Hordle Cliff, Hampshire

[SZ 254 925]–[SZ 270 921]

Introduction

Hordle Cliff has produced one of the richest early Late Eocene (early Priabonian) mammalian faunas in Europe, belonging to the Headonian European Land Mammal Age. Other taxa, for example turtles, crocodilians, lizards, snakes and birds, are also well-represented (Benton and Spencer, 1995; Holman, 1996; see Chapter 4). What also makes the site exceptional is the exquisite preservation of fragile bones, especially in the Mammal and Crocodile beds.

The Hordle (formerly Hordwell) Cliff locality (Figure 3.11) exposes a sequence of Late Eocene sediments in the low sea cliffs between Becton Bunny and Milford-on-Sea. The lithostratigraphical units seen here are the Totland Bay Member (formerly known as the 'Lower Headon Beds') and the base of the Colwell Bay Member (formerly known as the 'Middle Headon Beds') of the Headon Hill Formation.

Fossils have been recovered from Hordle Cliff since the 19th century, when Searles Wood and the Marchioness of Hastings made extensive collections of vertebrate material. The Hastings Collection is held at the Natural History Museum, London. Hordle Cliff also has a long history of geological investigation and has been studied by Hastings (1848, 1852, 1853), Tawney and Keeping (1883), Gardner *et al.* (1888), Curry (1958), Cray (1973), Milner *et al.* (1982), Plint (1984), Edwards and Daley (1997) and Hooker (1992). Early accounts of the fossil mammals from Hordle Cliff were published by Wood (1844, 1846), Owen (1848a,b 1857b), Lydekker (1884a, 1885a,b) and Cooper (1926b). Stehlin (1910) provided an overview of the fauna, and he listed 16 species from Hordle Cliff. Further revisions and additions of individual mammals from Hordle Cliff were made by Butler (1946), Simons (1961), Franzen (1968), Hooker (1991a, 2001), Harrison *et al.* (1995), Norris and Harrison (1998a,b) and Hooker and Thomas (2001). Cray (1973) provided an overview of the fauna and revised the non-ungulate 'mammals in some detail. Comprehensive revised faunal lists have been provided by Hooker *et al.* (1980), Collinson and Hooker (1987) and Hooker (1987, 1992).

Description

Since the 19th century, the sedimentary sequence exposed at Hordle Cliff has been successively described by Hastings (1852), Tawney and Keeping (1883), Gardner *et al.* (1888), Cray (1973) and Plint (1984). The most recent account is by Edwards and Daley (1997), from whom the following composite sequence (Table 3.2) is taken in abbreviated form.

The lowest part of the section, seen just east of Becton Bunny, exposes the Mammal Bed, which dips approximately 2.5° to the south-east across the cliff face. The Crocodile Bed is seen as a similar feature higher up in the cliff. The highest beds, the *Limnaea* marl/Rodent bed and associated horizons, occur discontinuously below the gravels capping the cliffs, farther to the east.

The fossil vertebrates have been found mainly in the lbtland Bay Member (Cray, 1973; Milner *et al.,* 1982; Benton and Spencer, 1995, pp. 285–7), although a few occur in the overlying Colwell Bay Member (Hooker *et al.,* 1980). Older specimens in collections bear generalized labels, such as 'Upper Eocene, Hordwell', which do not indicate the horizon more closely, although some are embedded in a characteristic matrix, sometimes with an associated shelly fauna, which often can be used to recognize the Mammal Bed, Crocodile Bed or Rodent Bed. The early accounts of Hastings (1848, 1852, 1853) indicate that most of her finds came from two main horizons, the Mammal Bed and the Rodent Bed, and from a fossiliferous pocket in the Crocodile Bed.

The Rodent Bed consists predominantly of grey clays and marls. It has produced an extensive fauna of rodent jaws, turtle carapace, teeth and bone fragments of crocodiles, snake vertebrae, and teeth and bones of other mammals (Hastings, 1852). Cray (1973) noted occasional rodent teeth and turtle fragments from this horizon and observed that all of the specimens were small and fragmentary and presumably transported and water-sorted.

