Hordle Cliff, Hampshire

[SZ 253 925]–[SZ 287 915]

Highlights

Hordle Cliff has produced one of the richest assemblages of fossil reptiles and mammals from the Late Eocene in the world. The reptiles include nearly 40 species of turtles, crocodilians, lizards and snakes, and the specimens include the original named material of 15 species. New specimens come to light all the time.

Introduction

The Late Eocene (Priabonian) Totland Bay Member of the Headon Hill Formation (formerly the Lower Headon Beds or Headon Member; (Figure 9.2)) exposed at Hordle Cliff (Figure 9.6), a series of low cliffs between Becton Bunny and Milford-on-Sea, have produced an important assemblage of reptiles (Figure 9.7). A recent discovery of abundant squamate remains in the Mammal Bed has greatly enlarged the faunal list, rendering the Hordle herpetofauna equal in terms of diversity to the Late Eocene herpetofaunas of continental Europe. The section is usually masked by a thin covering of talus, and some parts are heavily slipped, but the relevant horizons remain accessible and may easily be cleared. The geology of Hordle Cliff has been described by Hastings (1848, 1852, 1853), Gardner *et al.* (1888), Curry (1958), Cray (1973), Milner *et al.* (1982) and Plint (1984).

The first vertebrate remains reported from the sections of Hordle (or Hordwell) Cliff were described from the extensive collections of Searles Wood and Barbara, Marchioness of Hastings which had been assembled during the late 1840s. These remains, including numerous specimens of mammals, fishes and reptiles (crocodilians, turtles, snakes, lizards), were initially reported by Wood (1844) and Charlesworth (1845). Wood (1846) listed and figured further material from Hordle Cliff, and Hastings (1852, 1853) reported the results of six years' further collecting, listing important finds of mammals, fishes, reptiles and birds. Subsequently, in 1855, the Hastings collection was acquired by the British Museum (Natural History).

The Hordle crocodilians were discussed further by Owen (1848), Pomel (1853), Meyer (1857), Huxley (1859e) and Lydekker (1882b, 1889h). The abundant turtles from Hordle Cliff were described by Owen and Bell (1849), Seeley (1876e), Baur (1889), Lydekker (1889b) and Hooley (1905), and the snake and lizard material was described by Owen (1850), Hastings (1852), Lydekker (1888a, 1888c), Hoffstetter (1942), Sullivan (1979), Rage and Ford (1980), Estes (1983) and Rage (1984).

A recent collection of small tetrapods from Hordle Cliff made between 1976 and 1981, containing numerous new specimens, has greatly expanded the faunal list. The specimens were obtained by Mr Roy Gardner of Fareham from the Mammal Bed, from the same locality which had produced some of the Hastings material. Milner *et al.* (1982) gave reports of the new finds and identified the occurrence of 16 new taxa of lizards and snakes, some of which were previously unknown from the Eocene of the British Isles.

Description

The stratigraphy of the Early Palaeogene rocks at Hordle Cliff has been described by Gardner *et al.* (1888) and Cray (1973). The following section is abridged from Cray (1973, p. 11). All the beds dip gently south-east at about 2.5°.

	Thickness (m)
Totland Bay Member	
('Lower Headon Beds')	
Marl	seen 0.5

Rodent Bed: *Limnaea* Marl with overlying dark clay (=Rodent Bed Marl)	0.25
Unio Beds: grey clays with sandy layers	3.5
Green clays	2.5
Chara Bed: dark clays	1.4
Blue and green clays	2.7
Limnaea Limestone	0.4
13 Ironstone Bed	1.2
12 Crocodile Bed: sands	2.0
11 Rolled-Bone Bed: sand with abraded bones	0.3
10 Clay and sands	1.4
9 (pars) Leaf Bed: carbonaceous clay	1.0
9 (pars) Mammal Bed: clays, sands and sandy clays	3.5
8 Ironstone bed	0.4
7 Clays	1.1
6 Lignites	seen 1.4

