Shipmoor Point–Butterstreet Cove and Tidmoor Point–Fast Fleet Coast, Dorset

[SY 576 836], [SY 585 830], [SY 598 822], [SY 606 814], [SY 608 822], [SY 612 808], [SY 633 799] [SY 643 785]

B.M. Cox and K.N. Page

Introduction

The Shipmoor Point–Butterstreet Cove GCR site, belonging to the Bathonian GCR Block, comprises six separate exposures along the coast of The Fleet in Dorset, together with a nearby disused quarry at Langton Herring. From west to east, the coastal exposures are at and adjacent to Shipmoor Point, Berry Knap, Rodden Hive Point, Langton Hive Point, Herbury and Butterstreet Cove–Tidmoor Point (western side) (Figure 2.5). The continuation of the last named exposure as far as the eastern tip of Tidmoor Point, a shoreline distance of nearly 3 km, comprises the Tidmoor Point–East Fleet Coast site of the Callovian GCR Block. The Fleet is a saline lagoon that is largely protected by Chesil Beach, a major linear pebble and cobble storm feature some 18 km in length extending from the Isle of Portland in the east to near Abbotsbury in the west (Figure 2.5). The oldest strata exposed in the low and degraded cliffs and banks and on the foreshore of The Fleet belong to the uppermost part of the Bathonian Fuller's Earth Formation (Figure 2.6), which crops out in the core of the E-W-trending Weymouth Anticline, a structure first noted by Conybeare and Phillips (1822). The structural crest of the anticline passes approximately due east from Clay Hard Point [SY 605 818] such that younger strata crop out along The Fleet coastline both to the north-west and south-east (House, 1961; (Figure 2.5)).

Description

(1) Shipmoor Point [SY 576 836]

This westernmost part of the GCR site covers the low cliff and foreshore around Shipmoor Point, south of Abbotsbury, where Chester's Hill meets the coast. Lying within the Abbotsbury Swannery Nature Reserve, it extends for *c.* 180 m on the north side of Shipmoor point and *c.* 100 m on the south side. Douglas and Arkell (1928) described the exposure of Cornbrash Formation there as a splendid natural section, and Madfadyen (1970) noted it as showing the thickest development of these beds in England (but see 'Description' (2) *Berry Knap*). The following section is based on that of Page (1988) using the bed numbers of Douglas and Arkell (1928) and Arkell (1947a), as extended (beds 15–18) by Page (1988). Faunal records are based on Douglas and Arkell (1928) and Page (1988).

	Thickness (m)
Cornbrash Formation	
Upper Cornbrash	
18: Sandstone, calcareous, massive to flaggy; occasional burrows and shell fragments	seen to 0.4
17: Sand, muddy; poorly exposed	*c.* 0.4
16: Limestone concretions, irregular, rounded; shell fragments	0.15–0.2
15: Sand, muddy, as Bed 17	*c.* 0.3
14: Limestone, sandy, hard, laminated; *Thalassinoides* burrow-networks on upper surface; scattered sub-vertical burrows and shell fragments; softer, sandy parting at base	0.4
13: Limestone, sandy, hard; forming a 'long-shore platform'; massive network of *Thalassinoides* burrows on upper surface	0.3
12: Marl, sandy, cream-coloured, laminated at top	0.4
11: Limestone, sandy, concretionary; shell fragments	0.3
10: Sand, muddy, pale-buff, or marl	0.35

9: Limestone, sandy, concretionary	*c.* 0.2
8: Marl, sandy, hard, laminated; brachiopods including *Microthyridina siddingtonensis* (Walker); serpulids; fish teeth	0.3
7: Marl, sandy; oysters common; brachiopods including *M. siddingtonensis*	0.6
6: Limestone concretions, sandy, large; brachiopods including *M. siddingtonensis* and *Rhynchonelloidea cerealis* S.S. Buckman	up to 0.2
5: Marl, sandy, rubbly; brachiopods (*M. siddingtonensis*)	0.35
4: Clay and sand, ferruginous	0.35
3: Limestone, sandy, hard; abundant *Thalassinoides* burrows on upper surface; bivalves including *Pholadomya deltoidea* (J. Sowerby)	0.8
Lower Cornbrash	
2: Limestone, rubbly and marly; bivalves including *Ctenostreon rugosum* (Wm Smith), *Gresslya peregrina* (Phillips), *Meleagrinella echinata* (*Wm* Smith), *Pholadomya deltoidea* (J. Sowerby), *P. lirata* (J. Sowerby) and *Radulopecten vagans* (J. de C. Sowerby); brachiopods including *Kallirhynchia yaxleyensis* (Davidson) and *Obovothyris obovata* (J. Sowerby)	1.2
1: Limestone, pinkish, hard, flaggy in part; brachiopods including *Cererithyris intermedia* (J. Sowerby); bivalves including *Meleagrinella echinata* (Wm Smith); echinoids including *Pygurus michelini* Cotteau; and nautiloids including *Paracenoceras truncatum* (J. Sowerby)	0.9
Forest Marble Formation Clay	seen

(2) Berry Knap [SY 585 830]

This part of the site comprises *c.* 170 m of low cliff and foreshore centred on the stunted headland at the western end of Berry Knap. The whole of the Cornbrash Formation is exposed dipping 15° to the north (House, 1989). In recent years, exposure has been better than at Shipmoor Point, despite the latter's reputation (see 'Description' (1)), such that Page (1988) described it as the best and most complete exposure of the Cornbrash Formation known. Douglas and Arkell (1928) and Arkell (1947a) mentioned the section but gave no details other than a brief comparison with that at Shipmoor Point and a record of some additional fossils. Like Shipmoor Point, it also lies within the Abbotsbury Swannery Nature Reserve. The following section is based on that of Page (1989).

	Thickness (m)
Cornbrash Formation	
Upper Cornbrash	
14: Limestone concretions, sandy, rounded but irregularly sized; often with fossiliferous cores of brachiopods including *Microthyridina* cf. *lagenalis* (Schlotheim); bivalves including abundant *Entolium* sp.; rare ammonites including *Macrocephalites* aff. *terebratus* (Phillips)	*c.* 0.1
13: Sand, silty, brownish	*c.* 0.3
12: Sandstone, calcareous, buff to pale-grey; top irregular (?with *Thalassinoides* burrows); passing into concretionary, sandy limestone in basal part	0.4
11: As Bed 13	0.8

