Durlston Bay, Dorset

([SZ 035 772]–[SZ 039 786])

Highlights

Durlston Bay is one of Britain's richest fossil reptile sites, the source of over 40 species of reptiles living in the earliest Cretaceous (Figure 7.12). The small reptiles are especially important, and Durlston Bay is unique worldwide for its diverse early lizards, its turtles, its small crocodilians and its pterosaurs.

Introduction

The mile stretch of coastal sea cliffs between Peveril Point and Durlston Head displays the finest sections of the Purbeck Limestone Formation in Britain which comprise the type locality for the formation (Figure 7.13) and (Figure 7.14). The Purbeck Limestone Formation here is famous for its exceptionally diverse fauna, which includes mammal remains unique to the Early Cretaceous of Britain (to be dealt with in a subsequent volume in the GCR series). The Durlston Bay section is also well known for its reptiles (Figure 7.15) and (Figure 7.16) and is arguably Britain's most important fossil reptile site. The reptile fauna is large and diverse, containing abundant lizards, turtles, crocodilians, pterosaurs and dinosaurs (36 species; 29 type species). The small size of many of the animals, and their fine preservation, give this locality a unique position in comparison with other reptile faunas of the same age worldwide.

Most of the reptiles from Durlston have been obtained from the natural cliff exposures, but some remains, especially the turtles, came largely from underground stone workings, the products of now extinct quarrying operations. Although the latter source for reptiles is no longer available, the extensive cliff exposures (Figure 7.13) have continued to yield new specimens. Many finds were made by Beckles in the course of his excavation of the cliff in an area, just north of the Zigzag Path, that is well south of the outcrop of the Mammal Bed at beach level. Reports of the Durlston Bay vertebrates include Owen (1842b, 1853, 1854, 1855a, 1861b, 1871, 1874b, 1878a, 1878b, 1879a, 1879b), Mantell (1844), Owen and Bell (1849), Seeley (1869a, 1875a, 1893a, 1893b), Lydekker (1888a, 1889b), Boulenger (1891), Watson (1911b), Andrews (1913), Huene (1926), Nopcsa (1928), Hoffstetter (1967), Joffe (1967), Delair (1969b), Seiffert (1973), Evans and Kemp (1975, 1976), Gaffney (1976, 1979b), Galton (1978, 1981a), Estes (1983) and Howse (1986). Dinosaur footprints have been reported recently from Durlston Bay (Ensom, 1983, 1984b, 1985b, 1987c, 1987d; Nunn, 1990), as well as a new sphenodontid jaw bone (Evans, 1992c).

The Purbeck section at Durlston Bay has been described with varying degrees of accuracy by many authors (Austen, 1852, pp. 9–16; Bristow and Fisher, 1857, pp. 245–54; Strahan, 1898, pp. 91–6; Arkell, 1933, pp. 521–9; Clements, *in* Torrens, 1969a, figs A35–7; 1993). Cope and Clements (*in* Torrens, 1969a, pp. A57–A64) and Macfadyen (1970, pp. 134–52) give details of the history of research on the stratigraphy and palaeontology of the Durlston section. Parts of the coastline were formerly mined and quarried opencast for building stone, paving flagstone and gypsum.

Description

The section of the Purbeck Limestone Formation at Durlston Bay (Figure 7.13) and (Figure 7.14) is based on Wimbledon and Hunt (1983, p. 270, fig. 2) and new data from W.A. Wimbledon (pers. comm. to M.J.B., 1992), and using the numbering scheme of Clements (*in* Torrens, 1969a), where bed numbers are prefixed DB. A detailed map of the northern part of Durlston Bay, showing the occurrence of numbered Purbeck beds, has been published by Nunn (1992).

The Purbeck Limestone Formation is generally taken to span the Jurassic–Cretaceous (Portlandian–Berriasian) boundary, with the base of the Cretaceous taken in the *Cypris* Freestone, quite low in the formation (Allen and Wimbledon, 1992). Ammonites have not been found in these beds, and the stratigraphy is based on palynomorphs, ostracods and gastropods; the position for the boundary between the Cretaceous and Jurassic has been in dispute, but

an integrated approach to correlation has made possible the positioning of the base of the Berriasian in the section.

Fossil reptiles have been recorded from several levels in the section (Figure 7.14) between the Mammal Bed (14 and 16) at the base of the Middle Purbeck beds and the *Unio* Beds and above (197+) in the Upper Purbeck beds:

197–224 *Unio* Beds, Upper *Cypris* Clays and Shales: Delair (1966, p. 60) noted specimens of the crocodile *Goniopholis* (BGS(GSM) Zm.7702) and of turtles (BGS(GSM) Zm. 7703–4) 'in and just above the *Unio* Bed at Peveril Point'.

200 (Bed 6 of Austen; Bed 81 of Bristow; bed 221 of Clements) Crocodile Bed: 'teeth of crocodile'; plants, coprolites, fish, turtles, crocodiles (*Goniopholis*).

196 (Bed 9 of Austen; Bed 78 of Bristow; bed 220 of Clements) Broken Shell Limestone Member (Soft Burr): fishes and turtles. Ensom (1983) noted dinosaur footprints in this bed.

191 in the Chief Beef Beds: Ensom (1983) noted dinosaur footprints from this horizon.

131–174 (Beds 24–44 (in part) of Austen; Beds 59–70 of Bristow; beds 154–174 of Clements); *Corbula* Beds: insects, fishes, turtles and footprints (West and El-Shahat, 1985).

58–114 Intermarine Beds (Beds 45–70, Turtle Beds of Austen; Beds 45–57, Intermarine Beds of Bristow; beds 112–144 of Clements) Upper Building Stones: DB133 (Bed 52 of Austen; Bed 54 of Bristow, Red Rag), yields fishes, turtles and coprolites. Beds ?78–80 (Bed 61 of Austen; Bed 50d of Bristow; bed 124 of Clements) in the Roach (Freestone Quarry) includes the pink bed with reptile footprints. Bed 61 (Bed 69 of Austen; Bed 45d of Bristow; bed 113 of Clements) contains remains of fishes, fresh-water tortoises (*Pleurosternon*), pterosaurs and crocodiles. Evans and Kemp (1975) ascribe the type specimen of *Mesochelys duristonensis to* the '?Upper Building Stones'. Most of the larger crocodiles described by Owen (1878b) and the turtles (Owen, 1853) apparently come from the massive limestones of the Upper Building Stones. Ensom (1985b, 1987c) and Nunn (1990) note dinosaur footprints from beds 71, 74, 75, 78, and 96 (but see (Figure 7.14) herein).

