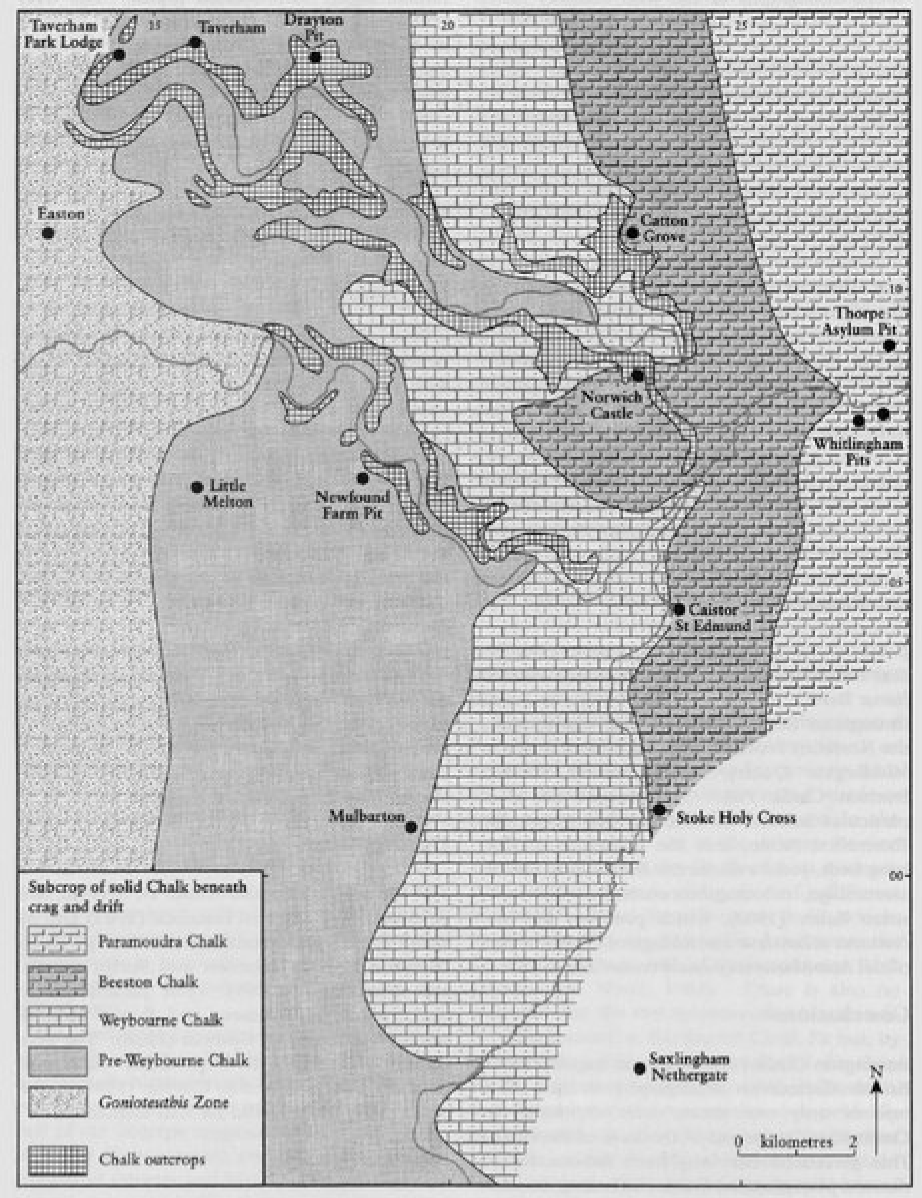
The Catton hardgrounds were formerly also seen in intermittent foreshore exposures at Sheringham, where the old Lifeboat House [TG 153 436] is actually sited on the Canon Sponge Bed. Hardground III, which can be recognized from its echinoid fauna, crops out to the east, opposite the Two Lifeboats Hotel (Peake and Hancock, 1970, p. 339E); a second hardground, possibly Hardground I, crops out a short distance to the west. The Catton Sponge Bed was not recognized in the British Geological Survey Trunch Borehole (Wood *et al.,* 1994), probably as a result of poor core recovery, but its position can be inferred from the resistivity log.

