
New Park Quarry, Longborough, Gloucestershire

[SP 176 282]

Highlights

New Park Quarry is the source of specimens of fossil crocodiles and dinosaurs, including the theropod *Megalosaurus*, the sauropod *Cetiosaurus* and the stegosaur *Lexovisaurus*. The site is important as one of the oldest Bathonian sites in the world.

Introduction

New Park Quarry, Longborough, 3 km NNW of Stow-on-the-Wold, has yielded the finest fauna of Mid Jurassic (Bathonian) dinosaurs in Britain this century. The quarry was in operation in the 1920s when the remains of several crocodiles came to light (Richardson, 1929). Around 1935, a collection of well-preserved dinosaur bones, representing several genera, was obtained (Gardiner, 1935), and the British Association for the Advancement of Science sponsored an excavation that produced many more specimens (Gardiner, 1937, 1938).

Reynolds (1939), Galton and Powell (1983) and Galton (1985b) described the stegosaur remains, some of the oldest of that group in the world, but the other material is yet to be studied. The quarry still offers good exposures in the Chipping Norton Limestone Member and could be re-excavated for further reptile finds (Figure 6.4).

Description

H.B. Woodward (1894, pp. 143–4) briefly described the geology of New Park Quarry, and Richardson (1929, p. 89) added a section. Arkell and Donovan (1952, p. 249) gave a fuller account with stratigraphic information:

	Thickness ft	in
Chipping Norton Limestone		
6. Flaggy oyster limestone. <i>Exogyra</i> sp.	2	0
5. Marl with oysters, chiefly <i>Exogyra</i> sp.		10
4. False-bedded, white, shelly oolite	c. 18	0
?Roundhill Clay		
3. Impersistent seam of clay and locally sandy marl with small irony claystone pellets	nil to	8
Hook Norton Limestone		
2. Nodular buff limestones, with dark fossil bones 1–2 feet down. <i>Parkinsonia neuffensis</i> auct. from this bed, <i>teste</i> P.J.	5	0
Channon		
1. Brownish and buff limestones with sandy marl partings	seen to 5	0

The Chipping Norton Limestone (5–6 m thick) consists of wavy-bedded white or cream coloured sandy limestone which weathers to a reddish colour in places. Low-angle cross-beds are present. The rock takes on a more nodular appearance in the lower portions. Richardson (1929, p. 89) reported that the 'black pebble-like bodies' (in bed 3 of Arkell and Donovan 1952) consisted of manganese, limonite, calcium carbonate and phosphate. The lower unit (1–2 m visible; bed 1 of Arkell and Donovan, 1952) is similar to the main limestone, but appears to be less nodular.

Richardson (1929, p. 89) noted crocodiles (9 fragments of a mandible of *Steneosaurus* and a scute of *Teleosaurus subulidens*) in the Chipping Norton Limestone (Arkell's bed 4), and the bones collected in the 1930s were found in a hard cream-coloured limestone which was worked for road metal (Reynolds, 1939, p. 193). Arkell and Donovan (1952, p. 249) clearly identify their bed 2 as the source of bones of *Steneosaurus* and *Megalosaurus*, and they indicate that the other bones in the British Museum and the Stroud Museum came from this horizon.

The sequence at New Park Quarry spans most of the Chipping Norton Formation, which is dated as belonging to the *zigzag* Zone, the basal zone of the Early Bathonian (Torrens, *in* Cope *et al.*, 1980b). The Chipping Norton Limestone (=Chipping Norton Member) is ascribed to the *yeovilensis* Subzone of the *zigzag* Zone on the basis of specimens of the ammonite *Oppelia* (Torrens, 1969b, p. 74). The Hook Norton Limestone (=Hook Norton Member) at New Park Quarry has yielded specimens of the ammonites *Parkinsonia neuffensis* Opper and *P. subgalatea* Buckman (Reynolds, 1939; Arkell, 1951–8, p. 160; Arkell and Donovan, 1952, p. 249), which indicate a zonal assignment to the *convergens* Subzone (Torrens, 1969b), the lowest Subzone of the *zigzag* Zone, hence earliest Bathonian (Torrens, 1969b; Cope *et al.*, 1980b, fig. 6a). Thus, some of the crocodiles come from the top of the *zigzag* Zone, and the dinosaurs and some crocodiles from the base of the *zigzag* Zone.

The reptile remains from New Park Quarry in museum collections have been prepared so that no matrix remains; hence, nothing can be said of the relationship of the bones to the sediment nor of the relative association of the bones. Nevertheless, it seems evident that all elements were disarticulated and must have been transported at least a short distance. There is no sign of major abrasion to the bones, although some delicate processes have been lost.