Beds 20–52 (Beds 72–88 of Austen, Beds 25–42 of Bristow). Cherty Freshwater Beds: Austen (1852) notes 'bones' in his beds 72 (=51) and 81 (=37) and 'turtle' in his beds 83 and 84 (=30–32). The Feather Bed (Bed 74 of Austen, Bed 40 of Bristow, bed 108 of Clements =45–48) yielded postcranial remains of the dinosaur Nuthetes (Owen, 1854, 1878a; Delair, 1959, p. 80), granicones (Owen, 1878a, 1879b), and the 'dwarf crocodilians *Nannosuchus* and *Theriosuchus* (Owen, 1879a, 1879b; Joffe, 1967). Owen (1879b) also referred the small crocodilians *Goniopholis tenuidens, Oweniasuchus major, O. minor* and *Nannosuchus gracilidens* to the Feather Bed. However, Owen (1861b) stated that the type *Nuthetes* jaw came from Bed 93 of Austen (1852), namely the Mammal Bed (bed 14–16). The Under Feather (Bed 76 of Austen; Bed 38 of Bristow; 106 of Clements =43) yielded *Iguanodon hoggi* Owen, 1874b (p. 3). Ensom (1984b) reported dinosaur footprints from DB94, exposed south of the point where the Cinder Bed is present at shore level [SZ 0360 7835]. A related pod of limestone (DORCM G7261) was discovered in the carbonaceous shale below (DB93). Ensom (1984b) noted isolated impressions on the base of DB103 and DB102 (Clements 1969).

The Mammal Bed ('Dirt Bed') of Beckles' excavations (Bed 93 of Austen; Bed 22 of Bristow; bed 83 of Clements): always equated with bed 14–16 (Figure 7.14) of the shore section, has yielded plant remains, ostracods, gastropods, bivalves, lizards (Macellodus, *Saurillus* etc; Owen, 1854, 1855a, 1861b; Hoffstetter, 1967), dinosaurs (*Echinodon;* Owen, 1861b; Galton, 1978; *Nuthetes,* type jaw; Owen, 1861b), and mammals (18 species). Certain authors (e.g. H.B. Woodward, 1895, p. 251; Macfadyen, 1970, p. 137) referred the dwarf crocodilians to the Mammal Bed, and such remains are abundant from about same level in the southern half of the bay (*fide* W. A. Wimbledon, 1993).

Fauna

Many thousands of identifiable reptile specimens have been collected from Durlston Bay, and there is no point in attempting to list them all. About 41 species have so far been recognized. Collections in the following institutions were examined: BMNH, BGS(GSM), CAMMZ, CAMSM, DORCM and OUM. Many specimens are labelled merely 'Swanage', and they could have come from some of the inland quarries. Type specimens are indicated, as well as an estimate on the

numbers of specimens of each species in major British collections. The numbers are probably rather too high because of the lack of recent reviews of most groups and, in the case of the lizards, because of the existence of such recent reviews!

Testudines: Cryptodira: Pleurosternidae	
Mesochelys durlstonensis Evans and Kemp, 1975 Holotype: CAMMZ T.1041	1
Pleurosternon bullocki (Owen, 1842) Type specimen: BMNH R911	70
Pleurosternon sp.	47
Tretosternon punctatum Owen, 1842 Type specimen: lost	16
Testudines: Cryptodira: Plesiochelyidae	
Plesiochelys belli (Mantell, 1844)	2
Plesiochelys emarginata Owen, 1853 Type specimen: DORCM G.16/ BMNH 46317(?)	7
Plesiochelys latiscutata (Owen, 1853) Type specimen: DORCM G.20	3
Plesiochelys sollasi Nopsca, 1928 Type specimen: OUM J.13796	1
Plesiochelys sp.	13
Testudines: Cryptodira:	
inc. sed.	
Dorsetochelys delairi Evans and Kemp, 1976 Holotype: DORCM G.23	1
'Chelonian indet.'	17
Testudines: Pleurodira	
Platychelys ?anglica Lydekker, 1889 Type specimen: BMNH 48357	1
Lepidosauria: Sphenodontida	
Homoeosaurus sp./Opisthi as sp.	3
Lepidosauria: Squamata: Sauria:	
Paramacellodidae	
Becklesisaurus scincoides Hoffstetter, 1967 Holotype: BMNH R8082	1
Macellodus brodiei Owen, 1854 Neotype: BMNH R8182 (some specimens = *Becklesisaurus hoffstetteri* Seiffert, 1973)	35
Paramacellodus oweni Hoffstetter, 1967 Holotype: BMNH R8131–2	12
Pseudosaurillus becklesi Hoffstetter, 1967 Holotype: BMNH R8095	27
Saurillus obtusus Owen, 1855 Neotype: BMNH R8135	57
Saurillus robustidens Hoffstetter, 1967 Holotype: BMNH R8130	2
Lepidosauria: Squamata: Sauria:	
Dorsetisauridae	
Dorsetisaurus purbeckensis Hoffstetter, 1967 Holotype: BMNH R8129	32
Dorsetisaurus hebetidens Hoffstetter, 1967 Holotype: BMNH R8109	1
Lepidosauria: Squamata: Sauria:	
inc. sed.	

