Chapter 9 British Caenozoic fossil reptile sites

Introduction: British Caenozoic stratigraphy and sedimentary setting

The British Caenozoic is marked by extensive vulcanism in northern areas (especially Mull and the other Hebridean islands, and Northern Ireland), and by deposition of sediments in a number of basins in the North Sea, the English Channel and the southern Irish Sea. These offshore basins exhibit sections that correlate with onshore outcrops (Figure 9.1) on the Isle of Wight, in the Hampshire Basin and in the London Basin (northern Kent, London, Berkshire, Essex and extending up the coasts of Suffolk and Norfolk). The sedi ments are all Palaeogene (Palaeocene, Eocene, Oligocene, Figure 9.2) in age, except for a limited Neogene (Pliocene) sequence in Suffolk, and restricted Mio-Pliocene occurrences in Kent, Norfolk and Cornwall (Curry *et al.,* 1978). Younger Caenozoic sediments (Pleistocene, Holocene) are more abundant, being distributed over much of the British Isles and yielding fossil vertebrates especially in East Anglia and southern counties of England.

At the end of the Cretaceous much of Britain lay beneath the Chalk sea, but uplift was taking place. A large part of Britain became land during the Tertiary, with strongest uplift in the north and west, and renewed subsidence in the south-east.

The sediments of the London and Hampshire Basins record the interplay of marine sediments from the subsiding basins and tongues of terrestrial sediments feeding off the lands to the north. This produces cyclic patterns recording repeated transgressions and regressions.

The earliest transgressive beds, of Late Palaeocene age, occur in eastern Kent (Thanet Formation), and these marine units extended ever further westwards through Berkshire and into Wiltshire during the Late Palaeocene (Woolwich and Reading Beds) and Eocene (London Clay Formation, Bagshot beds). The Reading Formation (Late Palaeocene) is represented by a sequence of non-marine, red, mottled, kaolinitic clays and sands of fluvial origin that have yielded plant and insect fossils, as well as a marine horizon toward the base (Bone, 1986). The London Clay Formation (Early Eocene) is characterized by monotonous dark-grey to bluish mudstones, some of which are intensely bioturbated, together with more sandy beds near the base. The abundant fossils include diverse molluscs (bivalves, gastropods, nautiloids), crustaceans, fishes and tetrapods, and over 500 species of flowering plants (angiosperms) and gymnosperms, both groups being represented by pollen, logs, fruits and leaves. The Bagshot beds (Early–early Mid Eocene) are composed of decalcified, sparsely fossiliferous, marine sands and continental clays of the London Clay Formation and Bracklesham Group.

The Tertiary sediments of the Hampshire Basin (including the Isle of Wight; Figure 9.2) begin slightly later than in the London Basin, with the Late Palaeocene Reading Formation, the Early Eocene London Clay Formation, and the Early–early Mid Eocene Bracklesham Group (Insole and Daley 1985; Edwards and Freshney 1987). These represent several Late Palaeocene/Early Eocene marine transgressions from the North Sea over East Anglia and southeastern England as far west as Dorset. The same episode drowned areas of Belgium, the Netherlands, northern France and north-western Germany. The sedimentary sequence in the Hampshire Basin spans from the latest Palaeocene to the Early Oligocene, and it consists of lateral equivalents of the Belgian and Paris basins where the sequences consist of limestones terrigenous clastics including sands, clays and thick deposits of lignite.

The Bracklesham Group includes a variety of marine and continental facies that appear to have been deposited over a long interval of time spanning the Early to early Mid Eocene. The marine units of the Group are restricted to the east of the outcrop, while in the Isle of Wight it is in part continental, and the commonest fossils are leaves and palynomorphs. The succeeding 'Barton Sands' and lower part of the Headon Hill Formation (Totland Bay Member; Late Eocene) are marine in the lower section and broadly continental toward the top. The upper parts of the Headon Hill Formation (Colwell Bay Member to Seagrove Bay Member; latest Eocene), and the Bembridge Limestone and Bouldnor formations (Early–Mid Oligocene), which is confined to the north of the Isle of Wight, consist of mainly continental facies, with rare marine-influenced units in the Cranmore Member of the Bouldnor Formation (Insole and Daley, 1985). This whole sequence, barring the 'Barton Sands' at the base, is placed in the Solent Group (Insole and Daley, 1985).