The Totland Bay Member (Late Eocene) is included in the zone of the dinofiagellate *Wetzeliella perforata.* At Hordle Cliff the sediments form a series of low cliffs and slipped undercliffs between the east of Barton-on-Sea (just west of Becton Bunny) and Milford-on-Sea. The Mammal Bed, near the base, occurs beneath Plateau Gravel to the west of Becton Bunny, from where it may be traced as a distinct scar obliquely down the cliffs to reach sea-level just east of Long Mead End. Just east of Hordle House the highest unit in the Totland Bay Member, the *Limnaea* Marl and associated horizons, outcrops. The basal Colwell Bay Member ('Middle Headon Beds' (pars)) are represented at Paddy's Gap by the occurrence of the Milford Marine Bed.

As has been established by Cray (1973) and Milner *et al.* (1982), among others, the Hordle reptiles were all found in the Totland Bay Member. The provenance of the early collections, however, is difficult to assess, the locality information provided by Hastings being merely 'Upper Eocene, Hordwell' or, in Lydekker's Catalogue (1888a, 1888b), 'from the Headon Beds of Hordwell'. The matrix on a number of specimens, although sparse, yields ambiguous information and cannot be used to demonstrate provenance with any degree of accuracy. Some of the specimens with adhering greenish-blue sandy clay may have come from the Mammal Bed, but other lithologies are undiagnostic. The accounts of Hastings (1848, 1852, 1853), however, indicate that most of the material came from two main horizons, the Mammal Bed and the Rodent Bed, and also from fossiliferous pockets within the Crocodile Bed.

The Rodent Bed (Hastings Bed 1), consisting predominantly of grey clays and marls, is limited in lateral extent, outcropping just to the east of Hordle House, and extending eastwards for some 275 m before wedging out. To the west the beds are absent, having been removed by recent erosion. The highest horizon of the Rodent Bed consists of clays, tinted pink and heavily altered by percolation from the overlying Plateau Gravel. These clays are underlain by a thin, dark, clayey sand which in turn rests on a comminuted shell bed, the *Limnaea* Marl.

Hastings (1852, p. 194) recorded an extensive vertebrate fauna from the Rodent Bed. The finds may be bracketed with the dark clayey marl on the basis of Hastings' detailed description of the host sediment and mention of the underlying *Limnaea* Marl. In her brief description of the fauna, Hastings (1852) recorded "This band contains much debris, generally very compressed and fragile. You find here small rodent jaws, portions of carapace and a plastron of *Emys,* many teeth and bone fragments of crocodiles, some snake vertebrae, and rarely the teeth and bones of mammals' [translation]. Gardner *et al.* (1888, p. 596) also mention the occurrence of a large fauna from the dark clayey sand, listing 'serpents' vertebrae, rodents' teeth, etc.', but Tawney and Keeping (1883, p. 567), in their detailed stratigraphic account of Hordle Cliff, list only 'serpents' vertebrae' from the *Limnaea* Marl, without mention of the more abundant remains from the beds above.

Cray (1973, pp. 10–12) described the occurrence and preservation of the vertebrates: 'occasional rodent teeth and turtle fragments were recovered from the upper levels of the *Limnaea* marl, and the overlying dark sandy clay has yielded a moderate quantity of small-sized vertebrate debris… This material is always of very small size and evidently represents a

current-sorted accumulation; all the large Headon Beds species are absent. All the specimens are fragmentary and… some of the material is water worn'.

The upper part of the Crocodile Bed is made up of fine, soft, white sands, but the lower layers are composed of more indurated sediments which are brownish in colour. The outcrop lies to the west of Hordle House, where the beds seem to rise from the base of the cliffs, and continue westwards until just west of Long Mead End. Hastings (1852, p. 198) noted crocodilians and the freshwater turtles *Trionyx* and '*Emys'* from the Crocodile Bed. *Diplocynodon hantoniensis,* collected by Wood in 1843 and described by Taylor in 1844, also appears to have come from this bed, in which the remains 'were embedded in the fine siliceous sand of which the freshwater deposit at Hordwell is chiefly composed'.