Durotrigia triconidens Hoffstetter, 1967 Holotype: BMNH R8122	1
Archosauria: Crocodylia: Neosuchia: Goniopholididae	
Goniopholis crassidens Owen, 1842 Type specimen: BMNH 3798	15
Goniopholis simus Owen, 1878 Type specimen: BMNH 41098	1
Goniopholis tenuidens Owen, 1879 Type specimen: BMNH 48300	1
Goniopholis sp.	75
Nannosuchus gracilidens Owen, 1879 Type specimen: BMNH 48217 (?= juvenile *G. simus*)	22
Oweniasuchus major (Owen, 1879) Type specimen: BMNH 48304	5
Oweniasuchus minor (Owen, 1879) Type specimen: BMNH 48328	2
Oweniasuchus sp.	1
Petrosuchus laevidens Owen, 1878 Type specimen: BMNH 41099	2
'crocodile'	28
Archosauria: Crocodylia: Neosuchia: Pholidosauridae	
Pholidosaurus decipiens Watson, 1911 Type specimens: BMNH 28432, R3956	2
Pholidosaurus sp.	2
Archosauria: Crocodylia: Neosuchia: Atoposauridae	
Theriosuchus pusillus Owen, 1879 Type specimen: BMNH 48330	54
Archosauria: Pterosauria: Pterodactyloidea	
Doratorhynchus validus (Owen, 1870) Type specimen: BMNH 40653	2
' Ornithocheirus' sp.	7
Dinosauria: Saurischia: Theropoda	
Megalosaurus sp.	1
Nuthetes destructor Owen, 1874 Type specimen: DORCM G.913	6
Dinosauria: Ornithischia: Ornithopoda	
Echinodon becklesi Owen, 1861 Type specimen: BMNH 4820	13
Iguanodon hoggi Owen, 1874 Type specimen: BMNH R29982	2
Sauropterygia: Plesiosauria: Plesiosauroidea	
'plesiosauroid'	1
Ichthyopterygia: Ichthyosauria	
'ichthyosaur'	1

Interpretation

Turtles are the commonest remains from Durlston. A 'petrified tortoise' was recorded in 1809 (Anon., 1809). Owen (1842b), and Owen and Bell (1849, pp. 62–6) described *Platemys bullocki* on the basis of a turtle supposedly from the London Clay of Sheppey. It was later shown to have come from Durlston (Lydekker, 1889b, p. 209). Meanwhile, Owen (1853, pp. 1–9) erected the genus *Pleurosternon,* with the new species *P. concinnum, P. emarginatum, P. ovatum* and *P. latiscutatum,* all from Durlston. The first three belong to *P. bullocki* (although *P. emarginatum* only in part; Lydekker, 1889b, pp. 206–15), as do four invalid species named by Seeley (1869a, pp. 86–8). *P. bullocki* was a medium-sized (400 mm long), probably freshwater, turtle. The carapace was oval and relatively low. The relationships of the Pleurosternidae are uncertain because of the general absence of skull material (Gaffney, 1975b; M■ynarski, 1976). Gaffney and Meylan (1988) regard the family as the basal cryptodires in their cladogram.

Owen (1842b, pp. 165–7) also described *Tretosternon punctatum* on the basis of carapaces from the Purbeck Limestone Formation of Durlston and from the Wealden. The type specimens were lost, but a few others were identified (Lydekker, 1889b, pp. 141–3). *Tretosternon* was a moderate-sized form with a thick sculptured armour and a very flat, broad carapace about 500 mm long. It has been placed in the Pleurosternidae (Romer, 1956) and the Dermatemydidae (Cryptodira), but a restudy is required (M■ynarski, 1976).

Several species of *Plesiochelys* have been described from Durlston: *P. latiscutata* (Owen, 1853), *P. emarginata* (Owen, 1853, in part), *P. bent* (Mantel, 1844) (see Lydekker, 1889b, p. 194) and *P. sollasi* Nopsca, 1928. *Plesiochelys* is a thick-shelled form, with a low carapace which is round to oval in outline. The limbs are adapted for aquatic and terrestrial life. Most of the species are defined on characters of the carapace, but their general relationships are not certain. All are moderate in size: *H. latiscutata* was 400 mm long, *H. emarginata* some 500 mm and *H. sollasi* had a carapace about 450 mm long and about 455 mm wide. Romer (1956) classed *Plesiochelys* in the Plesiochelyidae, with *Pleurosternon in* the Amphichelydia. Gaffney (1975a, 1975b, 1976) argued for the abolition of the Amphichelydia and placed the Plesiochelyidae in the Chelonioidea, a group of cryptodires (the large suborder of turtles that withdraw their heads in a vertical plane), but without reference to the Purbeck species. On the other hand, M■ynarski (1976) associated the Plesiochelyidae with the Dermatemydidae (a group of primitive cryptodires). Gaffney and Meylan (1988) place the Plesiochelyidae in their Eucryptodira, between the Baenidae and the more derived cryptodires.

Platychelys (?) anglica Lydekker, 1889b (pp. 217–18) was a small turtle; the species was erected on a single carapace from Durlston. *Platychelys* is classed in the second turtle suborder, the Pleurodira (side-necked turtles) (Gaffney, 1975b; M■ynarski, 1976; Gaffney and Meylan, 1988), but Lydekker's assignment of such a poor specimen may be incorrect.

Two recently described turtles are important. *Mesochelys durlstonensis* Evans and Kemp, 1975 is based on an excellent skull (Figure 7.15)A and partial skeleton. Evans and Kemp (1975) suggested that *Mesochelys* was related to the North American Late Jurassic *Glyptops,* a primitive cryptodire. The second specimen, *Dorsetochelys delairi* Evans and Kemp, 1976, also a cryptodire, is based on a good skull ((Figure 7.15)(B). Evans and Kemp (1976) considered that it represented a group related to both Glyptopsidae and Baenidae. Gaffney (1979b) stressed the primitive nature of both genera and their importance in the classification of cryptodire turtles. *Mesochelys is* placed by Gaffney and Meylan (1988) in the Pleurosternidae, the basal cryptodire family.

A sphenodontid rhynchocephalian is represented only by three jaw fragments (Boulenger, 1891; Delair, 1960, pp. 77–8, Evans, 1992c) (BMNH R1765, R4808, DORCM G10831). These show the characteristic triangular acrodont teeth and squared-off symphysis found in the extant *Sphenodon,* and the new specimen has been ascribed to *Opisthias,* a sphenodontid known from the Late Jurassic of North America (Evans, 1992c). The earlier specimens (Figure 7.15) are assigned to *Homoeosaurus* (Boulenger, 1891), a genus better known from the Late Jurassic of France and Germany, and a comparison of all the material is required.