The Crocodile Bed is composed of an upper, soft, white sandy layer and a lower brownish indurated layer. Fossils from this horizon included crocodile and turtle remains (Hastings, 1852), with spectacular nearly complete crocodile skulls and turtle carapaces.

(Table 3.2) The sedimentary sequence at Hordle Cliff (after Edwards and Daley, 1997)

	Thickness (m)
Colwell Bay Member ('Middle Headon Beds')	
Sand, fine; carbonaceous mottles and streaks (Milford Marine Bed)	seen to 1.25
Totland Bay Member (lower Headon Beds')	
33. Marl, grey-green, weathering rusty, with intercalated lenticular fine-grained sand	0.85
32c. Mud, carbonaceous, weathering pale pinky-grey; shell debris and bone fragments (Rodent bed in part)	0.04
32b. Marl, sandy, pale-green; abundant shell debris and bone fragments; *Lymnaea,* theridomyid teeth (*Limnaea* marl, Rodent bed in part)	0.10
32a. Marl, sandy, pale-green to rusty, to manly sand; scattered shell fragments	0.20
31c. Sand, fine-grained	0.60
31b. Muddy silt, thin bedded, passing up into fine-grained sand	0.80–1.07
31a. Muddy silt, thin bedded with marl and thin black mud intercalations; lenses of *Viviparus lentus, Potamaclis turritissima, Unio solandri,* ostracods; bands of seeds at base (*Limnocarpus* band)	0.40–0.46
30b. Greyish marls and clays, with intercalated fine-grained sand beds	2.80
30a. Muds, thin bedded, with intercalated fine-grained sand, especially near base, with *U. solandri, V. lentus,* seeds of *Stratiotes,* charophytes	c. 2.50
29. Muds; seam of fine-grained sand with *P. turritissima,* basal sand resting on strongly burrowed junction	0.50
28. Sand, fine-grained, pale-brown to purplish; black muds with sand-filled burrows; humic muds at base (Chars bed)	0.50
26. Marl with sand-filled burrows passing down into sandy limestone	0.25–1.12+
25. Sand, medium-fine grained; thin marl near top	0.58
24. Marl, with calcareous mottles	0.75
23. Sand, fine-grained, passing up into muddy silt; black mud lenses in upper part	0.53
22. Mud, silty, blue; carbonate mottles common	0.36
21. Mud, shelly fine-grained sand layers; *Potamomya plana*	0.25
20. Sand, very fine-grained, passing up into mud with carbonate mottles; black mud lenses in upper part	0.28
19/18. Mud, blue carbonate mottles at top; shelly layers; *P. plana, Lymnaea* at base	0.40
17. Limestone; *Lymnaea, Australorbis* (Lymnaean limestone)	0.10
16. Mud, greenish; thin black mud at top, rusty-weathering mudstone; nodules towards base	0.95

15c. Silt, muddy; *P. plana*	0.10–0.20
15b. Sand, very fine-grained or silt; greenish mud bands; calcareous cementation near top; shell bed at base with *P. plana* (Crocodile bed)	1.36
15a. Thin bedded muddy silt and silty mud, brown and black; *P. plana* and seeds	0.32
14. Mud, silty; sand-filled burrows	0.04
13. Sand, medium-grained; shell debris at base (Rolled Bone Bed)	0.20–0.70
12. Muds, mainly very dark-grey, interbedded with layers and lenses of grey medium-grained sand; and sand, medium-grained; lignite layers; plant debris and seeds	0.50–1.90
11. Sand, medium-grained	1.30
10. Mud, silty: in-situ carbonaceous woody roots (Leaf bed)	0.40
9. Mud, blue-green, passing down into sand, fine, bluish mud mottles; muddy silt towards base; V. *lentus,* bones (Mammal bed)	2.50
8. Mud, massive, grey-blue; large rusty-weathering calcareous mudstone nodules near base	1.00
6. Silt or very fine sand, mottled with blue mud	0.15
5. Mud, massive, grey-blue, brown mottles, silty near base	1.70
1–4. Alternations of black and grey muds, some silty or sandy; some levels with rootlets and burrows; *P. plana, Corbicula deperdita*	1.25
Rests conformably on Becton Sand Formation ('Barton Sand')	