10: Limestone, sandy, burrowed, buff to pale-grey; rhynchonellid brachiopods	0.2
9: As Bed 13	0.4
8: Limestone, sandy, buff to pale-grey; undulating surface; brachiopods including *Microthyridina* cf. *siddingtonensis* (Walker)	0.3
7: Sand, silty, flaggy, brownish; burrows	0.8
6: Limestone concretions, sandy, irregularly sized, greyish, in double row; brachiopods including *Microthyridina siddingtonensis*	*c.* 0.4
5: Sand, flaggy; burrows and bivalves including *Liostrea*	1.6
4: Limestone, sandy, buff-coloured, in irregular beds with thin sandy seams; serpulids and burrows	0.7
Lower Cornbrash	
3: Limestone, marly and rubbly, pale-grey to white; small concretionary lumps of micritic and bioclastic limestone in marly matrix rich in shell fragments; bivalves including *Liostrea* sp., *Meleagrinella echinata* (Wm Smith), *Modiolus* sp. and *Pleuromya* sp.; brachiopods including *Kallirhynchia yaxleyensis* (Davidson), *Obovothyris grandobovata* (S.S. Buckman), *O. obovata* J. Sowerby) and *Ornithella classis* Douglas and Arkell; ammonites including *Clydoniceras* ex gr. *discus* (J. Sowerby) and *Homoeoplanulites* sp.	1.45
2: *Intermedia Bed:* Limestone, bioclastic and micritic, flaggy, in up to four courses separated by marl with shell-grit; pale-buff to yellowish or pale-greyish; *Meleagrinella echinata* (Wm Smith) abundant at top; other bivalves, including *Liostrea* and *Pleuromya,* throughout	1.25
1: Limestone, rubbly and marly; similar to Bed 3 but sandy in part and with brachiopods including common *Cererithyris intermedia* (J. Sowerby) and *Kallirhynchia yaxleyensis* (Davidson); bivalves including *Radulopecten* sp., *Liostrea* sp. and *Pleuromya* cf. *uniformis* (J. Sowerby); serpulids	seen to 0.45
Gap in exposure	
Forest Marble Formation	
Clay	seen

(3) Rodden Hive Point [SY 598 822]

This part of the GCR site, spanning *c.* 1 km of coastline, is centred around Rodden Hive Point (Figure 2.5). Between there and Rodden Hive, lumachelles of the oyster *Praeexogyra hebridica* (Forbes) var. *elongata* (Dutertre) totalling *c.* 1.2 m in thickness (the Elongata Beds of the basal Frome Clay Formation) are exposed. They also crop out at Seventeen Acre Point, at the western end of the site, where they are cut by a strike fault (House, 1957). However, the unit is better developed farther east at Langton Hive Point (see 'Description' (4)).

About 90 m east of Rodden Hive Point, exquisitely preserved fossils, notably species of the trigoniid bivalve *Myophorella,* have been washed out on the foreshore. These come from the Wattonensis Beds, which here comprise *c.* 1 m of grey clay immediately underlying the Elongata Beds. As well as trigoniids, the fauna includes the brachiopods *Rhynchonelloidella smithi* (Davidson), *R. smithi* var. *crassa* Muir-Wood and *Rugitela powerstockensis* Muir-Wood, the belemnite *Belemnopsis bessina* (d'Orbigny), other bivalves including arcids, astartids, *Camptonectes, Liostrea undosa* (Phillips), *Modiolus,* nuculaceans and *Thracia,* and crushed or fragmentary ammonites including *Eohecticoceras costatum* (Roemer), *Procerites mirabilis* Arkell and *P. quercinus* (Terquem and Jourdy); the fauna is often encrusted with

serpulids and bryozoans (Cunnington, 1925; Arkell, 1940, 1951–1958; House, 1957, 1989; Callomon and Cope, 1995). Microfossils include ostracods, foraminifera and numerous fish otoliths (Stinton and Torrens, 1968; Torrens, 1969b). Beneath the Wattonensis Beds, there are an estimated *c.* 15 m of poorly exposed grey clays (Fuller's Earth Formation), with white unfossiliferous mudstone nodules in the upper part (House, 1957); these are the oldest strata exposed along the coast of The Fleet.

(4) Langton Hive Point [SY 606 814]

The exposure in the low cliff below the coastguard station at Langton Hive Point shows one of the thickest (5–6 m) and best developments of the oyster lumachelles that characterize the basal beds of the Frome Clay Formation (see also 'Description' (3) Rodden Hive Point). First cited by Damon (1860), the locality has since been noted by Arkell (1933, 1947a), House (1957, 1961, 1989), Torrens (1969b) and Callomon and Cope (1995). The lumachelles, which dip gently to the south, comprise a mass of *Praeexogyra hebridica* (Forbes), particularly the elongate form known as var. *elongata* (Dutertre) (Arkell, 1934; Hudson and Palmer, 1976; (Figure 2.7)), with a little clay matrix. They have been called the 'Elongata Beds' following Arkell (1933). The fossil oyster-shells are often encrusted with foraminifera including *Nubeculinella.* Pectinid bivalves (*Camptonectes* and *Radulopecten*), often fragmentary, are also present, together with crushed rhynchonellid brachiopods.

(5) Herbury [SY 612 808]

Exposures on the shore of The Fleet at the Herbury peninsula show the uppermost part of the Frome Clay Formation overlain by the Forest Marble Formation. The locality is most famous for two brachiopod-rich marker beds in the Forest Marble Formation; the Boueti Bed at its base, and the Digona Bed, estimated by House (1961) to be about 18 m higher.

The Boueti Bed is exposed on the shore at the north-west corner of the peninsula where it overlies *c.* 7 m of Frome Clay Formation. The latter comprises up to *c.* 5 m of grey shale overlain by three courses of micritic limestone, with laminae of very fine bioclastic sand and silt, interbedded with sandy clay (Torrens, 1969b; English Nature unpublished notes). The Boueti Bed itself is a 0.6–0.9 m thick, rubbly, detrital limestone packed with fossils, many of which are encrusted with bryozoans and serpulids. Brachiopods are the most abundant group and include the eponymous *Goniorhynchia boueti* (Davidson), *Avonothyris langtonensis* (Davidson), *Dictyothyris coarctata* (Parkinson) and *Digonella* sp. Other fossils include bivalves (*Arcomytilus asper* (J. Sowerby), *Liostrea ancliffensis* (Cox and Arkell), *Radulopecten vagans* (J. de C. Sowerby) and *Trigonia elongata* J. de C. Sowerby), echinoid, crinoid and ophiuroid fragments, gastropods, serpulids, bryozoans and a rich microfauna including ostracods and foraminifera (Woodward, 1894; Strahan, 1898; Richardson, 1909b; Arkell, 1947a; Sylvester-Bradley, 1948a; House, 1957; Cifelli, 1959; Callomon and Cope, 1995). Torrens (1980b) attributed the specimen of the ammonite *Clydoniceras* (*Delecticeras*) cf. *ptychophorum* (Neumayr) figured by Arkell (1951a) from the Cornbrash Formation of *Langton Herring Quarry* to the Boueti Bed. According to Torrens (1969b) and Callomon and Cope (1995), fossil collecting from the Boueti Bed at Herbury can be spectacular, particularly after storms, but House (1989) described the bed as almost collected out. The overlying beds comprise greenish and brown clay with harder mudstone laminae, and hard, flaggy, ooidal and shelly limestone (Macfadyen, 1970).