Hardground I and the Catton Sponge Bed correlate with the North Antrim Hardgrounds of Northern Ireland, which comprise two closely spaced hardgrounds, the lower one weakly, and the higher strongly, hardened and glauconitized. The higher hardground is similarly succeeded by chalks with fragmented inoceramid shell and giant ring flints (Fletcher, 1977; Fletcher and Wood, 1978). Towards the depositional margins and over structural highs, the North Antrim Hardgrounds become even more indurated and more strongly mineralized. The Catton Sponge Bed and the North Antrim Hardgrounds reflect the *polyplocum'* regression in northern Germany (Niebuhr, 1995; Niebuhr *et al.,* 1997), where it is marked by evidence of significant shallowing, including a high-diversity macrofauna with many baculitid ammonites, and the development of siliceous spongiferous marls (opoka facies), following marl-chalk rhythmites. This inter-regional regressive event, which can now be identified by correlative hardgrounds in Belgium and the Netherlands (Christensen, 1999) is interpreted as a sea-level lowstand, associated with a sequence boundary (Niebuhr *et al.,* 1997).

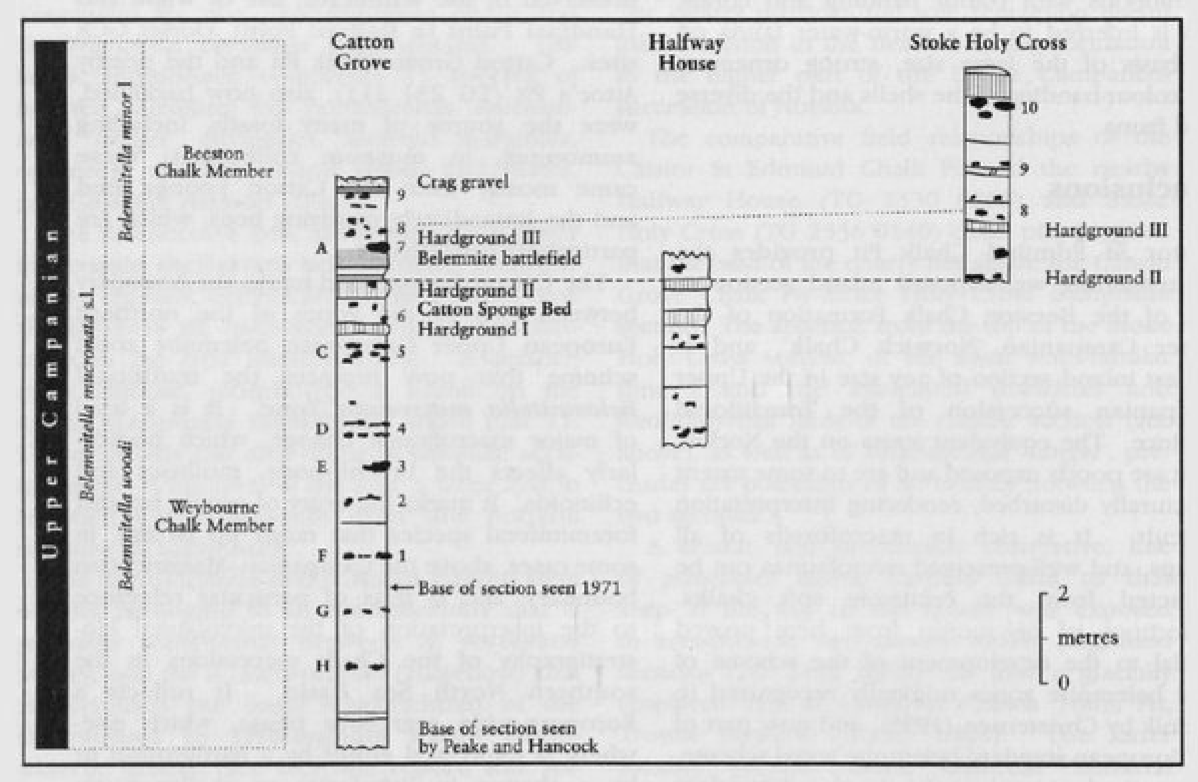
Conclusions

Catton Grove Chalk Pit is the type section and only remaining exposure of the Catton Sponge Bed, the other exposure on the foreshore at Sheringham having been permanently covered by the construction of a slipway. It forms the boundary between two of the belemnite zones of the standard northern European belemnite zonal scheme ((Figure 2.13), Chapter 2), and is a level of major macrofaunal change. It marks the entry of certain benthic foraminiferal species that range up to and, in some cases, above the Campanian–Maastrichtian boundary, and is thus of particular relevance to the interpretation of the microfaunal biostratigraphy of the offshore Chalk successions in the Southern North Sea Basin. It reflects a European-wide regressive phase, which elsewhere is expressed by a significant change in lithofacies to shallow water, coarse-grained, partly siliceous sediments.