The Mammal Bed (Curry 1958; Cray, 1973) yielded fossils from white sand, which also contained abundant remains of shells, and from lower bluish-green sandy clays. Fossils include fishes, crocodiles, turtles, birds and mammal bones, sometimes partly articulated. More recent collecting and sieving of pockets of fossiliferous sediment in the Mammal Bed have yielded thousands of small bones of fishes, reptiles, birds and mammals (Milner *et al.,* 1982; Collinson and Hooker, 1987; Benton and Spencer, 1995; Norris and Harrison, 1998a,b; Hooker, 2001).

Fossil vertebrates also have been found in the Rolled-Bone Bed and above and below the Lower Ironstone Band (Hastings, 1852; Cray, 1973).

Fauna

The extensive faunas from various horizons at Hordle Cliff include molluscs, fishes, some 40 taxa of reptiles (Benton and Spencer, 1995; Holman and Harrison, 1998a,b), birds (see Chapter 4) and over 40 mammals. The list of mammals below is taken from Hooker (1987, 1992), with additions from Hooker (1991a, 2001), Hooker and Weidmann (2000), Hooker and Thomas (2001) and Harrison *et al.* (1995). Letters at the end of a name distinguish occurrences in the mammal bed (M), Crocodile Bed (C) and Rodent Bed (R).

MAMMALIA

Marsupialia

Herpetotheriidae

Amphiperatherium spp. (M, C, R)

Leptictida?

Pseudorhynchocyonidae

Pseudorhynchocyon sp. (M)

Rodentia

Pseudosciuridae

Sciuroides ebrensteinensis Schmidt-Kittler, 1971 (R)

Treposciurus mutabilis Schmidt-Kittler, 1970 (R)

Treposciurus gardneri Hooker, 1991a (M)

Suevosciurus bosmae Hooker, 1991a (M, R)

Tarnomys depereti (Stehlin and Schaub, 1951) (M)

Tarnomys quercyi vectisensis Bosma, 1974 (R)

Theridomyidae

Thalerimys headonensis (Bosma, 1974) (M)

Thalerimys fordi (Bosma and Insole, 1972) (R)

Gliridae

Glamys priscus (Stehlin and Schaub,1951) (M)

Gliravus cf. *daamsi* Bosma and de Bruijn,

1982 (M)

Miniglis minor (Bosma and de Bruijn, 1982) (R)

Lipotyphla

Talpidae

Eotalpa anglica Sigé, Crochet and Insole, 1977 (M)

Amphilemuridae

Gesneropithex grisollensis Louis and Sudre, 1975 (M, R)

Archonta undiff.

Nyctitheriidae

Cryptotopos woodi (Cray, 1973) (M)

Cryptotopos beata Crochet, 1974 (M)

Saturninia gracilis Stehlin, 1941 (R)

Paradoxonycteris tobieni? (Sigé, 1976) (M)

Primates

Adapidae

Leptadapis magnus (Filhol, 1874) (M, R)

Omomyidae

Pseudoloris parvulus (Filhol, 1890b) (M, R)

Microchoerus erinaceus Wood, 1844 (M, C, R)

Microchoerus creechbarrowensis Hooker, 1986 (M/C)

Pantolesta

Pantolestidae

Opsiclaenodon major (Lydekker, 1887) (M, C, R)

Apatotheria

Apatemyidae

Heterohyus sp. 1 (M, R)

Creodonta

Hyaenodontidae

Hyaenodon minor Gervais, 1852 (M/C)

Carnivora

'Miacidae

Paramiacis sp. (M)

Viverravidae

Quercygale angustidens (Filhol, 1872) (M/C)

Artiodactyla

Cebochoeridae

Acotherulum saturninum Gervais, 1850 (R)

Acotherulum pumilum (Stehlin, 1908) (R)

Choeropotamidae

Haplobunodon lydekkeri Stehlin, 1908 (M/C)

Amphirhagatherium edwardsi Hooker and Thomas, 2001 (C)