The Digona Bed is exposed on the southeastern corner of the peninsula (Sylvester-Bradley, 1957; House, 1961; Holloway, 1981; Torrens, 1969b; Callomon and Cope, 1995). It comprises *c.* 1.5 m of pale-grey and cream-coloured limestone and marl, rich in fossils, particularly brachiopods including the eponymous *Digonella digona* (J. Sowerby), *Avonothyris bradfordensis* (Davidson), *Dictyothyris coarctata* (Parkinson) and *Rhynchonelloidella curvivarians* (S.S. Buckman). Other fossils include ossicles of the crinoid *Apiocrinites* and well-preserved bivalves including *Dacryomya lacrymya* (J. de C. Sowerby), *Oxytoma* cf. *costata* (Townsend), *Palaeonucula waltoni* (Morris and Lycett), *Plagiostoma subcardiiformis* Greppin, *Plicatula fistulosa* Morris and Lycett, *Praeexogyra hebridica* (Forbes), *Radulopecten hemicostata* (Morris and Lycett) and *R.* cf. *vagans* (J. de C. Sowerby), as well as micromorphic gastropods, serpulids, bryozoans and sponges (House, 1961, 1989; Torrens, 1969b; Holloway, 1981). At the base of the Digona Bed, Holloway (1981) reported a hardground encrusted with corals (*Isastraea* and *Thamnasteria*), which were themselves encrusted by *Praeexogyra hebridica* and bored by gastrochaenid or lithophagid bivalves. A loose specimen of the ammonite *Clydoniceras hollandi* (S.S. Buckman) from beneath the outcrop of the Digona Bed at Herbury has been reported by Torrens (1980b). The Digona Bed resting on a hardground has also been reported at Langton Herring Quarry (see

'Description' (6)).

(6) Langton Herring Quarry [SY 608 822]

A former exposure of Forest Marble Formation in a small quarry on the escarpment north of the coastguard station near Langton Herring was cited by Torrens (1968a) based on records made by F.H.A. Engleheart in an unfinished thesis for Oxford University in the 1920s. The quarry, which Torrens (1968a) described as 'now overgrown', exposed the Digona Bed, comprising up to 0.9 m of pale, cream-coloured, detrital limestone full of shell fragments, overlying 2.1 m of massive, somewhat ooidal, fine-grained limestone. A section at the quarry was subsequently recorded by Holloway (1981). As at Herbury (see 'Description' (5)), the Digona Bed rests on a surface bored by lithophagid bivalves and encrusted with oysters including *Liostrea wiltonensis* (Lycett), *Nanogyra crassa* (Wm Smith), *N. nana* (J. Sowerby) and *Praeexogyra hebridica* (Forbes). Beneath this hardground, the limestone, cross-bedded in its upper part, has two generations of cement: an early, radial sparry fringe around ooids and bioclasts, and a secondary, ferroan, void-filler. Torrens (1968a) and Holloway (1981) recorded an extensive faunal list very similar to that for Herbury (see 'Description' (5)); the latter author noted that the quarry was the only exposure of the Digona Bed where the eponymous brachiopod *D. digona* was common.

(7) Butterstreet Cove–Tidmoor Point [SY 633 799] and [SY 643 785]

The easternmost part of the Bathonian GCR site lies in Butterstreet Cove [SY 633 799] and is continued south-eastward by the Callovian GCR site as far as the eastern tip of Tidmoor Point; the boundary between the two sites is taken where the stream, that passes through East Fleet village crosses the shore (Figure 2.5). Within this *c.* 2.8 km stretch of coast, the Cornbrash, Kellaways and Oxford Clay formations are intermittently exposed on the shore or in banks or low cliffs (Blake, 1905; Arkell, 1947a, 1948; Cope, 1969; Macfadyen, 1970; Page, 1988; Chapman, 1997). Parts of the succession may be repeated by small faults.

Three small exposures of the Cornbrash Formation on the eastward-facing flank of Butterstreet Cove were described by Page (1988), who recorded up to 1.7 m of thinly bedded or massive, silty or calcareous sandstones and sandy limestones. The beds are burrowed but generally poorly fossiliferous with only shell fragments and serpulids, although one exposure yielded the ammonite *Macrocephalites.* Calcareous concretions, up to 0.5 m in diameter, are also present.

Passing eastwards on to the south-facing flank of Butterstreet Cove, Page (1988) recorded a small exposure of Kellaways Formation comprising *c.* 0.05 m of thinly bedded, grey, muddy sandstone with abundant bivalves, including *Goniomya literata* (J. Sowerby), *Nanogyra, Pholadomya* and *Pleuromya uniformis* (J. Sowerby), the ammonite *Cadoceras* and a nautiloid, passing down into *c.* 0.25 m of bluish-grey sandy clay with some shell fragments.

Between there and the shore at East Fleet, Page (1988) recorded two further exposures of the Cornbrash Formation. The following section is based on that recorded just west of the East Fleet stream.

	Thickness (m)
Cornbrash Formation	
Upper Cornbrash	
4: Sandstone, calcareous, pale brownish-grey, weathering buff; irregular upper surface; shelly concretions with bivalves including *Pholadomya deltoidea* (J. Sowerby); silty and sandy seam at base	0.2–0.3
3: Sandstone as Bed 4; massive in upper part; thin, irregular bedding in lower part; varied assemblage of trace fossils including *Rhizocorallium;* clusters of shells, often fragmentary, in upper part; 'myid' bivalves (*Pholadomya* and *Pleuromya*) in growth position; ammonites including *Paracadoceras breve* (Blake) on irregular upper surface and *Macrocephalites* cf. *terebratus* (Phillips) near middle	0.45–0.5

2: Limestone, sandy, rubbly/brashy, weathering brown, in sandy matrix with wisps of grey mud; calcareous concretions with shelly cores abundant in lower part; bivalves including '*Astarte*', *Chlamys* and *Pholadomya deltoidea* (J. Sowerby); passing down into	*c.* 0.5
1: Sandstone, calcareous, weathering buff, heavily burrowed; occasional serpulids; and bivalves including *Goniomya literata* (J. Sowerby)	seen up to 0.2

Southwards from East Fleet, the Kellaways Formation and lower part of the Oxford Clay Formation have been reported but the exposures are so shallow and intermittent that only the crudest succession can be inferred (Callomon and Cope, 1995). The Kellaways Clay Member of the Kellaways Formation crops out near the small headland to the south of East Fleet where Page (1988) reported traces of a bed crossing the shore that contained large septarian limestone concretions; large body chambers of the ammonite *Proplanulites* have also been recorded (Arkell, 1948; Cope, 1969; Callomon and Cope, 1995). Farther south on the shore, sandy shales with the oyster *Gryphaea dilobotes* Duff, possibly representing the Kellaways Sand Member of the Kellaways Formation, were reported by Arkell (1948) although not seen by Page (1988). Between there and Chickerell Hive Point (see (Figure 2.5)), the latter author reported an exposure of *c.* 1 m of grey clay with large septarian concretions occasionally containing the ammonite *Kosmoceras jason* (Reinecke); these Oxford Clay Formation beds had previously been seen by Arkell (1948) and noted by subsequent authors (e.g. Cope, 1969).