Hastings observed (1852, p. 197) that abundant shells invariably accompanied the vertebrate remains and recorded that the most richly fossiliferous level lay about 3 ft (*c*. 1 m) from the top of the bed, and that the middle of the outcrop, a little to the west of Hordle House was the most productive locality. Most material from the Crocodile Bed, however, appears to have been derived from isolated lenses rich in vertebrate remains, and such an origin is explicit in the earliest account by Hastings (1848, p. 63): 'the vertebrae and other bones of the Crocodile and *Paloplotherium* were found at intervals of from four inches to three feet apart to the westward of the heads… I must not omit likewise to state, that close to this crocodile's head (the whole group comprising a space of about six feet long by ten inches only in thickness, and following each other nearly in a straight line) were found the nearly entire shell of a fossil *Trionyx…* and the jaw, vertebrae, and scales of a fish of the order *Lepidosteus'.*

The Mammal Bed (*sensu* Curry, 1958; Cray, 1973), bed no. 9 of Tawney and Keeping (1883), and the upper part of bed 15 of Hastings, outcrops from beach level just west of Hordle House, westwards to Becton Bunny. Reptile material, although rare, was reported (Hastings, 1852) as coming from layers of white sand containing abundant remains of shells. Hastings (1852) provided a brief summary of the fauna listing *Trionyx* and *Emys,* fragments of mammal jaws with teeth, fish vertebrae, occasional bones of birds, and some very small jaws, but no crocodiles' [translation]. The better-preserved remains appear to have come from the lowermost part of the Mammal Bed from bluish-green sandy clays, from which Hastings (1852, p. 201) recorded the dissociated remains of crocodilians, *Trionyx* and Seeley (1876e, p. 445) reported the remains of '*Emys'* from a horizon 'about 20 feet below the bed which yields the chief remains of *Crocodilus hastingsiae,* and about 10 feet above the brackish-water Upper Bagshot Beds, which are seen in the cliff rising westward at an angle of 3 degrees at Mead End', and therefore probably from the base of the Mammal Bed. Hastings (1852) also records remains from the next well-defined bed, of whitish brown sand with scattered bands of green clay, the upper half of which contained the same vertebrate material.

The specimens collected recently by Mr Gardner also derive from the Mammal Bed, from the stretch of Hordle Cliff sometimes referred to as Beacon Cliff, between Becton Bunny in the west and Long Mead End in the east (upper part of bed 15 of Hastings, 1852, Bed 9 of Tawney and Keeping, 1883). The material, consisting of many thousands of bones, all of small size, was found in numerous bone-bearing shelly pockets composed of pale-greenish, grey sand differing in some respects from the same level as described by Hastings (1852, p. 200).

Other horizons which have yielded reptile remains include the Rolled-Bone Bed. In 1852 (p. 199), Hastings reported finds of turtles and crocodilians from it. However, most of the specimens are generally highly abraded and cannot be identified precisely.

The Thin Shell Bed above the Lower Ironstone Band has yielded one of the largest collections of reptiles from Hordle. This bed occurs immediately above the ironstone band (numbered 8 in Tawney and Keepings' section), which is usually considered to mark the base of the Mammal Bed. Cray (1973, pp. 17–18), however, regards this unit as distinct on the basis of its mammal fauna, which is similar to that of a bed below the ironstone band. Hastings listed a wide range of taxa: 'You find here an equal quantity of snake and lizard vertebrae, some mammal teeth, rodent jaws, scales and vertebrae of fish, crocodile debris, *Trionyx* and *Emys,* and more rarely larger and better preserved bones including astragalus and carpal bones' [translation]. A similar fauna to the above was mentioned by Hastings as occurring in the thin white sandy marl below the lower Ironstone Band, bed No. 7 of Tawney and Keeping (1883).

Fauna

The Hastings Collection is curated in the BMNH, and other material is held in CAMSM, OUM and YORMS. Repository numbers are only given for type specimens, but an estimate of the total numbers of each species preserved in these major collections is appended.