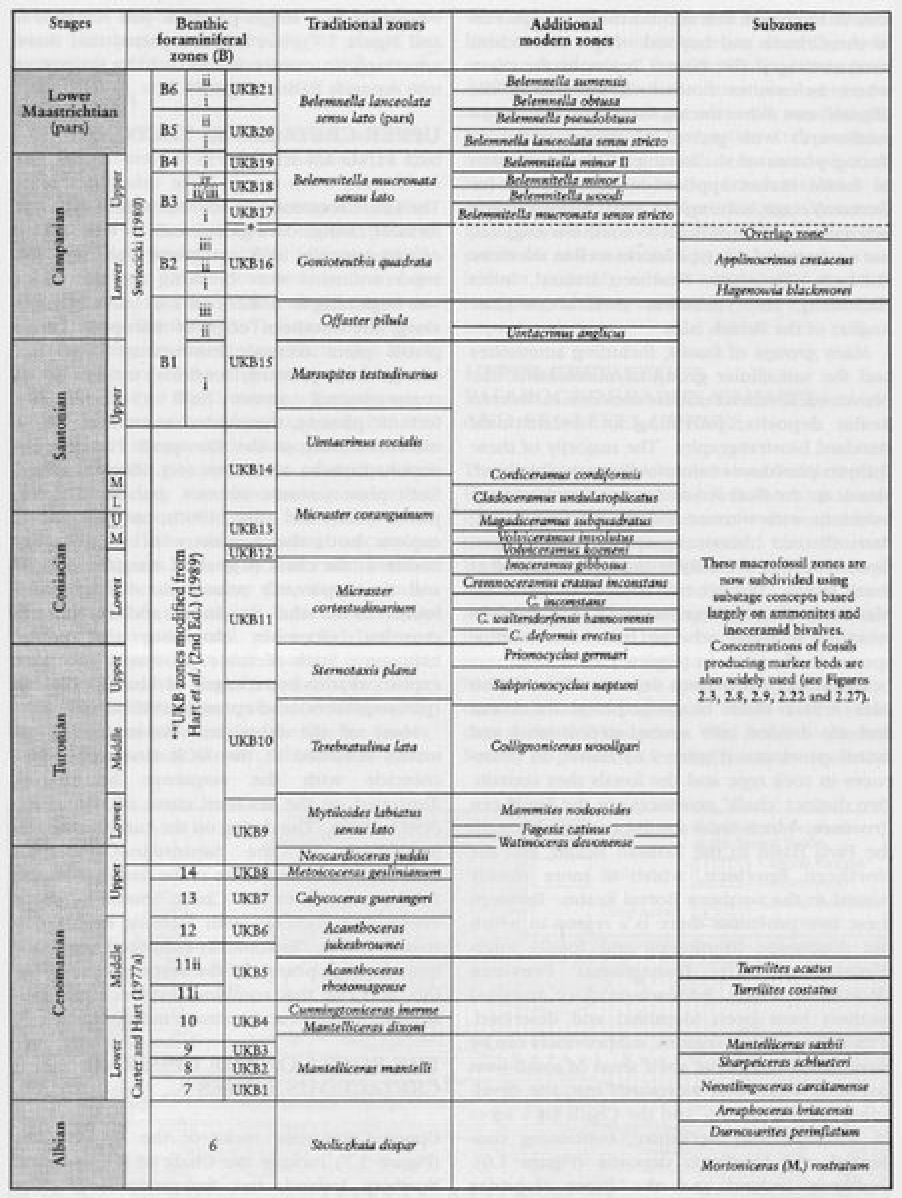
References



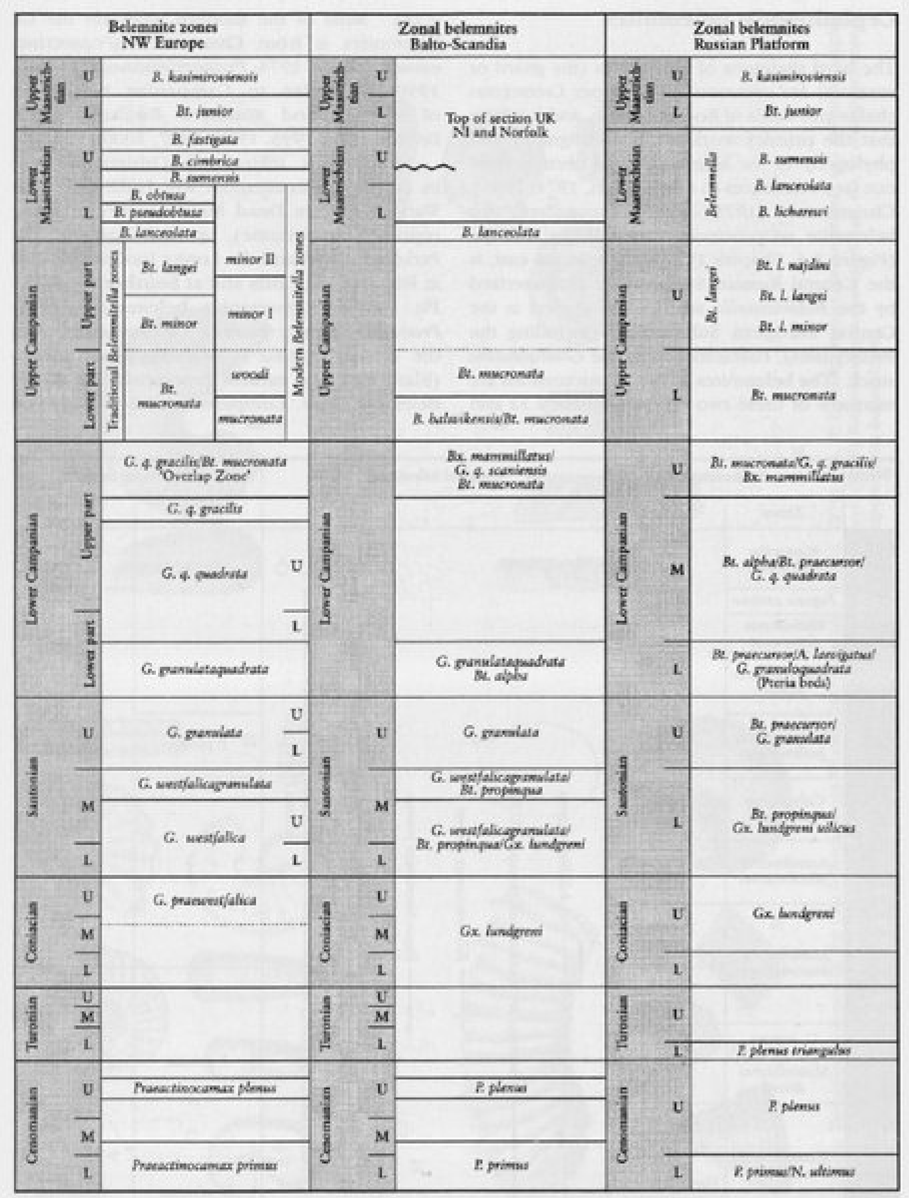
(Figure 4.24) The location of Caistor St Edmund Chalk Pit and Catton Grove Chalk Pit, and other sections mentioned in the text, around Norwich, Norfolk. (After Cox et al., 1989.)



(Figure 4.26) The Campanian Chalk (White Chalk Subgroup) at Cation Grove Chalk Pit, Norwich, and nearby exposures (see (Figure 4.24) for locations). (Letters A-H for flint bands are those of Peake and Hancock, 1970; numbers 1–10 are those of Wood, 1988.)



(Figure 1.5) Zones of the Upper Cretaceous Chalk. (= Gap in UKB scheme; ** = UKB zonal scheme modified for this book.)*



(Figure 2.13) Comparison of Upper Cretaceous belemnite zones across Europe, which are only partly represented in the UK and mainly on the Anglo-Brabant Massif. (After Christensen, 1991.) (A. = Actinocamax; B. = Belemnella; Bt. = Belemnitella; Bx. = Belemnellocamax; G. = Gonioteuthis; Gx. = Goniocamax; N. = Neohibolites; P. = Praeactinocamax.)