Higher levels of the Oxford Clay Formation are exposed along the shore on the north-east side of Chickerell Hive Point, where bituminous shales with some layers of large septarian concretions up to 0.6 m in diameter have been reported together with the ammonites *Kosmoceras castor* (Reinecke) and *Kosmoceras grossouvrei* Douvillé, and in the hay on the west side of Tidmoor Point where shales with *Kosmoceras transitionis* Nikitin have been recorded (Arkell, 1948; Cope, 1969; Callomon and Cope, 1995).

The banks of Tidmoor Point itself expose slipped grey clays with occasional pale phosphatic and calcareous nodules, typically comprising ammonite body chambers. Clays on the flat foreshore have yielded countless small pyritic and limonitic ammonites of the genera *Alligaticeras, Distichoceras, Euaspidoceras, Grossouvria, Hecticoceras, Kosmoceras, Pachyceras, Paralcidia, Peltoceras* and *Quenstedtoceras,* but these are not now found in such abundance, even after winter storms, and no succession can be made out easily (Chapman, 1997). Belemnites, including common *Hibolithes hastatus* de Montfort and *?Lagonibelus,* nautiloids (*Paracenoceras*), pyritized bivalves (*Grammatodon* and *Nuculana*) and gastropods (*Proceritbium*), and penta-crinoid stem fragments are also common.

East of Tidmoor Point, and beyond the eastern boundary of the GCR site, younger (Oxfordian) beds of the Oxford Clay Formation crop out but are commonly heavily obscured by seaweed (Callomon and Cope, 1995; Chapman, 1997, 1999).

Interpretation

The small and discontinuous nature of the exposures along The Fleet coastline and general lack of useful borehole data in the Weymouth Anticline as a whole has meant that previously published formational thicknesses for the Middle Jurassic succession have largely been crude estimates. The values shown in (Figure 2.6) are based on those given on the latest edition of the 1:50 000 geological map (British Geological Survey, 2000), which are based on deep borehole data (C.R. Bristow, pers. comm.) and the BGS Seabarn Farm Borehole [SY 6263 8054] (Whittaker *et al.,* 1985; Hamblin *et al.,* 1992). Some of the thicknesses, notably those of the Frome Clay and Forest Marble formations, are substantially greater than previous estimates.

Frome Clay Formation

Up until the 1980s, the beds now classified as the Frome Clay Formation were referred to as 'Upper Fuller's Earth Clay' (e.g. Torrens, 1969b, 1980b; Holloway, 1981, 1983) but since then, the consensus view has increasingly favoured use of the former term following Penn and Wyatt (1979) (see Watton Cliff GCR site report, this volume, for discussion). At

Watton Cliff, the basal stratum of the Frome Clay Formation is the Wattonensis Beds (Kellaway and Wilson, 1941), which there comprise *c.* 8 m of alternating clays and thin limestones with a rich and varied fauna dominated by brachiopods including the eponymous *Rhynchonelloidella wattonensis* Muir-Wood and *Wattonithyris wattonensis* Muir-Wood. Within the Shipmoor Point–Butterstreet Cove GCR site area, almost all authors have recognized the Wattonensis Beds as the *c. 1* m of clay yielding exquisitely preserved fossils that underlies the Elongata Beds at *Rodden Hive Point* (see 'Description' (3)). However, House (1989) preferred only to infer possible equivalence to the Wattonensis Beds, noting the absence at *Rodden Hive Point* of the brachiopod *Wattonithyris.* Some earlier authors had thought the clay belonged to the Kellaways Formation (e.g. Arkell, 1932) or the Oxford Clay Formation (e.g. Cunnington, 1925), but Arkell (1940) corrected these interpretations after seeing in-situ material in excavations made beneath the Elongata Beds. The ammonites recorded from the Wattonensis Beds at *Rodden Hive Point* (e.g. Callomon and Cope, 1995) indicate the Upper Bathonian Retrocostatum Zone, Quercinus Subzone (Page, 1996a).

When first noted and figured by Damon (1860) and later cited by other authors (e.g. Woodward, 1894; Buckman, 1922a), the characteristic elongate oyster (*Praeexogyra hebridica* var. *elongata*) of the Elongata Beds, which are seen at both Rodden Hive Point and Langton Hive Point (see 'descriptions' (3) and (4)), was identified incorrectly as *Ostrea acuminata* J. Sowerby. The latter species occurs in the underlying Fuller's Earth Formation where, farther north, it gives its name to a marker bed(s) (see (Figure 3.4), Chapter 3). The oyster lumachelles that constitute the Elongata Beds, although quite widely distributed, show considerable variation in thickness (see, for example, 'descriptions' (3) Rodden Hive Point and (4) Langton Hive Point) and, in places within the area of the Weymouth Anticline, may thin out altogether (House, 1957). Some authors have not adopted Arkell's (1933) name, as endorsed by Torrens (1980b), for this stratum, but instead have used the term Ilebridica Beds' (e.g. House, 1989) or 'Oyster Beds' (e.g. Callomon and Cope, 1995).

Forest Marble Formation

The richly fossiliferous Boueti Bed provides a widespread marker bed at the base of the Forest Marble Formation from the Weymouth Anticline to nearly as far north as the Mendip Hills (see also Watton Cliff GCR site report, this volume). Brachiopods, in particular the eponymous *Goniorhynchia boueti* (Davidson), are more abundant at Herbury (the type locality of the latter species) than at Watton Cliff. Arkell (1933) noted that the Boueti Bed at Herbury had supplied nearly enough rhynchonellids and terebratulids to pave the beach. The morphological variation of a random *G. boueti* population from there was assessed by Aitken and McKerrow (1948) and Blundell (1948) whose statistical studies of external morphology indicated that all of the morphological variants, however extreme, belonged to a single homogenetic community. De la Beche (1846) regarded the fauna as suggestive of the Bradford Clay of Wiltshire, and Woodward (1894) and later authors (e.g. Richardson, 1909b; Arkell, 1947a) endorsed this correlation. However, Sylvester-Bradley (1957) thought instead that the Bradford Clay might correlate with his newly named 'Digona Bed', the higher brachiopod marker bed in the Forest Marble Formation at Herbury but which cannot be recognized at Watton Cliff (see GCR site report, this volume). Torrens (1969b) subsequently correlated the Boueti Bed with the Twinhoe Ironshot of the Great Oolite Formation, which underlies the Forest Marble Formation in the Bath area (see (Figure 2.4) and Hinton Hill GCR site report, this volume). However, the discovery that, in the latter area, faunas of Bradford Clay aspect occur at a number of horizons, especially at the base of and directly above the Upper Rags Member of the Forest Marble Formation (Green and Donovan, 1969; Cave, 1977; Penn and Wyatt, 1979) has led to the current view that the Boueti Bed correlates with the basal shell-bed of the Upper Rags Member, and that the Digona Bed correlates with the Bradford Clay of Bradford-on-Avon (see Gripwood Quarry GCR site report, this volume; Penn, 1982; see also (Figure 2.4)). The ammonite *Clydoniceras hollandi* (S.S. Buckman) reported loose from below the outcrop of the Digona Bed at *Herbury* (Torrens, 1980b) indicates the Upper Bathonian Discus Zone, Hollandi Subzone (Page, 1996a). The poorly preserved *Clydoniceras* (*Delecticeras*) cf. *ptychophorum* (Neumayr) alleged to come from the Boueti Bed (see 'Description' (5) Herbury) may indicate the underlying Retrocostatum Zone and Subzone but this is not certain (Torrens, 1980b; Page, 1996a).