	Numbers
Testudines: Cryptodira:	
Cheloniidae	
Argillochelys sp	1
Chelone sp.	1
Testudines: Cryptodira:	
Dermatemydidae	
Trachyaspis hantoniensis Lydekker, 1889 Type specimen: BMNH R1443	1
Testudines: Cryptodira:	
Carettochelyidae	
Anosteira anglica Lydekker, 1889 Type specimen: BMNH 33198 y,x	1
Testudines: Cryptodira:	
Trionychidae	
Aulacochelys (Trionyx) circumsulcata (Owen, 1849) Type specimen: BMNH 30404	2
Geoemyda (Nicoria) headonensis (Hooley, 1905) Type specimen: BMNH R1542	2
Geoemyda sp.	1
Trionyx barbarae Owen, 1849 Type specimen BMNH 30409	2
Trionyx bowerbanki Lydekker, 1889	1
Trionyx henrici Owen, 1849 Type specimen: BMNH 30406–7	11
Trionyx incrassatus Owen, 1849 Type specimen: BMNH R1433	5
Trionyx planus Owen, 1849 Type specimen: BMNH 30410,a	2
Trionyx rivosus Owen, 1849 Type specimen BMNH 30405	1
Trionyx sp.	9+
Testudines: Cryptodira:	
Emydidae	
Ocadia crassa (Owen, 1849) Type specimen: CAMSM C20923	6+
Ocadia oweni (Lydekker, 1889) Type specimen: BMNH 36811	3
Ocadia sp.	1
Turtle indet.	100+
Archosauria: Crocodylia: Neosuchia:	
Eusuchia: Alligatoridae	
Crocodilus' sp.	18
Diplocynodon hantoniensis (Wood, 1844) Type specimen: CAMSM ?unnumb.	*c.* 55
Diplocynodon sp.	*c. 30*
Lepidosauria: Squamata:	
Sauria Gekkonid	
Necrosaurus sp.	5+
Ophisaurus sp.	50+
Anguine	5+
Glyptosaurinae *incertae sedis*	3

Plesiolacerta lydekkeri Hoffstetter, 1942 Type specimen: BMNH 32840a	2
Lacertid	5+
Cordylid	50+
Squamata: Amphisbaenia:	
Amphisbaenidae	
Blanus sp.?	5+
Lepidosauria: Squamata: Serpentes	
Eoanilius cf. *E. europae*	1
Paleryx rhombifer Owen, 1850 Type specimen: BMNH 25259	8
Paleryx sp.	3
Cadurcoboa sp.	1
Palaeophis	1
Calamagras sp.	50+
Platyspondylia sp.	1
cf. *Dunnophis*	5+
Vectophis wardi Rage and Ford, 1980	5+

Interpretation

Plint (1984) has interpreted the Hordle succession as representing a coastal environment, including littoral marine, barrier island shoreface, storm washover, and barrier flat, brackish lagoon, distributary channel and floodplain lake environments. The sequence indicates reducing salinity through time, and a transition towards river-dominated sedimentation in shallow flood-plain lakes. Hooker (1992, p. 500) interprets the Hordle Mammal Bed as an open-forest subtropical setting. Wood (1844) and Charlesworth (1845) reported the first turtle finds from Hordle. The most abundant specimens are trionychids (soft-shelled turtles), such as the six species of *Trionyx* ((Figure 9.7)A established by Owen and Bell (1849). These were based on carapace remains, such as complete scutes and fragments bearing characteristic pustulose ornament, which are of limited use in modern taxonomic schemes which rely heavily on cranial characters. Meylan (1987) provides a cladistic classification of extant Trionychidae, but makes little reference to fossil taxa. Lydekker (1889h, pp. 53–4) established the genus *Aulacochelys* on the basis of carapace remains, and assigned *Trionyx circumsulcatus* Owen (1849) to it. However, Baur (1889) argued against this, pointing out that a free border on the costals, used by Lydekker to distinguish *A. circumsulcatus,* in fact occurs widely in the Trionychidae, and hence, that the genus must be regarded as invalid. Another trionychid was named *Geoemyda headonensis* by Hooley (1905), but was regarded as a *nomen vanum* by M■ynarski (1976, p. 82), and was not mentioned by Moody (1980a).