Rbagatherium valdense Pictet, 1857

Choeropotamus depereti Stehlin, 1908 (WC)

Tapirulus cf. *perrierensis* Sudre, 1978 (R)

Anthracotheriidae

Diplopus aymardi Kovalevskii, 1873b (WC)

Anoplotheriidae

Dacrytherium ovinum (Owen, 1857b) (M/C)

Xiphodontidae

Dichodon cervinus (Owen, 1846) (R)

Dichodon cuspidatus Owen, 1848b (M, C)

Amphimerycidae

Pseudamphimeryx hantonensis Cooper, 1928 (M)

Perissodactyla

Palaeotheriidae

Plagiolophus annectens (Owen, 1848b)(M,

C)

Palaeotherium magnum stehlini Deperet, 1917 (M/C)

Palaeotherium muehlbergi praecursum Franzen, 1968 (WC)

Palaeotherium duvali priscum Franzen, 1968 (M/C)

Pachynolophidae

Anchilophus dumasi (Gervais, 1849) (M/C)

Anchilophus radegondensis gaudini Pictet and Humbert, 1869 (M/C).

The marsupials, species of *Amphiperatherium,* opossum-like forms, are known from jaws with teeth ((Figure 3.12)a). The rodents from Hordle Cliff are important, as a relatively diverse assemblage of 11 species is known. Bosma (1974) and Bosma and de Bruijn (1979, 1982) described several taxa that are unique to the Headon Hill Formation. The species *Treposciurus gardneri* was established by Hooker (1991a) for an upper jaw ((Figure 3.12)b) and a number of isolated teeth from Hordle Cliff, as well as material from Headon Hill and Whitecliff Bay, which Bosma (1974) had ascribed to the French species *T. intermedius.* It differs from this species in being a smaller animal with different patterns of cusps on the molar teeth. The theridomyid *Thalerimys headonensis* also is known from jaw fragments with teeth ((Figure 3.12)c). Collinson and Hooker (2000) reported seeds of the aquatic floating plant *Stratiotes* bearing predation holes from the *Chara* bed (Bed 28 of the Totland Bay Member). The gnaw marks resemble those made today on hazelnuts by wood mice, but according to size they are attributed to one of the glirids (dormice) in the fauna, probably *Glamys.* These are the oldest examples of rodent seed-gnawing yet reported.

The tiny nyctitheres are known from teeth and jaws ((Figure 3.12)d,e), as well as ankle bones ascribed to *Cryptotopos* by Hooker (2001). These ankle bones show that nyctitheres are not primitive shrews as had previously been thought, but stem members of the superorder Archonta, to which primates, treeshrews, colugos and possibly bats belong. The ankle bones also show that nyctitheres could invert their feet, allowing them to climb trees. The pantolestid *Opsiclaenodon major* is represented by jaws and teeth; it was a larger animal, probably semi-aquatic, and may have fed on fish like its relative *Buxolestes* from Messel. The amphilemurid *Gesneropithex grisollensis* is represented by jaws (Hooker, 1986) and a probable ear bone (Norris and Harrison, 1998b), indicating distant relationships with hedgehogs. Hordle Cliff also records the oldest mole (Talpidae), *Eotalpa anglica,* described first from Headon Hill (see GCR site report; Sigé *et al.,* 1977)

Four taxa of primates, three omomyids and one adapid, have been recorded, two of them species that were already known from France. *Microchoerus erinaceus,* a small fruit-eater and browser, was the first mammal to be described from Hordle Cliff (Wood, 1844); it is represented by jaws, cranial fragments and isolated teeth (Cray, 1973; (Figure 3.12)f,g). The tiny related *Pseudoloris parvulus* has been identified from lower jaws similar to the French type specimen. *Leptadapis magnus,* an indri-sized, tree-dwelling, browsing herbivore, also is represented by jaw and tooth material (Cray, 1973; (Figure 3.12)h).