The lizards from Durlston Bay are of particular significance in representing some of the earliest known types. Owen (1854) described several jaw fragments as *Macellodus brodiei.* He also referred some associated dermal scutes to *Macellodus,* but these probably pertained to a dwarf crocodile. Owen (1855a, 1861b) then described further jaws as *Saurillus obtusus,* but Lydekker (1888a, p. 289) synonymized this taxon with *Macellodus.*

The NHM, London later acquired the Beckles collection of 170 lizard specimens from Durlston Bay. Hoffstetter (1967) restudied these and erected five new genera and seven new species. He could not locate the type specimens of *Macellodus* and *Saurillus,* but considered that they were quite distinct. The new species were nearly all based on dentary or maxilla fragments, and the diagnostic characters were based on jaw shape and tooth morphology. The seven genera of Purbeck lizards recognized by Hoffstetter (1967) are: *Macellodus* and *Paramacellodus* (jaws 25 mm long; teeth tubular, peg-like, with rounded ends), *Saurillus* and *Pseudosaurillus* (jaws 12–25 mm long, teeth peg-like and pointed), *Becklesisaurus* (jaw 40 mm long, teeth peg-like, with rounded ends), *Durotrigia* (poorly known, teeth with multiple points) and *Dorsetisaurus (jaw* 40 mm long; teeth flattened, leaf-shaped and pointed). Most of the genera are represented by assorted skull bones, vertebrae and limb bones in addition to jaws, but there is not sufficient to reconstruct a complete skull or skeleton in any specimen. The lizards are referred to the extant groups Scincomorpha and Anguimorpha.

Seiffert (1973) reviewed Hoffstetter's (1967) work when he described new lizards from the Oxfordian of Guimarota, Portugal. He noted that Hoffstetter's (1967) interpretation of *Macellodus* differs from Owen's (1854, 1861b): Owen (1854) clearly showed the teeth as compressed, spade-shaped, with striations, and 8–10 mm wide, whereas Hoffstetter's (1967) neotype has peg-like rounded teeth without striations, and is 2 mm wide. Seiffert (1973) referred the *Macellodus*' material of Hoffstetter (1967) to a new form, *Becklesisaurus hoffstetteri* Seiffert, 1973, and noted that *Macellodus'* differs from *Becklesisaurus* only in the size of the jaws. Seiffert (1973) also expressed doubt about the validity of some other Hoffstetter taxa. Estes (1983) supported these views and erected the family Paramacellodidae for some taxa, and renamed others in Hoffstetter's (1967) Dorsetisauridae. Estes' (1983) list of taxa is as follows:

Family Paramacellodidae Estes, 1983

Paramacellodus oweni Hoffstetter, 1967 (Figure 7.15)D

(=*Saurillus robustideus, Becklesisaurus scincoides*).

Becklesius hoffstetteri (Seiffert, 1973) (Figure 7.15)E

(=*Macellodus brodiei* of Hoffstetter 1967)

Saurillus obtusus Owen, 1854 (Figure 7.15)F

Pseudosaurillus becklesi Hoffstetter, 1967 (Figure 7.15)G

Pseudosaurillus sp. (=*Saurillus obtusus* of Hoffstetter, 1967)

Family Dorsetisauridae Hoffstetter, 1967

Dorsetisaurus purbeckensis Hoffstetter, 1967 (Figure 7.15)H

D. hebetidens Hoffstetter, 1967

Sauria *incertae sedis*

Durotrigia triconodeas Hoffstetter, 1967

Not lizard

Macellodus brodiei Owen, 1854 is crocodilian

The Purbeck beds of Durlston Bay have yielded nine crocodilian species. The best-represented forms belong to the Family Goniopholididae, which includes terrestrial-aquatic forms typical of the Purbeck and Wealden: broad-faced, with stout and rounded skulls, and with moderately long snouts reminiscent of modern crocodiles. *Goniopholis crassidens* was one of the first crocodilians recorded from Durlston, and was referred to as the 'Swanage crocodile' by Mantel (1837); the type skull and skeleton was described from one of the Swanage quarries (inland or coastal?) by Owen (1842b). *G.*

crassidens was of large size, estimated at about 6 m long, with a 0.6 m long skull. The teeth are characteristic of the species, being remarkably stunted and thimble-shaped in outline. Owen (1878b) redescribed the type specimen from Swanage and reported abundant material from the Wealden. The species *G. simus* Owen, 1878 ((Figure 7.16)A was smaller, about 2.5 m long, with more slender teeth and less tapering head. The type specimen also came from a 'Swanage quarry', and the remains include a fine 0.4 m skull. *Petrosuchus laevidens* Owen, 1878 was erected on the basis of a 0.25 m long partial skull and a mandible also from 'the Middle Purbecks, now quarried at Swanage'. The animal is estimated to have been of moderately large size. The skull is characterized by possessing slender teeth and a distinct angle between the slender rostrum and the temporal region that is almost as abrupt as that of a gavial. Watson (1911b) noted that the lower jaw and the skull described as associated by Owen (1878b) in fact belonged to different animals. He retained the lower jaw as the type of *Petrosuchus laevidens* Owen, 1878, and ascribed the poorly preserved skull to the new species *Pholidosaurus decipiens* Watson (1911), a member of the Family Pholidosauridae, an advanced long-snouted aquatic group. Andrews (1913) further described and figured *P. decipiens.*

Owen (1879b) described a partial fragmentary mandible from the Middle Purbeck as *Goniopholis tenuidens,* and further jaw remains as *Brachydectes major* Owen, 1879 and *B. minor* Owen, 1879. These were all distinguished on characters of the teeth and tooth arrangement. Woodward (1885) and Lydekker (1888a, pp. 79–83) accepted the validity of Owen's three species of *Goniopholis.* Woodward (1885, p. 506) noted that *Brachydectes* was pre-occupied and renamed it *Oweniasuchus,* and Lydekker (1888a, pp. 85–6) accepted the two species as valid. These five species are all small short-snouted forms (skulls 0.25–0.40 m long with stout teeth) and they are placed in the Goniopholididae. Steel (1973, pp. 15–19) accepted the validity of all five species, and of *Petrosuchus laevidens.*

The best-known Purbeck crocodilians are the so called 'dwarf', or small, crocodilians from the Feather Bed (?45–48). Owen (1879a, 1879b) described two forms, *Nannosuchus gracilidens* ((Figure 7.16)B and *Theriosuchus pusillus* ((Figure 7.16)C, on the basis of good skulls and some post-cranial remains, noting (Owen, 1879b) the similarity of *Nannosuchus* to *Goniopholis,* and that *Theriosuchus* differed from the latter form in several respects. The skulls are 40–170 mm long, broad and short-snouted. *Nannosuchus* was like a miniature *Goniopholis,* but with long, slender, curved teeth adapted for catching fish. *Theriosuchus pusillus,* based on a nearly complete skeleton about 450 mm long, was discovered by Beckles in the Mammal Bed. Owen stated that its scattered teeth, scutes, vertebrae and limb bones are very numerous, and that a few skulls (about 90 mm long), mandibles and considerable portions of naturally articulated skeletons have also been found. The teeth of *T. pusillus* vary in shape and are consequently more specialized than those of any other Purbeck crocodilian in approaching a heterodont condition. Owen (1879a) argued at length that these small crocodilians captured the shrew-sized Purbeck mammals, and drowned them, just as crocodiles do today with larger mammals. Joffe (1967) re-examined the 'dwarf crocodiles, and concluded that *Nannosuchus* was a juvenile *Goniopholis simus* and that *Theriosuchus* was a juvenile atoposaurid (a group of small, short-snouted crocodiles restricted to the Late Jurassic of the northern hemisphere).