Other turtles from Hordle belong to largely marine groups, typical of most British Tertiary sites (see Sheppey report). *Argillochelys* was a moderate-sized cheloniid with an estimated total length of 200 mm. *Trachyaspis hantoniensis,* a dermatemydid, is based on limited carapace remains showing a distinctive ornament (Lydekker, 1889h, p. 54). *Anosteira anglica,* established by Lydekker (1889h, p. 54) on the basis of carapace remains, is a carettochelyid. Misynarski (1976, p. 73) was uncertain of the systematic position of the species, while Moody (1980a) assigned it to *Allaeochelys. Ocadia crassa* Owen, 1849 ((Figure 9.7)B and *O. oweni* Lydekker, 1889 are emydids, characterized by relatively thin unornamented scutes. The species '*Emys',* widely reported by the early authors, is probably referrable to this genus. M■ynarski (1976) synonymized *O. oweni* with *O. crassa* and is not certain of their true affinities, while Moody (1980a) records both species of *Ocadia* from the Hordle Member.

The first recorded Hordle reptile was a crocodilian, apparently derived from the Crocodile Bed, and named *Alligator hantoniensis* by Wood (1844). The specimen, consisted of 'A great portion of the head… having nearly all the upper range of teeth (42 in number) remaining, along with the humerus, dermal scutae and other parts of the skeleton'. Pomel (1853, p. 383) correctly referred this species to the genus *Diplocynodon* on the basis of sharing with the French *D. ratelii* an expansion of the third lower tooth, which was nearly as much enlarged as the fourth. Meyer represented by jaws and vertebrae, together with a few cranial and appendicular bones, and were the first lizards recognized from Hordle. The

remains were originally referred to the supposed iguanid *'Iguana europeana'* by Lydekker (1888a, 1888c), but were reidentified as lacertid by Hoffstetter (1942), who designated one of the Hordle specimens the holotype of *Plesiolacerta lydekkeri* (Estes, 1983, p. 103). The other material, including vertebrae, was identified by Lydekker (1888a, 1888c) as belonging to the large limbed anguid *Placosaurus.* Sullivan (1979), however, argued that *P. rugosus,* the type species of *Placosaurus,* is indeterminate, but Estes (1983, p. 158) accepts the validity of the genus. Milner *et al.* (1982) refer *Placosaurus* to the anguid subfamily Glyptosaurinae *incertae sedis.* A large cordylid is represented by jaws and vertebrae. The burrowing lizards, the Amphisbaenidae (subfamily Amphisbaeninae), are represented by a vertebra, a maxilla, and some dentaries apparently similar to those of the extant *Blanus.*

The snake vertebrae collected by Wood and Hastings in the late 1840s were described as *Paleryx rhombifer* ((Figure 9.7)E and *Paleryx depressus* by Owen (1850). Rage and Ford (1980) have questioned the validity of these assignments, pointing out that these species, designated on size differences in the vertebrae, are probably synonyms, since comparable modern taxa display similar size variations within a single species. The species *P. depressus* is consequently regarded as a junior synonym of *P. rhombifer* by Rage (1984, p. 20).

In the new collection snake remains are represented by vertebrae, occasional maxillae, palatines, pterygoids and dentaries, but only a few of the remains are suitable for taxonomic discussion. Besides distinctive remains of *Paleryx,* an erycine is the most abundant form present, known from caudal and trunk vertebrae with a complex morphology that most closely resemble those of *Calamagras.* Vertebrae bearing a distinct haemal keel are referred by Milner *et al.* (1982) to cf. *Dunnophis.* However, a haemal keel is unknown in other *Dunnophis* material. Two probable primitive caenophidians are present. The first, bearing tall neural spines on the trunk vertebrae, is referred to *Vectophis wardi.* The second form has a broad neural arch and a reduced neural spine. This may represent a new taxon, since no other comparable material is known. An aniliid is represented by an isolated dorsal vertebra. Several boids can be distinguished from the structure of their middle and posterior trunk vertebrae, and the aquatic snake '*Palaeophis'* is represented by somewhat limited remains of vertebrae, although this is a late record of this genus which should be checked (J.-C. Rage, pers. comm., 1993).