Cornbrash Formation

The relatively thick development of the Cornbrash Formation seen on The Fleet coast compared with other localities in Britain led Page (1989), in his stratigraphical revision of the English Lower Callovian strata, to propose addition of the

geographical epithet Abbotsbury to the formational name. He also formally divided the formation into two members — the Berry Member and the Fleet Member — to replace respectively the Lower and Upper Cornbrash of Douglas and Arkell (1928) and later authors. The section at Berry Knap (see 'Description' (2)), the most complete natural exposure of the formation, provided the type locality for both members. However, many authors feel that the two members cannot be distinguished on lithological criteria alone and have preferred to continue using the traditional terms Lower and Upper Cornbrash, of respectively Bathonian and Callovian age, within an unqualified Cornbrash Formation. The mollusc and brachiopod fauna of Bed 3 at Berry Knap is characteristic of the terminal Bathonian times (*Clydoniceras hochstetteri* Biohorizon, Discus Zone and Subzone; Page, 1996a). Stratigraphically important taxa include the ammonites *Clydoniceras* ex gr. *discus* (J. Sowerby) and *Homoeoplanulites* sp., and the brachiopod *Obovothyris obovata* (J. Sowerby).

The brachiopod *Microthyridina siddingtonensis* (Walker) in beds 5–8 at *Shipmoor Point* and in beds 6 and 8 at *Berry Knap* indicates the *siddingtonensis* Biozone of Douglas and Arkell (1928) and therefore the Lower Cabo-vian Herveyi Zone, Keppleri Subzone (Page, 1989). Confirmatory in-situ ammonite evidence is not yet available in the area but specimens of *Macrocephalites* cf. *jacquoti Douvillé* and *M.* cf. *verus* S.S. Buckman found loose near East Fleet (Page, 1988) also indicate the Keppleri Subzone. *Microthyridina* cf. *lagenalis* (Schlotheim) and *Macrocephalites* aff. *terebratus* (Phillips) from near the top of the section at *Berry Knap* suggest the next youngest Terebratus Subzone (Page, 1988, 1989). Similar levels near East Fleet have yielded the ammonite *Paracadoceras breve* (Blake), including its holotype (Blake, 1905); this is the only confirmed occurrence of this Arctic genus in Britain (Callomon, 1985b; Page, 1988, 1989).

Kellaways Formation

Following the loss of the former exposure at Putton Lane Brickpit (Arkell, 1947a, 1948; Macfadyen, 1970), only traces of the overlying Kellaways Formation remain visible in The Fleet area. The large *Proplanulites* body chambers recorded from the Kellaways Clay Member in Butterstreet Cove have been identified as *Proplanulites* cf. *majesticus* S.S. Buckman, suggesting the Gowerianus Subzone of the Koenigi Zone (Arkell, 1948; Page, 1988). Similar *Proplanulites,* with keppleritid ammonites including *Kepplerites* (*Gowericeras*)*metorchus* S.S. Buckman and septaria, from the former Putton Lane Brickpit provide supporting evidence for the lower part of the Koenigi Zone. There are no specific records of younger levels of the Kellaways Clay Member on the shores of The Fleet but the next youngest Curtilobus Subzone of the Koenigi Zone is indicated locally by calcareous nodules simply labelled 'Weymouth', which have yielded the holotype of *Kepplerites* (*Gowericeras*)*dorsetensis* Tintant, and the Calloviense Zone and Subzone were formerly seen at Putton Lane Brickpit (Arkell, 1933, 1947a, 1948). The diagnostic ammonite fauna of the latter, as re-determined by Page (1988), includes *Sigaloceras* (*S.*) *calloviense* (J. Sowerby), *Proplanulites* ex gr. *crassicostatus/ petrosus* S.S. Buckman, *Cadoceras sublaeve* (J. Sowerby), *Macrocephalites* sp. and *Reineckeia* cf. *britannica* Zeiss; *Oxytomarich* nodules are also present. *Macrocephalites* and *Reineckeia* are genera having southern affinities and are generally very rare or absent at equivalent levels elsewhere in Britain. Indeed, examination of old museum collections suggests that the Kella-ways Formation in The Fleet area may contain faunas unknown elsewhere in Britain. The overlying Kellaways Sand Member appears to be very thin in The Fleet area. In fact, as the Kellaways Clay Member itself normally includes some sandy and silty lithologies in which the 'muddy sandstone' at Putton Lane Brickpit (Arkell, 1947a, 1948; Page, 1988) and 'sandy shale' on The Fleet shore could be accommodated, it may be that the whole of the Kellaways Formation here can be assigned to that member (e.g. British Geological Survey, 2000). The ammonite fauna includes taxa with southern affinities that are generally very rare or absent at equivalent levels in Britain; for example, *Macrocephalites* and *Reineckeia* in the Calloviense Zone.