A few pterosaur remains are recorded from Durlston Bay. Owen (1870, pl. 19, fig. 7) figured a phalanx from Swanage (Acton Quarries, Langton Matravers: [SZ 990 783]) under the name *Ornithocheirus validus.* Although he appended no description, this is regarded as a valid characterization of the species. Seeley (1875a) erected the genus *Doratorhynchus* for a lower jaw and cervical vertebra ((Figure 7.16)D from Durlston Bay. The jaw is long (300 mm+) with small close-set teeth. He associated these remains with Owen's specimen as *D. validus* (Owen, 1870). Lydekker (1888a, p. 26) returned the species to *Ornithocheirus,* and Wellnhofer (1978, p. 58) listed it among 'Ornithocheiridae *incertae sedis'.* Howse (1986) suggested that the *Doratorhynchus* vertebra (CAMSM J5341) is an elongated cervical, the oldest evidence of an azhdarchid pterosaur, a group of giant forms known otherwise only from the Late Cretaceous.

The Purbeck dinosaurs from Durlston are represented by limited, but important, material. A large theropod tooth (BMNH 44806) was ascribed by Lydekker (1888a, p. 163, 1890b) to *Megalosaurus dunkeri,* which Huene (1926) referred to *Altispinax,* a genus known otherwise from the Wealden of Germany, England and Belgium. This genus, like so many, is based on such an agglomeration of odds and ends from different sites that its true affinities cannot be determined (Molnar, 1990). It now seems that *Nuthetes* is also a megalosaur. The type species, *N. destructor,* was described by Owen (1854) on the basis of a small, partial, left mandibular ramus ((Figure 7.16))F with pointed, recurved, double-rooted teeth with serrated edges from the Mammal Bed. Owen (1854) classified the specimen as a lizard, and ascribed to it some small scutes and limb bones from the Feather Bed. Owen (1861b, 1878a, 1879b) supplemented this description

and argued that certain small, conical, granulated objects (granicones) found in the Feather Bed also were dermal ossifications of *Nuthetes* since they were found mixed with *Nuthetes* fragments. These conical dermal ossi-cies, of up to 14 mm height and 8 mm across the base, are now considered as belonging to an unknown ornithischian dinosaur. Lydekker (1888a, p. 247) and Seeley (1893a, 1893b) noted the dinosaurian character of *Nuthetes* and Swinton (1934, p. 214) identified it as a megalosaur. This assignment has been accepted by Romer (1956, p. 599), Delair (1959, p. 79), Steel (1970, p. 34) and Galton (1981a, p. 253), although Molnar *et al.* (1990) term it a carnosaur *taxon dubium.*

Several ornithischian dinosaurs have been described from Durlston Bay. Owen (1861b) noted some small fragmentary jaws with leaf-shaped teeth ((Figure 7.16)E as *Echinodon becklesii* (ever since quoted as *E. becklesii,* but Owen (1861b) consistently misspelt the collector's name as S.H. 'Beccles'). Owen (1861b) interpreted the jaws as lacertilian', but noted similarities with dinosaurs. Lydekker (1888a, p. 247) noted the similarity of the teeth to those of *Scelidosaurus,* and *Echinodon* has generally been associated with it in the Stegosauria (Delair, 1959, p. 88; Steel, 1970, pp. 48–9). Galton (1978), on the other hand, argued that *Echinodon is* a fabrosaurid, one of a group of small bipedal ornithopods, and he later (Galion, 1981a) suggested that the granicones probably belong to *Echinodon* since an American fabrosaurid is known with small dermal ossicles possessing a similar structure. However, Coombs *et al.* (1990, p. 434) argue that *Echinodon* may well be a basal thyreophoran, related to *Scelidosaurus,* as had long been suspected.

Owen (1874b, pp. 3–4) described a small single imperfect mandible with teeth *as Iguanodon hoggii* on the basis of its tooth striations. Although clearly an *Iguanodon,* the differences from the better-known Wealden species have been regarded as slight (Delair, 1959, p. 85; Steel, 1970, p. 17). Nevertheless, it is probably a valid species (Norman and Weishampel, 1990, p. 530), and the oldest *Iguanodon* known. It is estimated to have been about 2.5 m long, small for an *Iguanodon.*

Marine reptiles have been described from Durlston, but their remains are poor. Lydekker (1889a, p. 227) noted a small, imperfect limb bone of a plesiosaur (BMNH 21974), and Delair (1969b) reported a series of postcranial remains of an ichthyosaur from the Purbeck of Swanage (OUM J.13795). The horizons of these marine reptiles are not known.

Finds of dinosaur trackways have been noted from Durlston Bay, and the earliest record found by P. Ensom (pers. comet., 1993) is in the minutes of the Purbeck Society for 1861, while W.T. Ord noted the discovery of tridactyl impressions 'near the Coastguard Station', observed during an excursion by the Bournemouth Natural History Society in 1912. A single print was found at nearby Peveril Point by G. Tyler in 1967 (Sarjeant, 1974, p. 357), and Delair and Sarjeant (1985, p. 148) suggested that this may have been an isolated fallen block related to the 1912 discovery. Ensom (1983, 1984b, 1985b, 1987c) and Nunn (1990) reported the discovery of poorly preserved tridactyl footprints preserved on the sole of DB103 in the Cherty Freshwater Beds at Durlston Bay.

Comparison with other localities

Durlston Bay is by far the richest Purbeck reptile site. The other recorded Purbeck locations producing significant finds of reptiles are listed near the beginning of the chapter.