Comparison with other localities

The Totland Bay Member of Hordle Cliff is directly correlated with the top of the same unit (Insole and Daley, 1985) at Headon Hill, Isle of Wight, on the basis of their Late Eocene (Priabonian) mammal fauna and occurrence of calcareous nannoplankton zones NP17 (Barton Clay below) and NP19/20 (Curry *et al.,* 1978). The Hordle fauna includes a range of turtles, snakes, lizards and crocodilians, comparable to the Headon Hill reptiles (see Headon Hill report), however, differences are noted in the range and abundance of the taxa present between the two localities, with the Hordle fauna being at least quantitively different from that at Headon Hill. This may be a local ecological or taphonomic effect (Milner *et al.,* 1982).

The turtles are known from several other Late Palaeocene to Early Oligocene faunas in Britain and in continental Europe (Moody, 1974, 1980a). The fresh-water *Trionyx* and *?Ocadia* and the crocodilian *Diplocynodon hantoniensis* are known from the Cliff End Member (Headon Hill Formation; Late Eocene) at Cliff End on the Isle of Wight ([SZ 332 893]–[SZ 335 895]) (Gamble, 1981, pp. 401–2; Moody, 1980a, pp. 23–4). The Late Eocene trionychids *T. henrici, T marginatus* and *T. incrassatus* are known from the Bembridge Marls Member and *Trionyx* sp. is known from the Lower Hamstead Member (both Hamstead Formation) (Moody, 1980a, pp. 23–4).

Among the squamates, all of the Hordle families are found in the Eocene of France and Germany, and only the lizard families Agamidae and Helodermatidae and the snake family Typhlopidae, present in these successions, are not represented. The lizard *Placosaurus* is recorded from the Late Eocene Phosphorites du Quercy, France and Shara Murun Formation, Mongolia, as well as the Mid Eocene of the Geiseltal, Germany, and other Palaeocene to Oligocene sites in Europe and China (Estes, 1983, pp. 158–63). *Plesiolacerta* is known also from the Late Palaeocene of Dormaal, Belgium, the Late Eocene Phosphorites du Quercy, France and possibly from the Late Palaeocene of Germany (Estes, 1983, pp. 103–4). The snake *Paleryx* is known also from the Mid Eocene of the Geiseltal, Germany (Rage, 1984, p. 20), and the other less well-defined taxa are known from Palaeocene to Oligocene units in continental Europe.