In Northern Ireland and the Inner Hebrides, rare Tertiary sediments include the eroded remnants of a vast Palaeogene region of plateau lavas (Tertiary igneous Province), and some associated subsidiary continental sedimentary deposits. In south-west England the Oligocene basins of Bovey and Petrockstow contain fluvially deposited and lacustrine beds. These unusual deposits were the result of penecontemporaneous faulting and local subsidence in the Palaeozoic basement along the line of the Sticklepath–Lustleigh fault zone.

During Neogene time the North Sea Basin continued to subside, and sediments accumulated in the Miocene and Pliocene. The Miocene and Pliocene are largely absent from onshore sites. The notable exceptions are the Coralline Crag and the Red Crag, a combined sequence of about 70 m of the Pliocene age. These are stratified cross-bedded sands containing marine invertebrate fossils which seem to have been deposited in shallow seas by tidal currents, and indicate a cooling of the climate. During Pleistocene times, as is well known, the British Isles experienced a number of cooling and warming episodes. There were as many as six cold phases during the past 2 Ma, with associated glaciation extending, at its maximum, southwards to a line roughly from London to Bristol. Pleistocene vertebrates have been found in cave deposits and in water-laid and glacial deposits. Reptiles are known, of course, exclusively from fluvial and estuarine deposits and from caves, of the warm interglacial periods.

Reptile evolution during the Caenozoic

After the extinction of the dinosaurs, the pterosaurs and the marine plesiosaurs and mosasaurs at the end of the Cretaceous, and the ichthyosaurs rather earlier in the Late Cretaceous, reptile evolution seemed rather less dramatic than it had been during the Mesozoic Era. The surviving reptiles included lizards, snakes, turtles and crocodilians, and terrestrial faunas were dominated increasingly by mammals. Palaeogene faunas include snakes, lizards and amphisbaenids of essentially modern type. The turtles, crocodilians and choristoderes survived the Cretaceous with little change, but the choristoderes became extinct by Oligocene times. Crocodilians continued to diversify, and several groups of terrestrial and aquatic forms radiated, but diversity plummeted towards the present day. Turtles likewise showed a number of radiations during the Tertiary in various parts of the world, but settled to a diversity pattern similar to that of today by Miocene times.

British Caenozoic reptile sites

Fossil reptiles occur rather sporadically through most of the British Palaeogene succession (Figure 9.2). In the Late Palaeocene there are few recorded occurrences, but remains of trionychid turtles are known from the Blackheath Beds and from the Woolwich Beds. The earliest Palaeogene reptiles have recently been obtained from rare, lignite-rich clay lenses in the Reading Formation. The remains, consisting of crocodilians and turtles, occur with fish debris and are associated with a diverse flora (seeds, other plant remains and rare amber). Early Eocene reptiles are extremely well represented in the London Clay, particularly at Sheppey, where the fauna is dominated by marine forms (turtles and the aquatic snake *Palaeophis*). In the succeeding Bracklesham Group, marine reptiles again dominate. The best Late Eocene reptiles have been obtained from the Totland Bay Member of the Headon Hill Formation (Insole and Daley, 1985) of the western Hampshire coast, and from the whole of the Headon Hill Formation of the Isle of Wight. The Late Eocene faunas are dominated by terrestrial forms (lizards, trionychid turtles, crocodilians, snakes). The Oligocene Hamstead Member of the Bouldnor Formation of the Isle of Wight has produced a fauna dominated by freshwater turtles and crocodilians. The GCR scheduled sites include a selection from these Palaeogene units.

Neogene and Pleistocene reptile localities are sparse and it was hard to determine particular locations that had assessable potential for future finds; hence, none was scheduled. The Pleistocene sites are reviewed at the end of this chapter.

Late Palaeocene and Eocene

The latest Palaeocene and Eocene series of Britain have produced significant faunas of terrestrial and marine reptiles. The remains obtained from several of the formations described above are listed by county from the Hampshire and London Basins respectively. The host formations are indicated.