The turtles *Dorsetochelys* and *Mesochelys* are unique to Durlston, although the latter genus is similar to *Glyptops* from the Late Jurassic (Kimmeridgian–Portlandian) of Wyoming, Utah and Colorado (Gaffney, 1979b). *Pleurosternon is* best known from Durlston, with some specimens also from the Isle of Portland (Portland Stone) and Asia (?) (M■ynarski, 1976, p. 120). Other pleurosternids come from the Early Cretaceous of Kelheim, Bavaria (*Helochelys*) and the Late Jurassic to Early Cretaceous of China (*Changyuchelys*) (M■ynarski, 1976, pp. 119–20). *Tretosternon is* well known from the English Wealden and from other parts of western and central Europe (M■ynarski, 1976, p. 60). *Plesiochelys* is well known from the Late Jurassic of Solothurn, Switzerland and Szechuan, China and the Wealden of the Isle of Wight (M■ynarski, 1976, pp. 55–6).

The sphenodontid *Homoeosaurus* is best known from the Kimmeridgian and Portlandian of Germany and France, and *Opisthias* from the Late Jurassic Morrison Formation of North America (Fraser and Benton, 1989). Comparable lizards to the Durlston genera are known from the Oxfordian of the Guimarota coal-mine, near Leiria, Portugal (Seiffert, 1973) and the Morrison Formation of Wyoming (Prothero and Estes, 1980). Kimmeridgian and Portlandian lizards belonging to other

groups are also known from France (Bugey), Germany (Franconia, Bavaria), Spain (Catalonia) and Manchuria (Hoffstetter, 1967; Estes, 1983).

Goniopholid crocodiles were widely distributed in the Late Jurassic of Europe and North America, and worldwide in the Cretaceous. *Goniopholis* is well known from the Wealden of southern England and the Late Jurassic Morrison Formation of North America, as well as from many scrappy remains elsewhere (Steel, 1973, pp. 15–18; Buffetaut, 1982). *Oweniasuchus, Petrosuchus* and *Theriosuchus* are restricted to Swanage, except for a partial jaw and tooth of *Oweniasuchus* from Portugal (Steel, 1973, pp. 18–19). *Pholidosaurus* is better known from the Wealden of northern Germany (Buffetaut, 1982). Teeth of *Bernissartia* have been found at the Sunnydown Purbeck site (Ensom *et al.,* 1991), but not in Durlston Bay.

The pterosaur *Doratorhynchus is* unique to Durlston and, if correctly determined by Howse (1986), is the world's oldest azhdarchid, a group known otherwise only from the Late Cretaceous.

Megalosaurus is widely distributed throughout the Jurassic and Early Cretaceous of Europe (Lower Lias–Wealden,of England, Portugal, France, Monaco, Germany, Transylvania) and Morocco (Steel, 1970, pp. 33–6), but this distribution is inflated by the identification as megalosaurids of a range of theropod taxa, most of which are indeterminate (Molnar, 1990). Early thyreophorans such as *Echinodon* are known from the Early Jurassic of Lyme Regis (*Scelidosaurus*), China (*Tatisaurus*) and Arizona (*Scutellosaurus*) (Coombs *et al., 1990). Iguanodon* is known from the Early Cretaceous of southern England, Belgium, Portugal, possibly Bohemia, Mongolia and the Lakota Formation of North America (Norman and Weishampel, 1990).

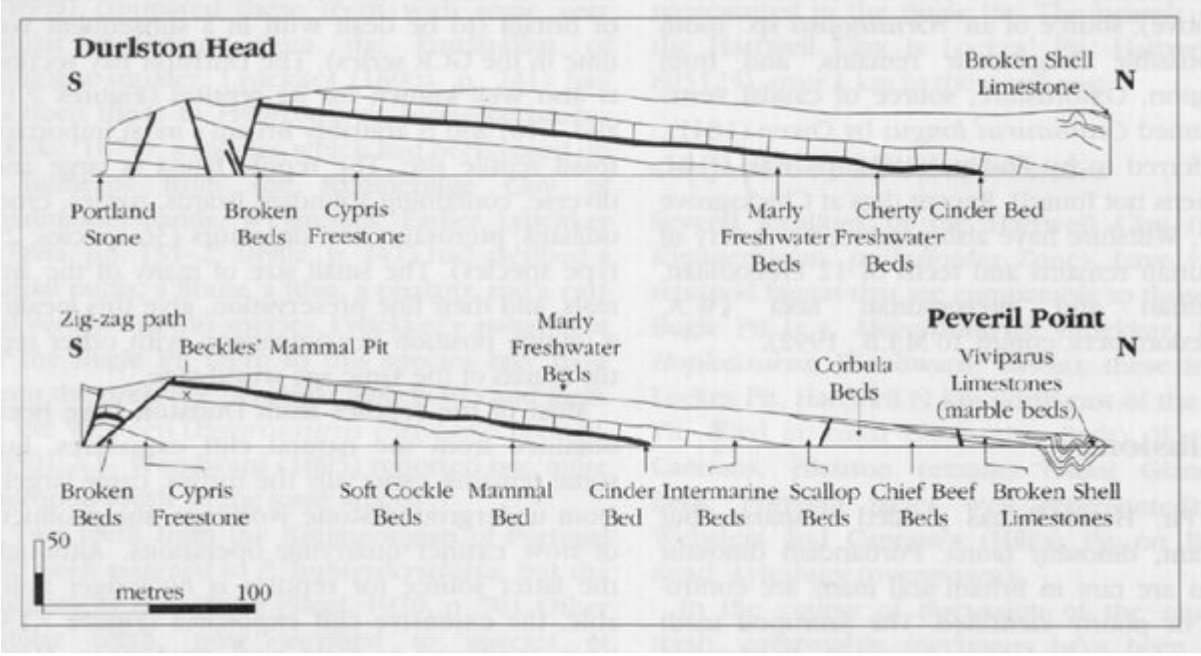
Dinosaur footprints are preserved as moulds and casts in the limestones of the Middle and Upper Purbeck in several quarries on the Isle of Purbeck (Delair, 1960, 1963, 1966, 1982b; Charig and Newman, 1962; Walkden and Oppe, 1969; Delair and Lander, 1973; Delair and Brown, 1975; Ensom, 1982a, 1982b, 1984a, 1984b, 1985a, 1985b, 1986a, 1986b, 1987b, 1987c, 1988; West and El-Shahat, 1985; Newman, 1990). The prints have been attributed mainly to *Iguanodon* or some similar ornithopod, but also to *Megalosaurus* after the discovery of three-toed footprints in a quarry at Herston, near Swanage (Charig and Newman, 1962; Newman, 1990), and to sauropods (Ensom, 1987b).