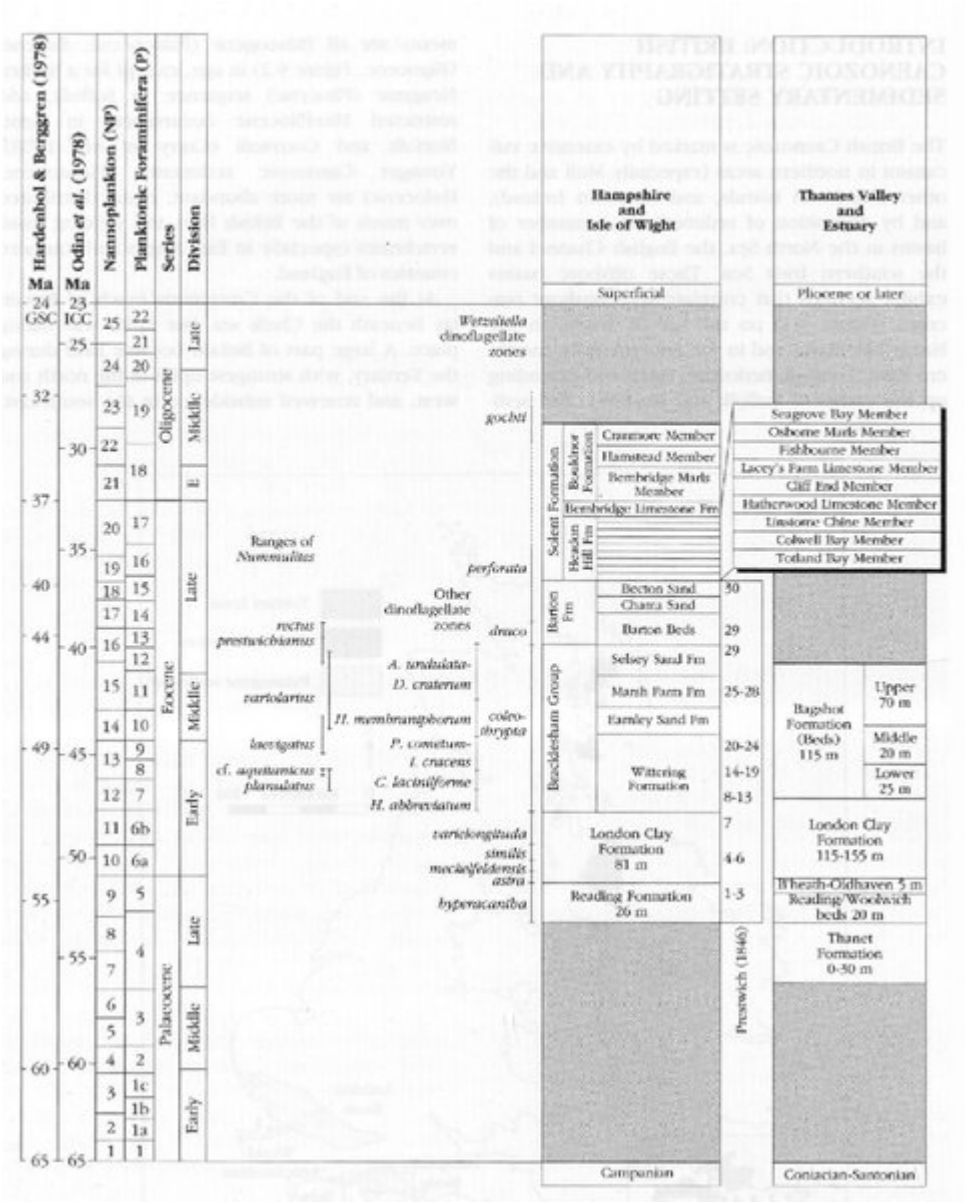
The crocodilian *Diplocynodon* was named from the Aquitanian (Early Miocene) of Allier and other sites in France. Other supposed records of *D. hantoniensis* include a partial specimen from the Mid Eocene of the Geiseltal in Germany and a partial jaw from the Early Oligocene of Borken, Lower Hessen (Steel, 1973, p. 82). Other species of *Diplocynodon* have been reported from the Mid Eocene of France, Messel and the Geiseltal, Germany, Spain and Wyoming, USA, the Oligocene of France, the Miocene of Austria and the Mid Pliocene of Bulgaria, among others (Steel, 1973, pp. 81–4).

Conclusions

The Totland Bay Member at Hordle Cliff has yielded a rich fauna of reptiles of Late Eocene age. The locality, known since the early 19th century, has continued to produce abundant reptile remains and has recently produced an important collection of squamates. These recent finds, which include a variety of forms newly recorded from the British Palaeogene, indicate that the herpeto-fauna of this region during the Late Eocene was as diverse as those of continental Europe.