ISLE OF WIGHT: Colwell Bay (Colwell Bay Member; Late Eocene; [SZ 33 88]; 'reptiles', *Crocodilus* sp.; Insole, pers. comm. to M.J.B.); Headon Hill and Totland Bay (Totland Bay Member–Lacey's Farm Limestone Member; Late Eocene, Priabonian; SZ 3085–[SZ 32 87]; lizards, snakes, type of *Vectophis wardi* Ford and Rage, 1980); Cliff End (middle to upper Headon Hill Formation; Late Eocene; [SZ 332 890]; *Trionyx* sp., *?Ocadia* sp., turtles indet., *Diplocynodon hantoniensis,* ?crocodilian, Insole, pers. comm. to M.J.B.; Gamble, 1981); Fishbourne (Fishbourne Member; Late Eocene; [SZ 537 941]–[SZ 556 934]; trionychid indet., *Ophisaurus, Paleryx rhombifer,* cf. *Calamagras,* erycine indet., cf. *Dunnophis;* Rage and Ford, 1980); Binstead (Seagrove Bay Member; Late Eocene; [SZ 57 92]; 'tortoise carapaces'; Mantell, 1854, pp. 79–82, *Crocodilus* sp.); King's Quay, Wootton (Fishbourne Member; [SZ 54 92]; lizards, turtle fragments); Ryde (upper Headon Hill Formation; Late Eocene; [SZ 59 92]; *Trionyx incrassatus* Owen, 1849); St Helens ([SZ 62 89]; tortoise carapaces; Mantell, 1854, pp. 79–82).

HAMPSHIRE: Warblington (Reading Formation; Late Palaeocene, Thanetian; [SU 731 058]; crocodilian teeth; Bone, 1989, p. 151); Bishop's Waltham (Late Palaeocene; [SU 55 17]; *Diplocynodon bantoniensis*); Southampton Docks (Earnley Member, Bracklesham Group; Mid Eocene, Lutetian, zone NP14, top zone P8 [=*coleothtypta* zone, King, 1981]; [SU 41 12]; *Argillochelys* sp., *Trionyx bowerbanki, Palaeophis porcatus, P. typhaeus, Palaeophis* sp.); Barton Cliff (Barton Clay and Becton Sand formations; Late Eocene; [SZ 305 834]–[SZ 262 922]; *Trionyx planus, Argillochelys* sp., *Trionyx* sp., '*Podocnemis', 'Palaeophis',* type of *Argillochelys athersuchi* Moody, 1980); Knight Bros., Higher Brickyard, near Bransgore (Becton Sand Formation, Horizon G; locality?; *Chelone* sp.; Burton, 1933, p. 148); Hordle Cliff (Totland Bay Member; Late Eocene; [SZ 28 91]; lizards, snakes, amphisbaenian, types of turtles *Aulacochelys circumsulcata* Owen, 1849, *Ocadia crassa* Owen, 1849, *O. oweni* Lydekker, 1889, *Geomydia headonensis* Hooley, 1905, *Trionyx barbarae* Owen, 1849, *T. incrassatus* Owen, 1849, *T. planus* Owen, 1849, *T. rivosus* Owen, 1849, *Trachyaspis hantoniensis* Lydekker, 1889, crocodilian *Diplocymodon hantoniensis* Wood, 1844).