Oxford Clay Formation

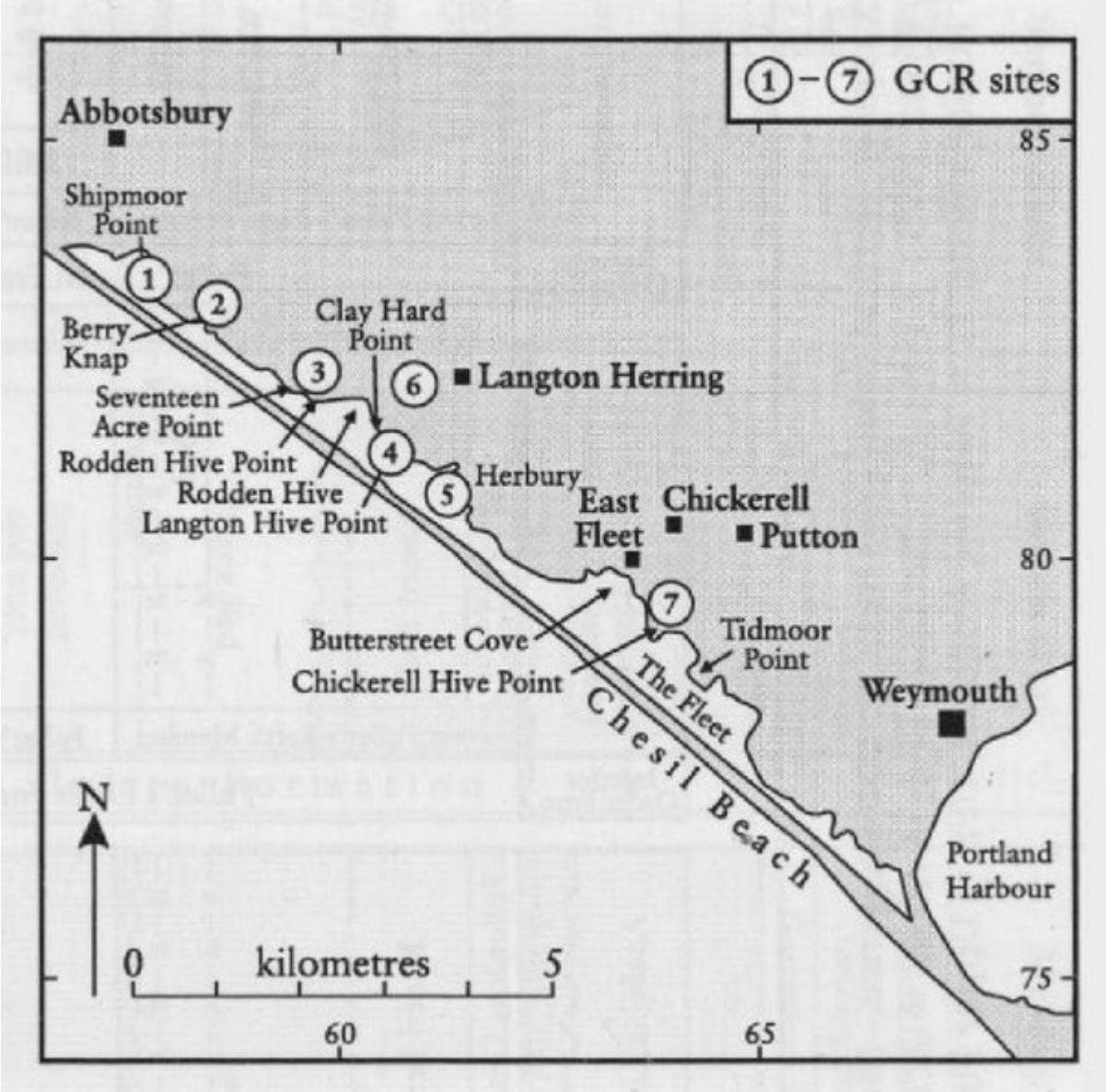
The Oxford Clay Formation straddles the Callovian and Oxfordian stages but the Callovian part is nowhere continuously exposed in the Weymouth area. The lowest beds (Calloviense to Jason zones), including a basal layer of large septarian concretions, were formerly exposed at the Putton Lane Brickpit (Arkell, 1947a). On the shores of The Fleet, a dark grey, pyritic septarian concretion yielding *Sigaloceras* (*Catasigaloceras*) cf. *anterior* (Brinkmann), *Cadoceras* sp. and *Macrocephalites* ex gr. *tumidus* (Reinecke) found loose in Butterstreet Cove near East Fleet (Page, 1988) may come from this level; the ammonite assemblage indicates the Calloviense Zone, Enodatum Subzone. The patchy exposures

reported above on the north-east side of Chickerell Hive Point and in the bay on the west side of Tidmoor Point show slightly higher levels of the Oxford Clay Formation Peterborough Member (Jason to Athleta zones); these are or have been better exposed in the nearby Crookhill Brickpit, (see GCR site report, this volume). The clays exposed on the western banks of Tidmoor Point belong to the overlying Stewartby Member, which, in this area, cannot be distinguished on lithological grounds alone from the overlying Weymouth Member. The latter, of Oxfordian age, can be seen to the east of Tidmoor Point and at Ham Cliff (see GCR site report, this volume) (Chapman, 1999). The prolific pyritic ammonite fauna that the clays at Tidmoor Point have yielded led Arkell (1947a) to describe it as one of the most celebrated fossil localities in England. Although many type specimens almost certainly come from here, it is possible that some specimens came instead from some now obliterated brickpit, from Radipole Backwater or from Weymouth Pottery, as the preservation of many old museum specimens is not absolutely typical of material from Tidmoor Point. Ammonite specimens from the latter are mainly nuclei or inner whorls. Identified taxa have been listed by Spath (1933) and Arkell (1947a); according to Page (herein), these include *Quenstedtoceras* ex gr. *lamberti* (J. Sowerby) (possibly including the type specimen of the species), *Q. leachii* (J. Sowerby) (including the neotype figured by Arkell 1947a, pl. 2, fig. 6), *Q.* cf. *brasili Douvillé*, *Kosmoceras* (*K.*) ex gr. *spinosum* (J. de C. Sowerby) (including possible topotypes and maybe the holotype of *K. tidmoorense* Arkell), *Hecticoceras* (*Putealiceras*) ex gr. *puteale* (Leckenby), *H.* (*Lunuloceras*) sp., *Paralcidia* sp., *Euaspidoceras hirsutum* Bayle, *Alligaticeras* (*A.*) aff. *alligatum* (Leckenby), *Grossouvria* (*Poculisphinctes*) aff. *poculum* (Leckenby), *G.* (*?G.*) *trina* (S.S. Buckman), *Peltoceras* (*Peltomorphites*) spp. including *P. subtense* (*Leckenby*), *Distichoceras bicostatum* (Stahl) and *Pachyceras lalandeanum* (d'Orbigny). The bulk of this fauna belongs to the Upper Callovian Lamberti Zone with evidence of both the Henrici and Lamberti sub-zones, but late Athleta Zone (Spinosum Sub-zone) faunas could also be represented. Thus, although Tidmoor Point remains a classic locality of historical interest, Arkell's (1947a) remark that 'for the classification of the Oxford Clay in north-west Europe the importance of this locality could hardly be over-estimated' is now an over-statement because the fauna is stratigraphically mixed, *ex situ,* and no succession can be deduced. Other localities in Yorkshire (see Chapter 5), central England (see Chapter 4), Dorset (see Ham Cliff GCR site report, this volume) and elsewhere in Europe have since provided measurable sections and in-situ stratigraphical and palaeontological information at this level.