The apatemyid *Heterohyus* sp., based on a single worn molar tooth, was the first apatemyid from Britain when Cray (1973) reported it, although several specimens of this genus were later identified from Creechbarrow Hill and Headon Hill. The hyaenodontid creodont *Hyaenodon* cf. *minor* is known from several jaws and teeth, including a beautiful complete paired lower jaw ((Figure 3.12)i,j). It was a wolf-sized carnivore with powerful carnassial molars for slicing flesh. The true carnivoran, the viverravid *Quercygale angustidens,* was a smaller fox-sized flesh-eater, represented by a single partial skull (Cray, 1973).

The ungulates from Hordle Cliff are diverse, consisting of 12 artiodactyls and six perissodactyls, and they include several taxa unique to the Headon Hill Formation, but the majority belong to taxa reported from France and Germany. The perissodactyls were all medium-sized terrestrial browsing herbivores, whereas *Palaeotherium magnum* was large — one of the largest mammals of its day, about the size and build of a modern tapir. Most of the artiodactyls were more modest in size, most of them terrestrial browsing herbivores, but *Cebochoerus* was a fruit-eater, and the choeropotamids had mixed browsing and fruit-eating diets (Collinson and Hooker, 1987; Hooker and Thomas, 2001). *Pseudamphimeryx* was a tiny leaf-eating ruminant, weighing less than 1 kg. The rare cebochoerid *Acotherulum pumilum* recently was described from the Rodent Bed (Harrison *et al.,* 1995).

Hordle Cliff is the type locality for 10 mammalian species and two subspecies: *Treposciurus gardneri* Hooker, 1991a; *Cryptotopos woodi* (Cray, 1973); *Microchoerus erinaceus* Wood, 1844; *Opsiclaenodon major* (Lydekker, 1887); *Haplobunodon lydekkeri* Stehlin, 1908; *Diplopus aymardi* Kovalevskii, 1873b; *Dactytherium ovinum* (Owen, 1857b); *Dichodon cuspidatus* Owen, 1848b; *Pseudamphimeryx hantonensis* Cooper, 1928; *Plagiolophus annectens* (Owen, 1848b), *Palaeotherium muehlbergi praecursum* Franzen, 1968 and *Palaeotherium duvali priscum* Franzen, 1968.

Interpretation

The Totland Bay Member (previously the 'Lower Headon Beds'), consisting of clays, sands and marls with occasional lignite beds, has been interpreted as a coastal sequence. The sediments represent brackish and freshwater lagoons, distributary-channel and floodplain–lake environments (Hint, 1984) that developed following a major sea-level fall at the end of Mid Eocene times (Hint, 1988). The lagoonal sediments show a trend of decreasing salinity through time, with the eventual removal of any marine influence. Deposition was then dominated by fluvial systems and shallow floodplain lakes. During this time several brackish incursions took place, probably because of the low topography (Plint, 1984).

Analysis of the mammal faunas suggests a more balanced range of body sizes than from the older Creechbarrow Hill fauna (see GCR site report). From ecological diversity analysis, the suggested habitat is open forest or one with glades, but of a less tropical type than Creechbarrow Hill. The arboreal percentage, however, implies a fairly complex structure (Hooker, 1992, p. 500).

The section is dated by using non-marine biostratigraphical indicators. The mammal faunas belong to the Headonian European Land Mammal Age (ELMA) (Bosma, 1974), shared with deposits of the same age on Headon Hill (see GCR site report), and comparisons with equivalents in southern France establish a clear sequence of assemblages immediately following those of the Bartonian Stage at Creechbarrow Hill. Charophytes from the Totland Bay Member, Hordle Cliff, are indicative of the *Gyrogona tuberosa* Zone, which occurs in the Marnes de Verzenay, overlying the marls with *Pholadomya ludensis* (type Ludian local stage) from the Paris Basin. The zone indicates an early Priabonian age mammal.

The Hordle Cliff faunas from the Totland Bay Member are equated with Mammal Paleogene Reference Level MP17 (Schmidt-Kittler, 1987) and belong to the *steblini–depereti* and *nanus–vectisensis* zones, which allow detailed correlation across Europe.