<table>
<tr><th colspan="2" rowspan="2">Stage</th><th rowspan="2">Southern England</th><th colspan="3">Norfolk (Peake and Hancock, 1961, 1970)</th><th rowspan="2">Norfolk
(Johansen and Surlyk, 1990)</th><th colspan="2" rowspan="2">Norfolk
(Christensen, 1995, 1999)</th></tr>
<tr><th></th><th>Belemnites</th><th>Echinoids</th></tr>
<tr><td rowspan="10">Maastrichtian</td><td rowspan="2">Upper</td><td rowspan="17">Not represented</td><td rowspan="3">Not represented</td><td>Belemnella kazimiroviensis</td><td rowspan="3">Not represented</td><td rowspan="3"></td><td rowspan="3">Not represented</td><td rowspan="3">Belemnella</td></tr>
<tr><td>Belemnitella junior</td></tr>
<tr><td rowspan="8">Lower</td><td rowspan="5">Belemnella lichareni</td></tr>
<tr><td>Grey Beds</td><td>Echinocorys aff. limburgica</td><td>Beacon Hill Grey Chalk</td><td rowspan="3"></td><td rowspan="3">Belemnella sumensis</td></tr>
<tr><td>White Chalk with O. lunata</td><td rowspan="2">Echinocorys ciplyensis</td><td>Little Marl Point Chalk Member</td></tr>
<tr><td rowspan="2">Sponge Beds</td><td rowspan="2">Trimingham Sponge Beds Member</td></tr>
<tr><td rowspan="2">Echinocorys belgica</td><td rowspan="4">Belemnitella minor II
[minor III]</td><td rowspan="3">Belemnella obtusa</td></tr>
<tr><td rowspan="2">Porosphaera Beds</td><td rowspan="3">Belemnella lanceolata</td><td rowspan="3">Sidestrand Chalk Member</td></tr>
<tr><td rowspan="2">Echinocorys passage forms</td></tr>
<tr><td>Sidestrand Chalk</td><td rowspan="18">B. pseudobtusa
B. lanceolata</td></tr>
<tr><td rowspan="17">Campanian</td><td rowspan="16">Upper</td><td rowspan="2">Paramoudra Chalk</td><td rowspan="4">Belemnitella langei dominant</td><td>Echinocorys pyramidata Portlock</td><td rowspan="2">Paramoudra Chalk Member</td><td rowspan="2">Belemnitella minor II</td></tr>
<tr><td>?</td></tr>
<tr><td rowspan="3">Beeston Chalk</td><td>Echinocorys conoidea
Galerites roemeri-abbreviatus</td><td rowspan="3">Beeston Chalk Member</td><td rowspan="4">Belemnitella minor I</td></tr>
<tr><td rowspan="2">Echinocorys aff. conoidea
Cardiotaxis ananchytis</td></tr>
<tr><td rowspan="7">Belemnitella mucronata minor and allied forms common</td></tr>
<tr><td>Catton Sponge Bed</td><td>Echinocorys ovata auct.</td><td>Catton Sponge Bed</td></tr>
<tr><td rowspan="3">Weybourne Chalk</td><td rowspan="2">Echinocorys gibba
M. stolleyi</td><td rowspan="3">Weybourne Chalk Member</td><td rowspan="4">Belemnitella woodi</td></tr>
<tr><td rowspan="9">Highest Chalk Isle of Wight and Dorset

Belemnitella mucronata Zone

Base of Zone in Hampshire
-------(2)-------</td></tr>
<tr><td rowspan="2">Echinocorys subglobosa fonticola</td></tr>
<tr><td rowspan="5">Pre-Weybourne Chalk [Eaton Chalk]</td><td rowspan="5">Eaton Chalk Member</td></tr>
<tr><td rowspan="2">Echinocorys subglobosa
C. heberti</td><td rowspan="6">Belemnitella mucronata sensu stricto</td></tr>
<tr><td rowspan="5">Belemnitella mucronata sensu stricto</td></tr>
<tr><td>Echinocorys pyramidata auct. var. quenstedi</td></tr>
<tr><td>Echinocorys marginata approaching subglobosa</td></tr>
<tr><td rowspan="2">Pre-Weybourne Chalk [Basal Mucronata Chalk]</td><td>Echinocorys lamberti</td><td rowspan="3"></td></tr>
<tr><td>Echinocorys lata fastigata</td></tr>
<tr><td>Lower (pars.)</td><td>Gonioteuthis quadrata Zone</td><td>Gonioteuthis Zone</td><td>Gonioteuthis quadrata</td><td>?</td><td></td></tr>
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(Figure 4.5) The 'high' Chalk of Norwich and north Norfolk based on Peake and Hancock (1961, 1970); Wood (1988); Johansen and Surlyk (1990); and Christensen (1995, 1999).