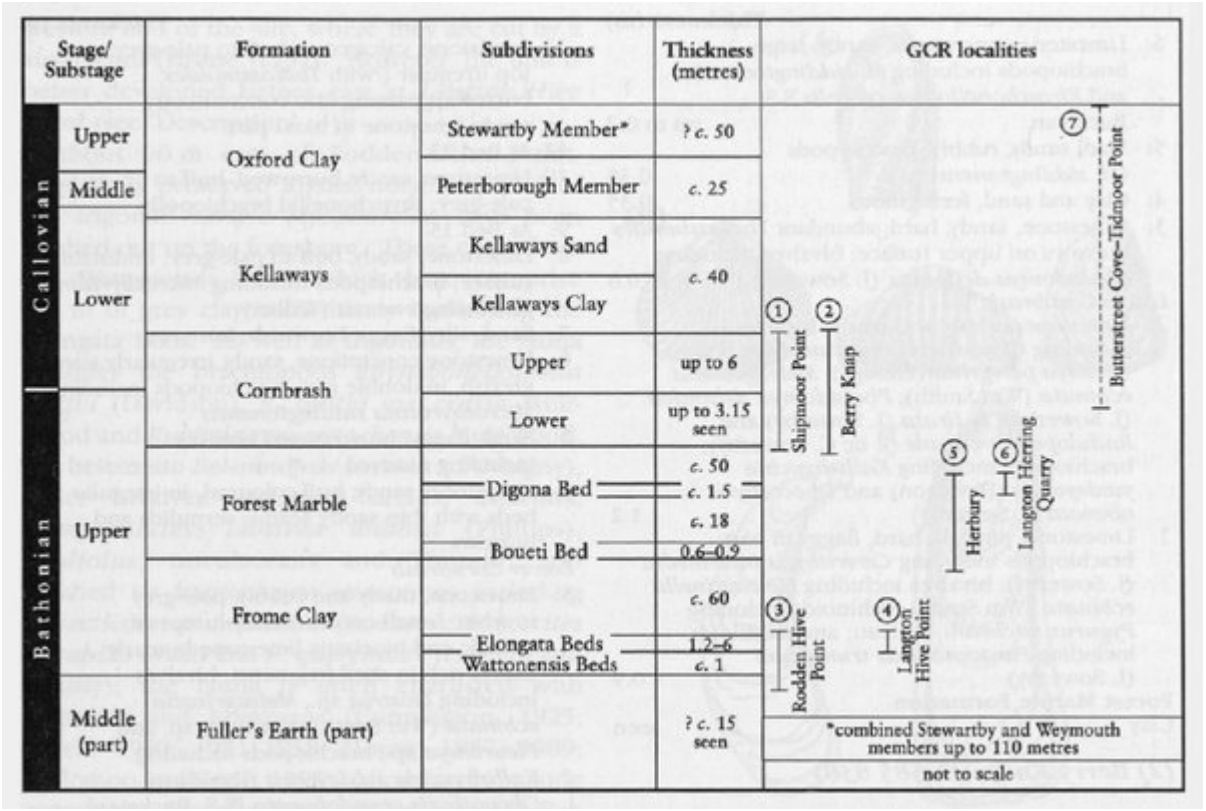
Conclusions

The exposures along the coast of The Fleet provide a cross-section through the E–W-trending geological structure known as the 'Weymouth Anticline', and have had a long history of investigation. Although much of the coastline is devel oped as scenically unattractive low clay banks and cliffs, and exposed sections are often short and scruffy, a discontinuous sequence through the upper part of the Bathonian Stage (uppermost Fuller's Earth Formation to Cornbrash Formation) and the entire Callovian Stage (Cornbrash, Kellaways and Oxford Clay formations) is recognized here. The site includes an important Bathonian–Callovian stage boundary section within the Cornbrash Formation, as well as the proposed type locality of the latter. Many beds are highly, sometimes uniquely, fossiliferous and they have yielded a number of type specimens including ammonites of international importance. The site thus has stratigraphical and palaeontological significance at a regional, national and international level.