WEST SUSSEX: Felpham, near Bognor Regis (Woolwich and Reading beds; Late Palaeocene, Thanetian; [SZ 95 99]; crocodilian skull, turtles; Bone, 1986); West Wittering, Bracklesham Bay (Wittering Formation, Bracklesham Group; Early Eocene; [SZ 777 973]–[SZ 793 966]; pelomedusid indet., *Puppigerus camperi* (Gray, 1831); *Argillochelys* sp., *Erycephalochelys fowleri* Moody and Walker, 1970 [in W9-W15 of Curry *et al.,* 1978]; 'chelonian'; Curry *et al.,* 1978, pp. 243–54; Moody and Walker, 1970; Walker and Moody, 1985); Bracklesham Bay (Earnley Formation, Bracklesham Group, beds E1–E8 of Curry *et al.,* 1978; Early-Mid Eocene), [SZ 807 961]–[SZ 823 951]; *Puppigerus camperi* (Gray, 1831), *Trionyx bowerbanki* Lydekker, 1889, tri-onychid indet.; Hooker and Ward, 1980, p. 5); Bracklesham Bay (Selsey Formation, Bracklesham Group, S1–S11 of Curry *et al.,* 1978, p. 249; Mid Eocene; [SZ 825 947]–[SZ 843 932]; *Argillochelys* sp., *?Psephophorus* sp., trionychid indet.; Hooker and Ward, 1980); Bracklesham Bay (Bracklesham Group; Early–Mid Eocene; [SZ 825 947]–[SZ 843 932]; *Trionyx* sp., *Palaeophis toliapicus* Owen, 1841, type of *P. typhaeus* Owen, 1850, *Argillochelys* sp., type of *Gavialis dixoni* Owen, 1850, *Lytoloma ?trigoniceps* Owen, 1849, *Psephophorus?* sp., type of *Thalassochelys eocaenica* Lydekker, 1889, type of *Trionyx bowerbanki* Lydekker, 1889, *Crocodilus* sp., *Chelone* sp., *Pseudotrionyx* sp., chelonian indet., *Palaeophis porcatus*); Barton-on-Sea (Barton I–K; Becton Sand Formation; Mid/Late Eocene; [SZ 251 925]–[SZ 263 923]; Hooker and Ward, 1980, p. 6, Burton, 1929; turtle indet., *Puppigerus* sp.); Lymington (Barton Beds; Mid/Late Eocene; [SZ 34 93]; *Crocodilus* sp., *?Diplocynodon,* chelonian); Brockenhurst (S11 3002; *Crocodilus* sp., *Ocadia crassa, Trionyx* sp.).

DORSET: Highcliffe (Barton Clay Formation; Mid/Late Eocene; [SZ 21 92]; *Argillochelys* sp., *Puppigerus* sp., trionychid indet.; Burton, 1929, 1933); Creechbarrow (Creechbarrow Limestone Formation, Mid Eocene; [SY 921 824]; crocodilian indet., chelonian indet., cf. *Cadurceryx* sp. indet., ?lizard indet.; Hooker, 1986).