Comparison with other localities

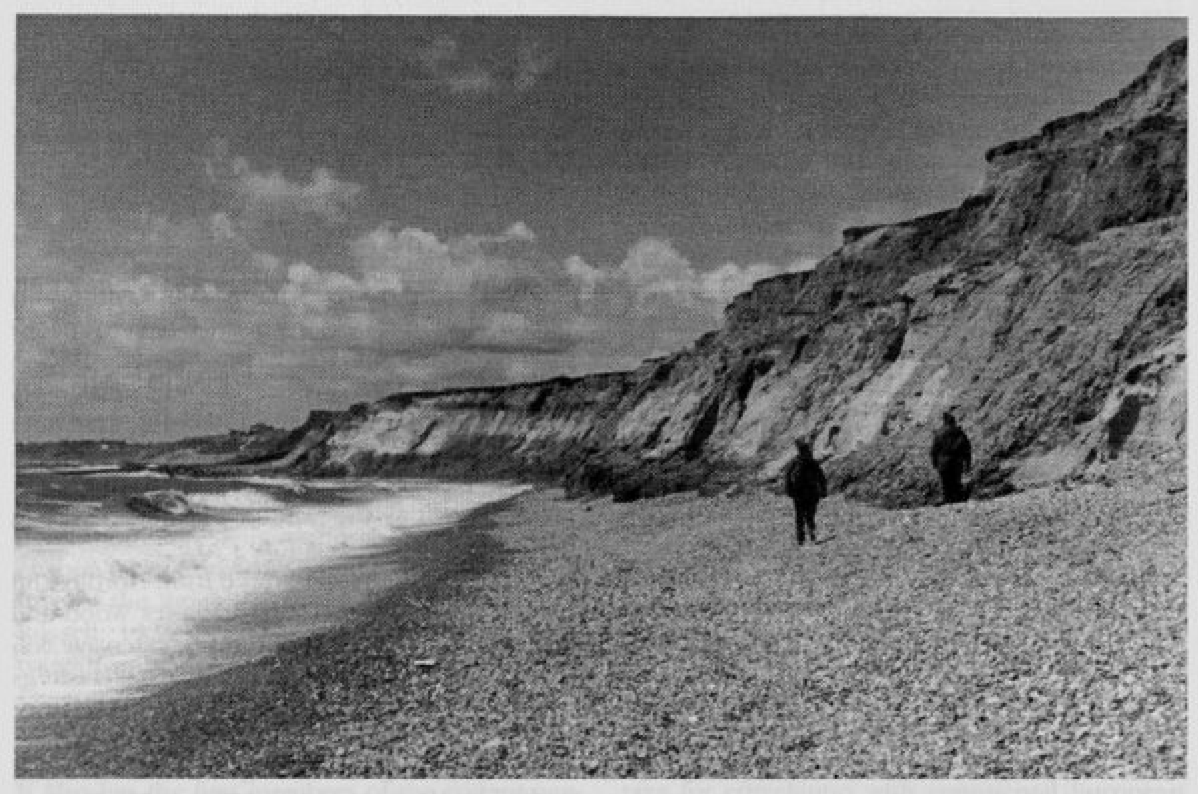
The sedimentary sequence preserved at Hordle Cliff spans in age the lowest two horizons at Headon Hill on the Isle of Wight (see GCR site report), and so the mammalian faunas can be compared (e.g. Hooker, 1987). Although there are many similarities in the faunal compositions of the two sites, the assemblages recorded from Hordle Cliff have a greater proportion of large animals, especially artiodactyls and perissodactyls. Generally the specimens collected at Hordle Cliff are better preserved.

Farther afield, the mammal faunas of the Tolland Bay Member can be compared with those in continental Europe. The classic site of Euzet-les-Bains in southern France has long been recognized as age-equivalent to some of the Hordle Cliff levels (e.g. Savage and Russell, 1983, pp. 104–8). Mammal Paleogene Reference Level MP17 encompasses numerous mammal faunas from sites in continental Europe, including Roc de Santa and Sossis in Spain, Aubrelong 2, La Bouffie, Baby 1, Les Clapies, Fons 1–7, Saleme, Les Pradigues, Les Sorcieres, Perriere, Malperie, Rosieres 5 and Euzet in France, and La Cantine 2 and Lebratieres 1 in Switzerland (Schmidt-Kittler, 1987).