Conclusions

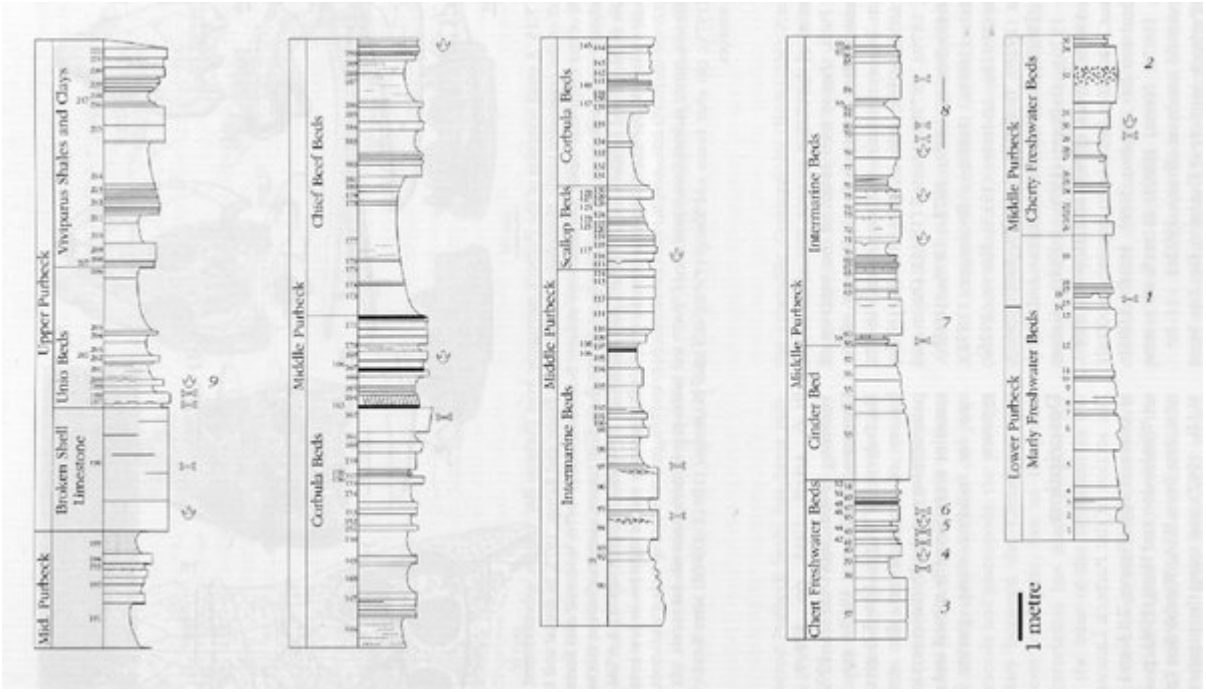
The Purbeck beds of Durlston Bay have yielded one of the most important Mesozoic terrestrial faunas in the world. The 10 species of turtles are nearly all unique to Durlston, and they represent the earliest members of several important lineages. Durlston is the best early lizard site in the world, having produced so far a more diverse and better preserved fauna than other comparable Late Jurassic and earliest Cretaceous sites. The crocodilians include several genera unique to Durlston, and the small juvenile ('dwarf) specimens are unique. The pterosaur *Doratorhynchus,* if correctly determined, is the oldest azhdarchid, otherwise a Late Cretaceous group. The few dinosaur remains include the smallest known megalosaur, *Nuthetes,* an unusual armoured ornithischian, *Echinodon,* and perhaps the oldest known specimen of *Iguanodon.* All of these taxa have been restudied recently, or are in need of revision, and new finds continue to be made. The Durlston fauna occurs in marine and non-marine rocks which occupy a unique position at the Jurassic–Cretaceous boundary, it has yielded many unique genera (29 type species), and the range of small- to medium-sized reptiles gives it a position of international significance in vertebrate palaeontology and its high conservation value.

References

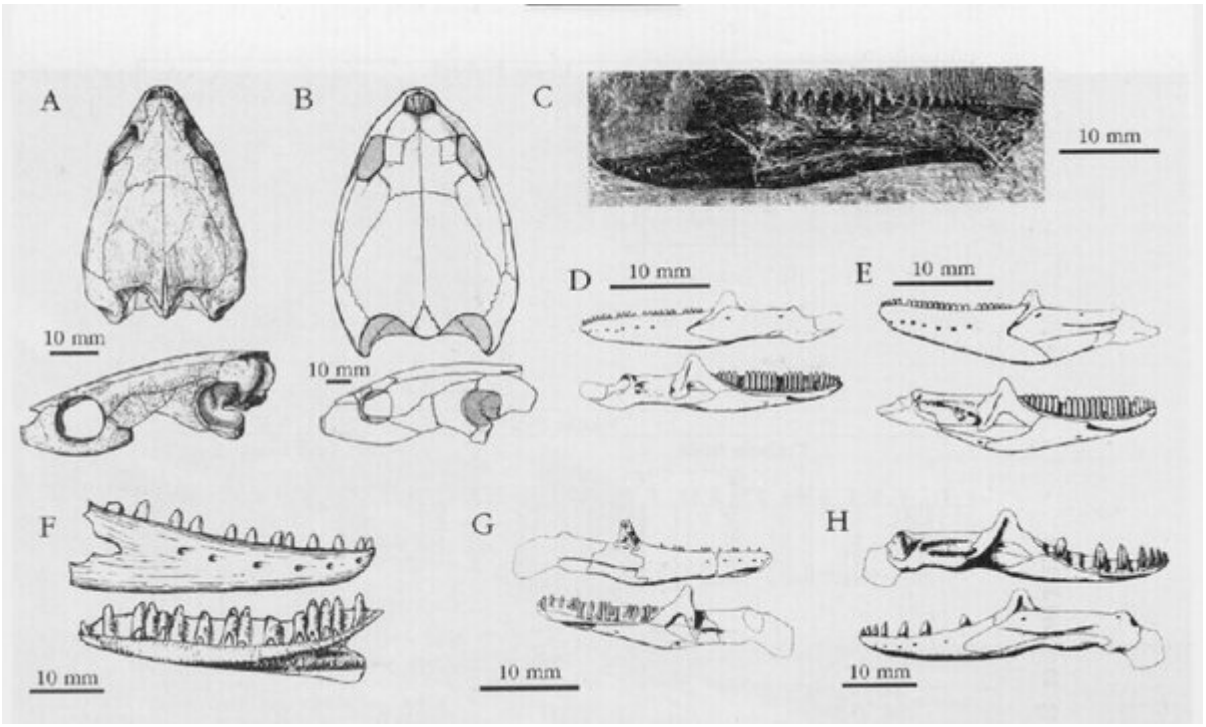
(Figure 7.12) The latest Jurassic and earliest Cretaceous sequences in Durlston Bay, showing marine limestones in the northern part of the section. (Photo: J.L. Wright.)