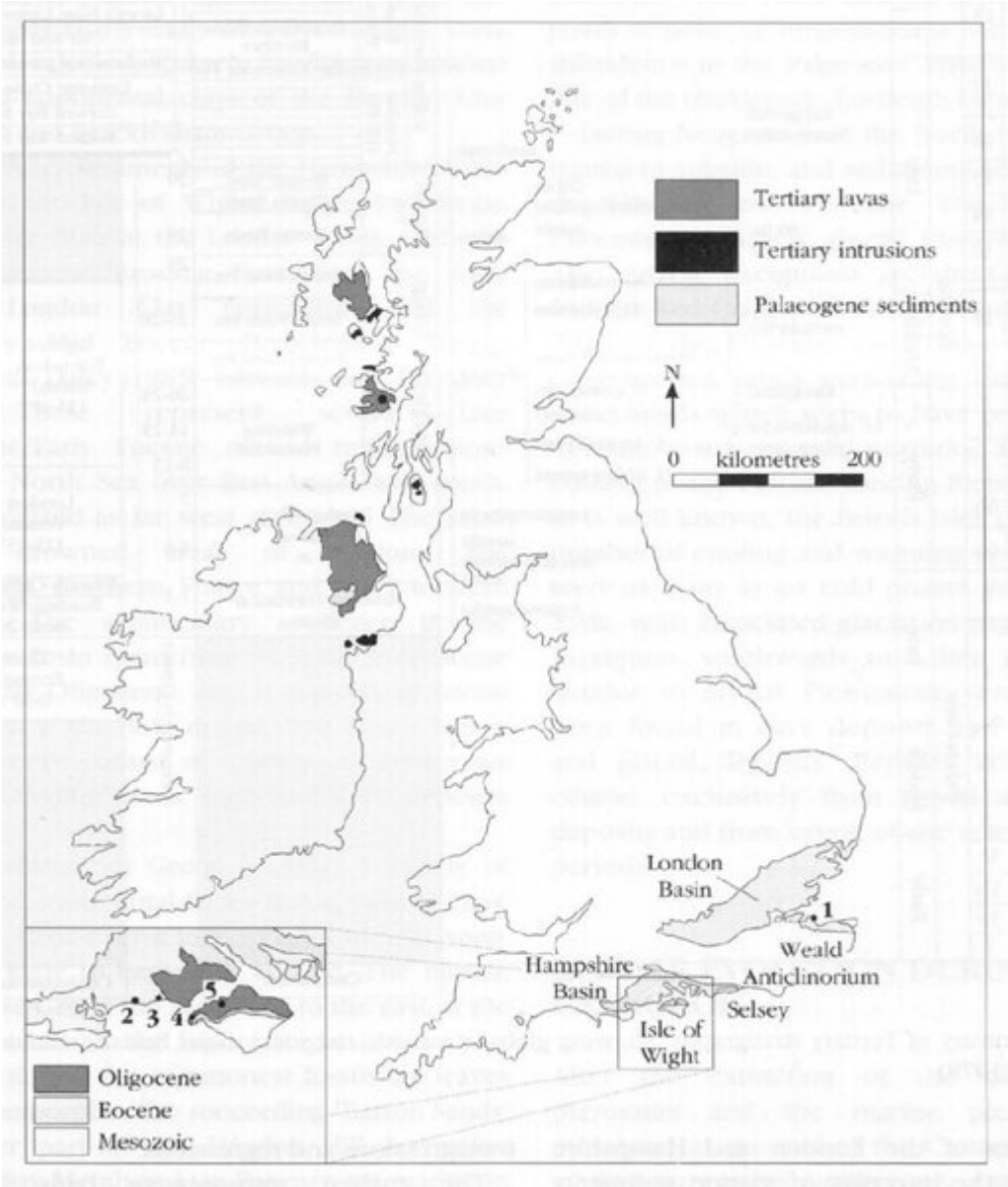
THAMES VALLEY AND ESTUARY: Abbey Wood, Kent (Blackheath Beds; Early Eocene; early Ypresian, Zone MP8–9; [TQ 480 786]; *Trionyx silvestris, Trionyx* sp.; Moody and Walker, 1970; Walker and Moody, 1974; Hooker 1991); Dulwich (Woolwich Shell Beds; Late Palaeocene; Thanetian; ?[TQ 33 74]; *Trionyx;* White, 1931, p. 9; Hooker and Ward, 1980); Herne Bay, Kent (Oldhaven Member, London Clay Formation, Early Eocene; [TR 198 688], [TR 203 688]; *Chelone, Trionyx;* Ward, 1979; Hooker and Ward, 1980); Bellfields, Guildford (London Clay; Early Eocene; ?[SU 99 51]; *Crocodilus*); Highgate (London Clay; Early Eocene; [TQ 28 87]; turtle); Isle of Sheppey, Warden Point (London Clay; Early Eocene; [TQ 955 738]–[TR 024 717]; types of *?Palaeaspis bowerbanki* Owen, 1842, *Argillochelys antiqua* Koenig, 1825, *Eosphargis gigas* Owen, 1861, *Chrysemys bicarinata* Bell, 1849, *C. testudiniformis* Owen, 1849, *Dacochelys delabechei* Bell, 1849, *Palaeophis toliapicus* Owen, 1841, *Crocodilus spenceri* Buckland, 1837); Old Haven, Forstall,

Kent (London Clay; Early Eocene; [TR 06 61]; *Palaeophis*); Harwich (London Clay; Early Eocene; [TM 263 317]; *Lytoloma, Erquelinnesia, Neurochelys;* Moody, 1980b); Walton-on-the-Naze, Essex (London Clay; Early Eocene; [TM 267 243]; *Eosphargis, ?Lytoloma*).