Conclusions

Hordle Cliff is important internationally for having one of the most taxonomically diverse early Late Eocene mammalian faunal suites in Europe. It is the type locality for 10 species and two subspecies of mammal. On a national scale, it has yielded many taxa of Late Eocene mammals, especially artiodactyls, perissodactyls and rodents, whose osteological remains are often exquisitely preserved and provide a wide range of anatomical information. The co-occurrence of diverse non-mammalian faunas and especially of floras (and including the oldest evidence for seed-gnawing by rodents in the world), together with the laterally well-exposed sequence, facilitating sedimentological study, allow for detailed palaeoenvironmental reconstruction. Coastal erosion here means that new material will be continually available for future study.

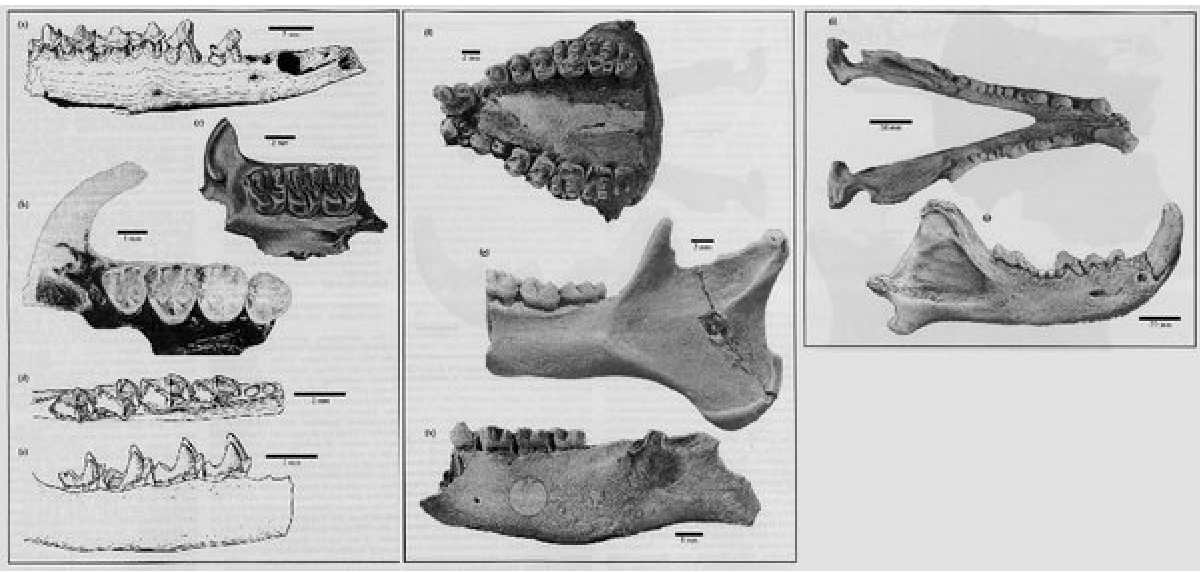
References



(Figure 3.11) Totland Bay Member resting on Becton Sand Formation, Hordle Cliff, looking towards Becton Bunny. (Photo: D.L. Harrison.)