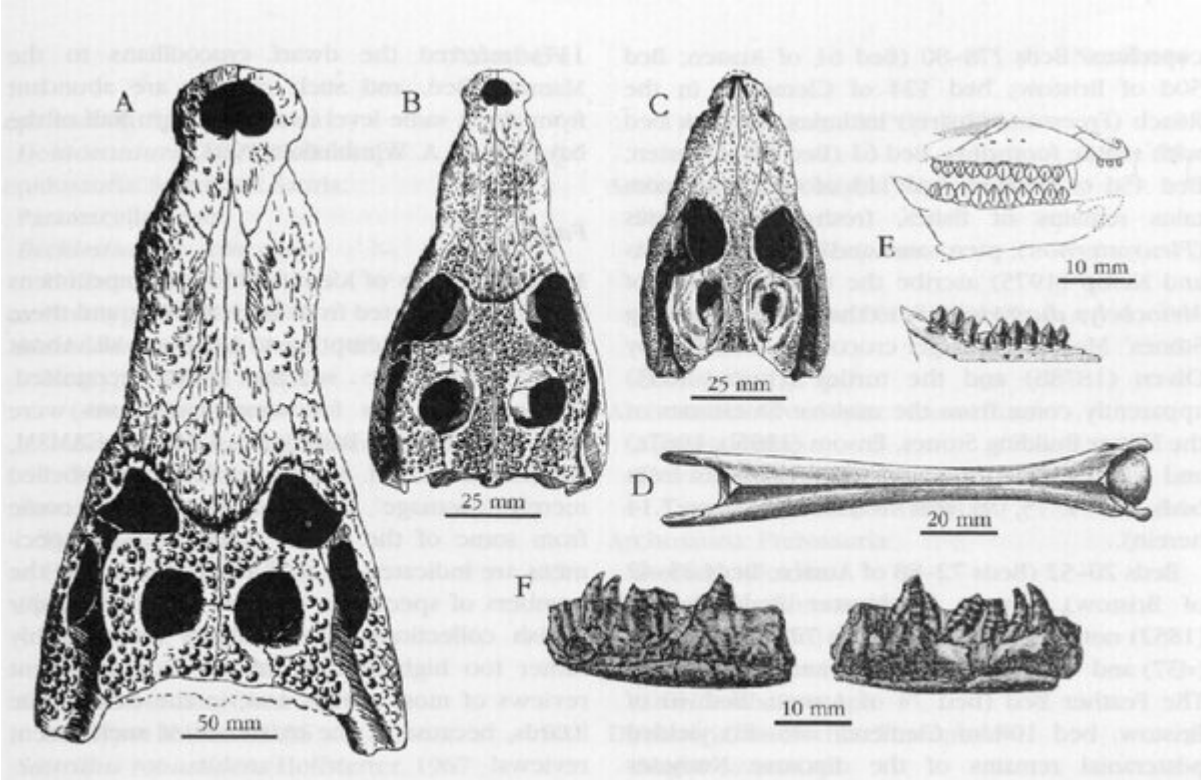
(Figure 7.13) Cliff profiles of Durlston Bay showing the type section of the Durlston Beds (after Strahan, 1898).



(Figure 7.14) Sedimentary log of the reptile-bearing units at Durlston Bay. Bone and footprint symbols indicate fos-siliferous horizons. Supplied by W.A. Wimbledon.



(Figure 7.15) A small selection of the Purbeck menagerie from Durlston Bay: turtles, sphenodontid, and lizards. (A) The skull of the cryptodire turtle Mesochelys durlstonensis Evans and Kemp, 1975, in dorsal and lateral views; (B) the skull of the cryptodire turtle Dorsetochelys delairi Evans and Kemp, 1976, in dorsal and lateral views; (C) the sphenodontid ?Homoeosaurus, partial left lower jaw; (D) the lizard Paramacellodus oweni Hoffstetter, 1967, left lower jaw in lateral and medial views; (E) the lizard Becklestus hoffstetteri (Seiffert, 1973), left lower jaw in lateral and medial views; (F) the lizard Saurillus obtusus Owen, 1854, anterior end of right lower jaw in lateral and medial views; (G) the lizard Pseudosaurillus becklesi Hoffstetter, 1967, right lower jaw in lateral and medial views; (H) the lizard Dorsetisaurus purbeckensis Hoffstetter, 1967, left lower jaw in lateral and medial views. (A) After Evans and Kemp (1975); (B) after Evans and Kemp (1976); (C) after Boulenger (1891); (D)–(H) after Estes (1983), based on various sources.



(Figure 7.16) A small selection of the Purbeck menagerie from Durlston Bay: crocodilians and dinosaurs. (A) Skull of the crocodilian Goniopholis simus Owen, 1878, in dorsal view; (B) skull of the crocodilian Nannosuchus gracilidens Owen, 1879, in dorsal view; (C) skull of the crocodilian Theriosuchus pusillus Owen, 1879, in dorsal view; (D) elongate cervical vertebra of the pterosaur Doratorhynchus validus Owen, 1870, dorsal view; (E) the ornithopod dinosaur Echinodon becklesi Owen, 1861, partially restored snout region, and detail of lower jaw; (F) jaw fragment of the theropod dinosaur Nuthetes pusillus Owen, 1854, in lateral and medial views. (A)–(C) After Joffe (1967); (D) after Howse (1986); (E) after Galion (1978); (F) after Owen (1854).