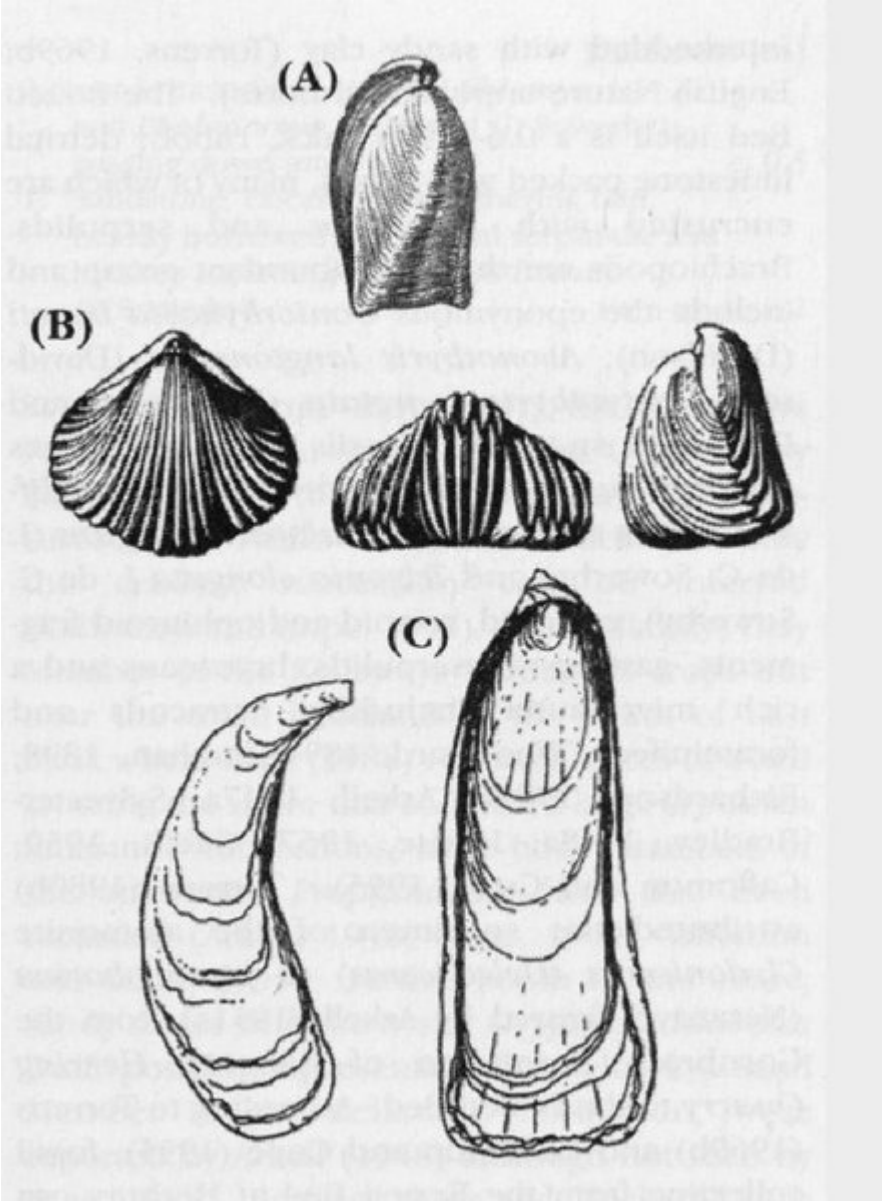
References



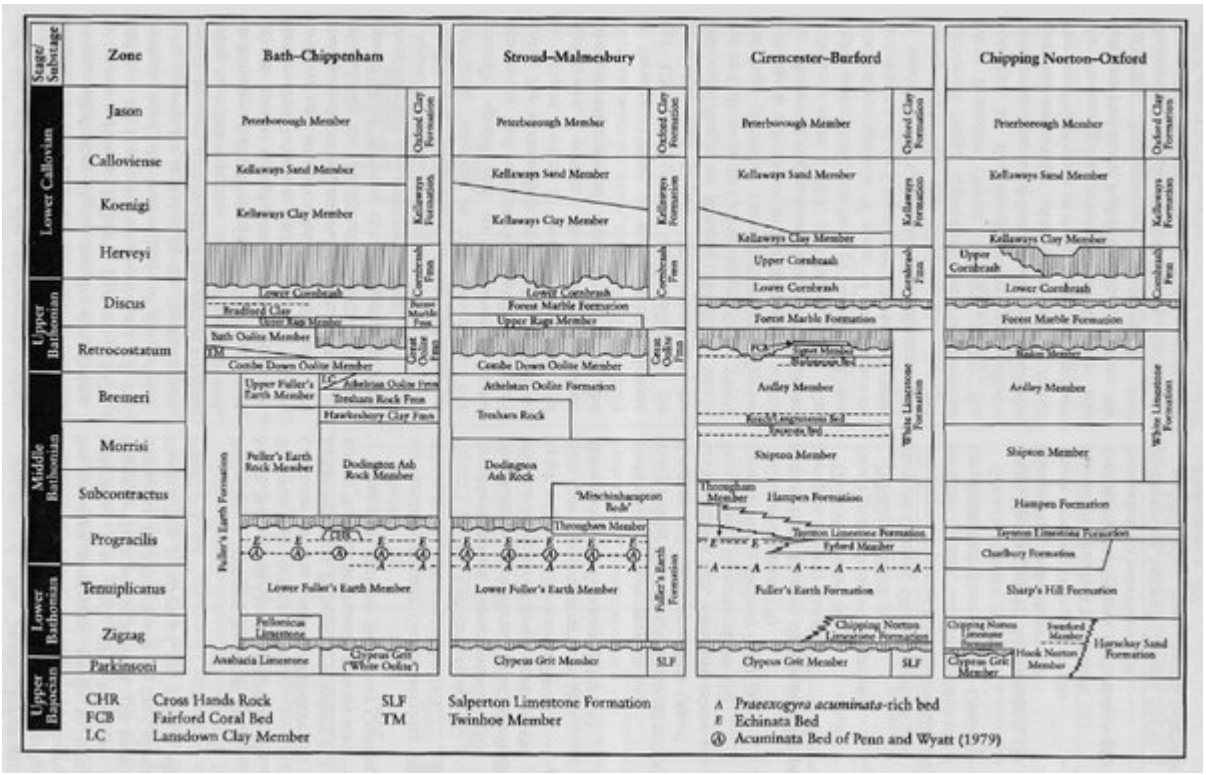
(Figure 2.5) Sketch map showing the position of the seven localities that comprise the Shipmoor Point–Butterstreet Cove and Tidmoor Point–East Fleet Coast GCR sites. (1) Shipmoor Point; (2) Berry Knap; (3) Rodden Hive Point; (4) Langton Hive Point; (5) Herbury; (6) Langton Herring Quarry; (7) Butterstreet Cove–Tidmoor Point.)



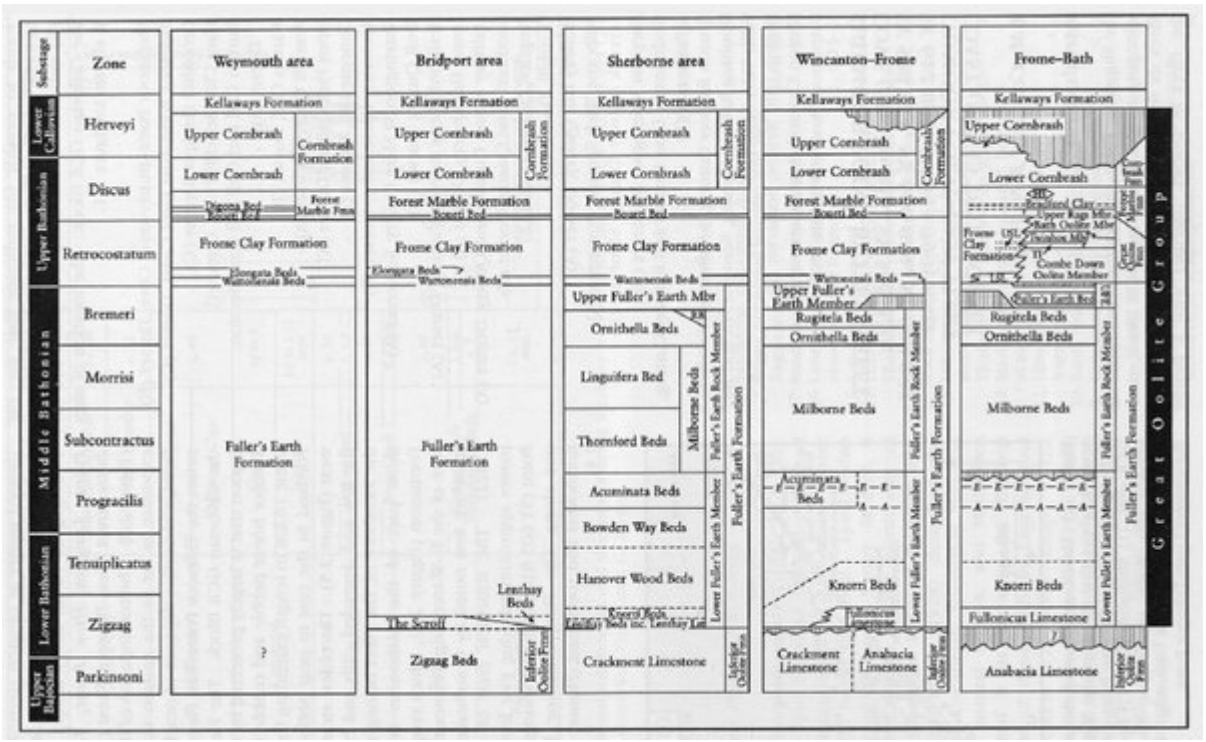
(Figure 2.6) Stratal subdivisions and thicknesses at the localities within the Shipmoor Point–Butterstreet Cove and Tidmoor Point–East Fleet Coast GCR sites.)



(Figure 2.7) (A) Digonella digona (J. Sowerby); (B) Goniorhynchia boueti (Davidson); (C) Praeexogyra hebridica (Forbes) var. elongata (Dutertre). (Reproduced from Damon, 1860, fig. 4; and Arkell, 1947a, fig. 3.) All specimens are natural size.)



(Figure 3.4) Lithostratigraphical classification of the Great Oolite Group and overlying beds in the Cotswold area. Columns are deliberately separated one from the other because the nomenclature as used in different areas is in need of rationalization. Vertical ruling indicates non-sequence. (Based on data in Cave, 1977; Horton et al., 1987; Page, 1989, 1996a; Sumbler et al., 2000; Wyatt in Sumbler, 1996; and herein.))



(Figure 2.4) Lithostratigraphical classification of the Great Oolite Group in the Wessex region. Vertical ruled lines indicate non-sequence. (Based on data in Penn and Wyatt, 1979; Torrens, 1980b; Page, 1989, 1996a; Bristow et al., 1995, 1999; and Wyatt, 1998.) (-E-E-E-E- = Echinata Bed; -A-A-A-A- = Acuminata Bed of Penn and Wyatt (1979); HS = Hinton Sand Member; LSL = Lower Smithi Limestone; RB = Rugitela Beds; TI = Twinhoe Ironshot; UFE = Upper Fuller's Earth Member; USL = Upper Smithi Limestone.))