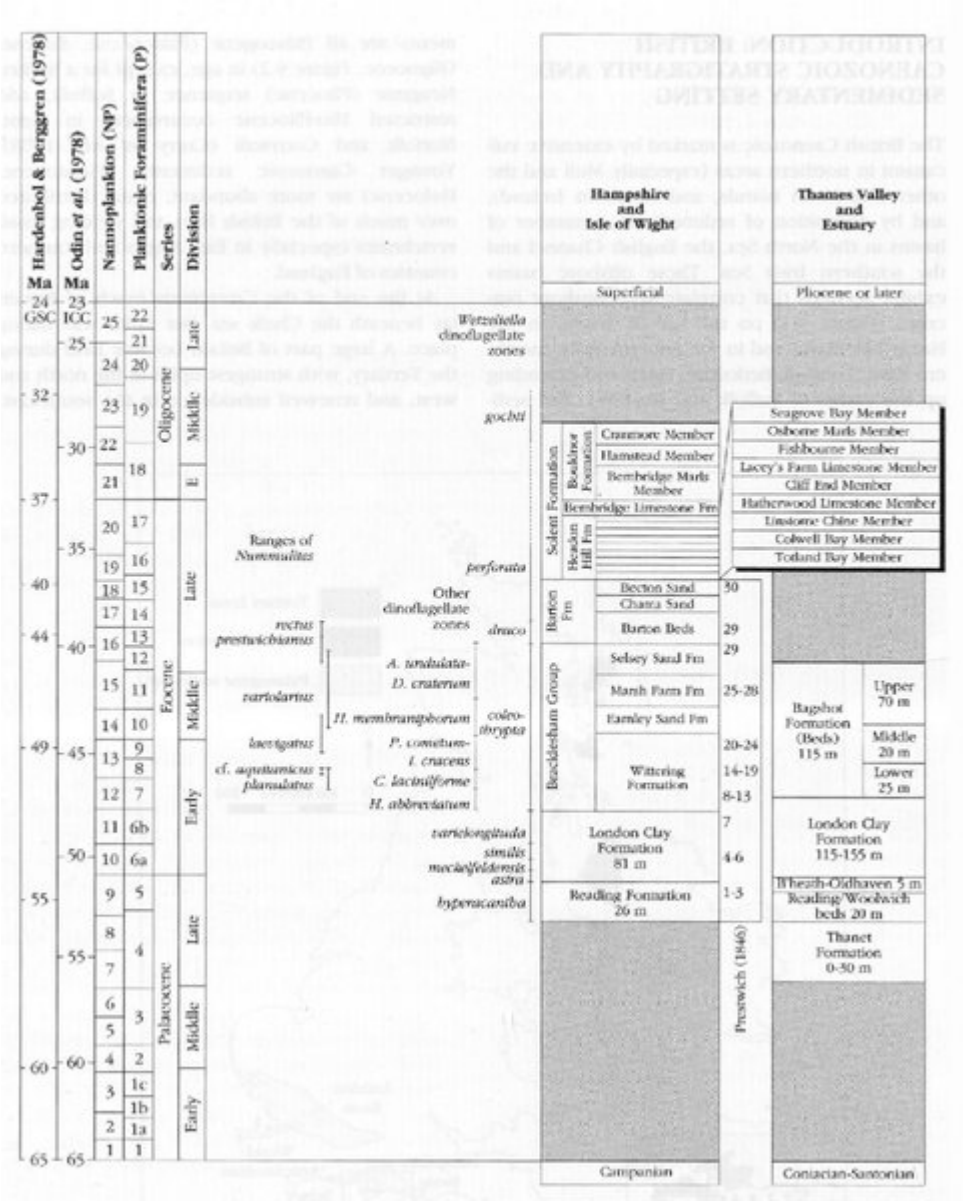
Four GCR sites have been selected from this list as those with the best potential for future finds of Palaeogene reptiles. The first, at Warden Point (Ypresian), is of historical and scientific importance for its wealth of predominantly marine reptiles. The other sites are Bartonian and Priabonian in age, and include two localities in the Barton–Hordle coast section and a third at Headon Hill on the Isle of Wight, all important for their large faunas of terrestrial and marine forms.

1. Warden Point, Kent ([TQ 955 738]–[TR 024 717]). Early Eocene (Ypresian), London Clay Formation.
2. Barton Cliff, Hampshire ([SZ 305 854]–[SZ 262 922]). Late Mid Eocene (Bartonian), Barton Clay and Becton Sand formations.
3. Hordle Cliff, Hampshire [SZ 28 91]. Late Eocene (Priabonian), Totland Bay Member, Headon Hill Formation.
4. Headon Hill and Totland Bay, Isle of Wight [SZ 30 85]–[SZ 32 87], Late Eocene (Priabonian), Totland Bay Member-Lacey's Farm Limestone Member, Headon Hill Formation.

References



(Figure 9.1) Map showing the distribution of Tertiary rocks in Great Britain. Only major divisions are indicated, and an enlargement of the Hampshire and Isle of Wight areas is given. GCR Tertiary reptile sites: (1) Warden Point; (2) Barton Cliff; (3) Hordle Cliff; (4) Headon Hill and Totland Bay; (5) Bouldnor and Hamstead Cliffs.



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