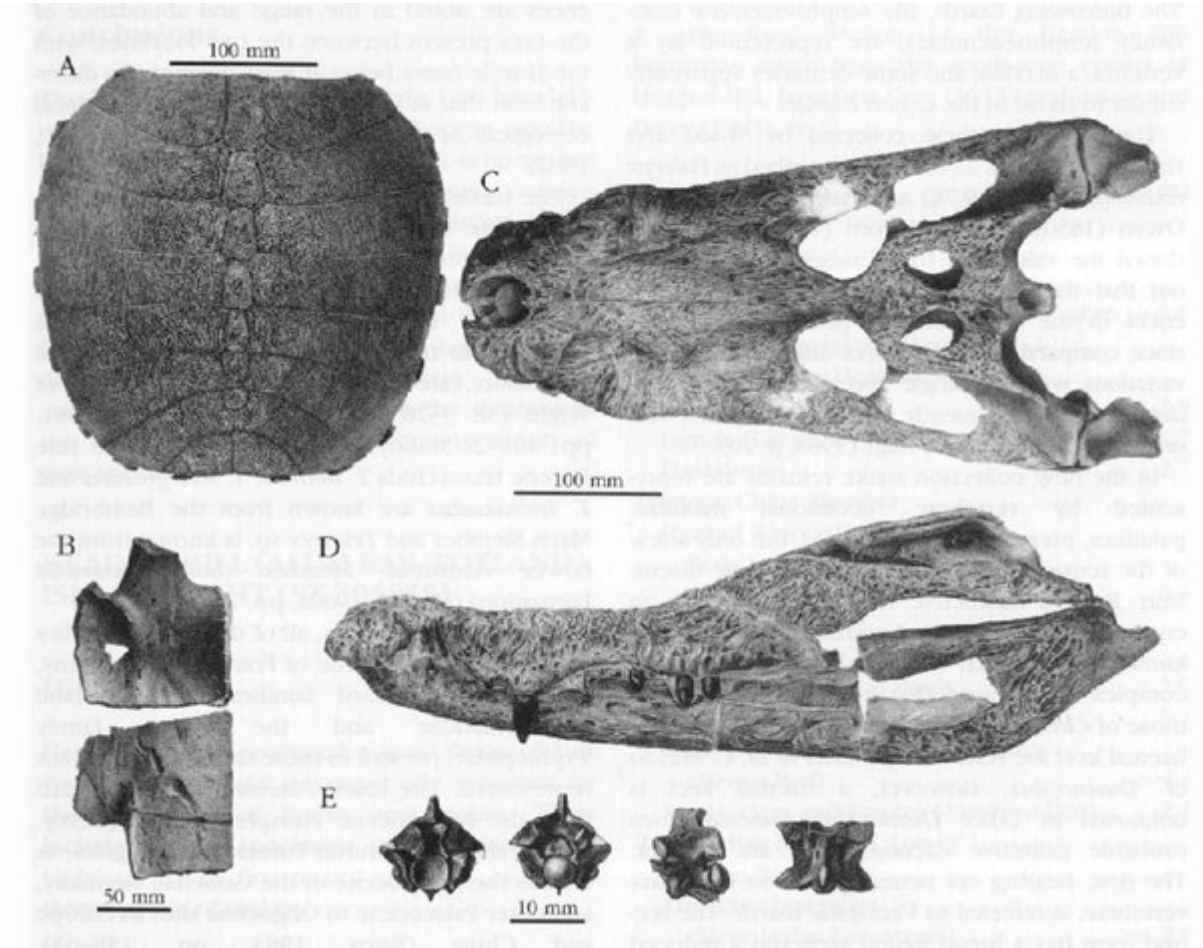
The conservation value lies in the richness of the reptile fauna and the continuing supply of new specimens.

References



(Figure 9.2) Summary of Tertiary stratigraphy, showing global standards and some major British formations. Based on Curry et al. (1978).

(Figure 9.6) The Lower Headon Beds of Hordle Cliff, looking towards Becton Bunny. (Photo: DI. Harrison.)



(Figure 9.7) Typical reptiles of the Late Eocene Lower Headon Beds of Hordle Cliff. (A) The turtle Trionix henrici Owen, 1849, carapace in dorsal view; (B) the turtle Ocadia crassa (Owen, 1849),internal views of plastron elements; (C) and (D) the crocodilian Diplocynodon hantoniensis (Wood, 1844), skull in (C) dorsal and (D) lateral views; (E) the snake Paleryx rhombifer Owen, 1850, mid-body vertebra in posterior, anterior, lateral, and dorsal views. (A) and (B) After Owen and Bell (1849); (C) and (D) after Owen (1850h); (E) after Owen (1850c).