		Thickness (m)
Colwell Bay Member ('Middle Headon Beds')		
	Sand, fine; carbonaceous mottles and streaks (Milford Marine Bed)	seen to 1.25
Totland Bay Member ('Lower Headon Beds')		
33.	Marl, grey-green, weathering rusty, with intercalated lenticular fine-grained sand	0.85
32c.	Mud, carbonaceous, weathering pale pinky-grey; shell debris and bone fragments (Rodent bed in part)	0.04
32b.	Marl, sandy, pale-green; abundant shell debris and bone fragments; *Lymnaea*, theridomyid teeth (*Limnaea* marl, Rodent bed in part)	0.10
32a.	Marl, sandy, pale-green to rusty, to marly sand; scattered shell fragments	0.20
31c.	Sand, fine-grained	0.60
31b.	Muddy silt, thin bedded, passing up into fine-grained sand	0.80–1.07
31a.	Muddy silt, thin bedded with marl and thin black mud intercalations; lenses of *Viviparus lentus*, *Potamaclis turritissima*, *Unio solandri*, ostracods; bands of seeds at base (*Limnocarpus* band)	0.40–0.46
30b.	Greyish marls and clays, with intercalated fine-grained sand beds	2.80
30a.	Muds, thin bedded, with intercalated fine-grained sand, especially near base, with *U. solandri*, *V. lentus*, seeds of *Stratiotes*, charophytes	*c.* 2.50
29.	Muds; seam of fine-grained sand with *P. turritissima*, basal sand resting on strongly burrowed junction	0.50
28.	Sand, fine-grained, pale-brown to purplish; black muds with sand-filled burrows; humic muds at base (Chara bed)	0.50
26.	Marl with sand-filled burrows passing down into sandy limestone	0.25–1.12+
25.	Sand, medium-fine grained; thin marl near top	0.58
24.	Marl, with calcareous mottles	0.75
23.	Sand, fine-grained, passing up into muddy silt; black mud lenses in upper part	0.53
22.	Mud, silty, blue; carbonate mottles common	0.36
21.	Mud, shelly fine-grained sand layers; *Potamomya plana*	0.25
20.	Sand, very fine-grained, passing up into mud with carbonate mottles; black mud lenses in upper part	0.28
19/18.	Mud, blue carbonate mottles at top; shelly layers; *P. plana*, *Lymnaea* at base	0.40
17.	Limestone; *Lymnaea*, *Australorbis* (Lymnaean limestone)	0.10
16.	Mud, greenish; thin black mud at top, rusty-weathering mudstone; nodules towards base	0.95
15c.	Silt, muddy; *P. plana*	0.10–0.20
15b.	Sand, very fine-grained or silt; greenish mud bands; calcareous cementation near top; shell bed at base with *P. plana* (Crocodile bed)	1.36
15a.	Thin bedded muddy silt and silty mud, brown and black; *P. plana* and seeds	0.32
14.	Mud, silty; sand-filled burrows	0.04
13.	Sand, medium-grained; shell debris at base (Rolled Bone Bed)	0.20–0.70
12.	Muds, mainly very dark-grey, interbedded with layers and lenses of grey medium-grained sand; and sand, medium-grained; lignite layers; plant debris and seeds	0.50–1.90
11.	Sand, medium-grained	1.30
10.	Mud, silty: in-situ carbonaceous woody roots (Leaf bed)	0.40
9.	Mud, blue-green, passing down into sand, fine, bluish mud mottles; muddy silt towards base; *V. lentus*, bones (Mammal bed)	2.50
8.	Mud, massive, grey-blue; large rusty-weathering calcareous mudstone nodules near base	1.00
6.	Silt or very fine sand, mottled with blue mud	0.15
5.	Mud, massive, grey-blue, brown mottles, silty near base	1.70
1–4.	Alternations of black and grey muds, some silty or sandy; some levels with rootlets and burrows; *P. plana*, *Corbicula deperdita*	1.25
Rests conformably on Becton Sand Formation ('Barton Sand')		

(Table 3.2) The sedimentary sequence at Hordle Cliff (after Edwards and Daley, 1997)



(Figure 3.12) Fossil mammal specimens from the Totland Bay Member, Headon Hill Formation of Hordle Cliff, Hampshire. (a) Partial right lower jaw of the marsupial Amphiperatherium in external view. (b) Partial maxilla of the rodent Treposciurus gardneri in crown view. (c) Partial maxilla of the rodent Thalerimys headonensis in crown view. (d,e) Partial left lower jaw of the nyctithere Cryptotopos woodi in crown (d) and internal (e) views. (Based on Cray, 1973; Bosma,

1974; Hooker, 1991a.) (f,g) The primate Microchoerus erinaceus, palate and upper dentition (f) and partial left lower jaw in external view (g). (h) Partial left lower jaw of the primate Leptadapis magnus in external view. (Based on Cray, 1973.)(i,j) Complete pair of lower jaws of the creodont Hyaenodon minor in crown (i) and external (j) views. (Based on Cray, 1973.)