Fauna

The reptilian fauna from New Park Quarry was described by Reynolds (1939), and the species are listed together with a note of major specimens in the BMNH, BGS(GSM) and SDM. The Stroud Museum display of these specimens is described by Walrond (1976):

Archosauria: Crocodylia: Thalattosuchia:

Steneosauridae

Steneosaurus cf. *subulidens* (Phillips, 1871) BMNH R.6307; BGS(GSM) 37520–2 (mentioned, Richardson 1929, p. 89); SDM 44.42, 44–8, 51–7, 59–68

Dinosauria: Saurischia: Theropoda:

Megalosauridae

Megalosaurus sp. BMNH R.9666–76, R.9678–9, R.9681–7, R.9689–700; SDM 44. 1, 4–10, 12–5, 18, 21, 23–6

Dinosauria: Saurischia: Sauropoda: Cetiosauridae

Cetiosaurus sp. SDM 44. 30–40

Dinosauria: Ornithischia: Stegosauria: Stegosauridae

Lexovisaurus? vetustus (Huene, 1910) SDM 44. 41; BMNH R.5838

Interpretation

The remains of the marine crocodile *Steneosaurus* include skull bones, a braincase, several partial snouts, isolated teeth, scutes, vertebrae and a scapula. The New Park crocodile evidently had a skull 0.3–0.6 m long and probably a total body length of 1.5–3.0 m, thus a fairly large animal. Comparisons are difficult because of the confused taxonomy of Jurassic marine long-snouted crocodiles and, in particular, the distinction between the genera *Pelagosaurus*, *Steneosaurus* and

Teleosaurus and the multiplicity of their included species (Westphal, 1962; Steel, 1973). Bathonian species include *S. boutillieri*, *T. cadomensis*, *T. geoffroyi* and *T. gladius* from the 'Fullers Earth' and 'Great Oolite' of Normandy; *S. brevidens*, *S. latifrons*, *T. cadomensis* and *T. subulidens* from the 'Great Oolite' of Oxfordshire and Northamptonshire; and *S. stephani* from the Cornbrash of Closworth, Somerset. All of these specimens come from the Mid or Late Bathonian, younger than the New Park material.

The remains of *Megalosaurus* include a good sacrum, some caudal vertebrae, a rib, two coracoids, a scapula, a humerus, three ischia, a femur, a metatarsal and a partial lower jaw. The postcranial bones are well preserved, and the lower jaw shows seven teeth in various stages of growth. Other Mid Jurassic material of *Megalosaurus* is known from the Upper Inferior Oolite of Sherborne, Dorset (*M. hesperis* Waldman, 1974; *M. nethercombensis* Huene, 1923), the Stonesfield Slate (*sensu lato*) of Oxfordshire, Gloucestershire and Dorset (*M. bucklandi* Meyer, 1835; *M. bradleyi* Woodward, 1910; *M. incognitus* (Huene, 1932)), the Oxford Clay of Dorset (*M. parkeri* Huene, 1926) and the Bathonian of Morocco (*M. mersensis* Lapparent, 1955). The New Park material could belong to any of these species, or to some other.

The bones of the sauropod *Cetiosaurus* from New Park Quarry include ribs, a coracoid and a pair of ischia. Because of their size (the ischia are 1.0 m long), these specimens undoubtedly belong to *Cetiosaurus*, but they cannot be assigned to a species since the taxonomy is in need of revision. At least eleven species have been described from the Mid and Late Jurassic of England, France and Morocco, and the Early Cretaceous of England. The Mid Jurassic forms are *C. rugulosus* (Owen, 1841), *C. oxoniensis* Phillips, 1871 and *C. glymptonensis* Phillips, 1871 from the 'Great Oolite' of Wiltshire, Gloucestershire, Oxfordshire and Northamptonshire, and *C. mogrebiensis* Lapparent, 1955 from the Bathonian of Morocco. It has never been made clear what the diagnostic characters of each species are supposed to be. The New Park sauropod is slightly older than all of these forms.

The 'dermal plates of *Stegosaurus*' from New Park represent some of the earliest records of stegosaurid dinosaurs. Galton (1983c) and Galton and Powell (1983) described a dorsal vertebra (OUM J29770) and a cervical centrum (OUM J29827) from Sharps Hill, Oxfordshire as the oldest British stegosaurid, and this claim was repeated by Boneham and Forsey (1991) who reported further stegosaur remains from Sharps Hill. However, the Sharps Hill Member lies partly in the *progracilis* Zone, the earliest zone of the Mid Bathonian, and partly in the *tenuiplicatus* Zone, the topmost zone of the Early Bathonian (Torrens, 1968; Torrens *in Cope et al.*, 1980b), hence above the Chipping Norton Formation. Therefore, the New Park stegosaur finds are one or two ammonite zones older than those from Sharps Hill, and in, any case, *Tatisaurus oehleri*, from the Lower Lufeng Formation (Sinemurian–Hettangian) of Yunnan Province, China, hitherto regarded as an unidentifiable ornithischian, may be a true stegosaur (Dong, 1990).

Reynolds (1939) referred the two large dermal plates to the North American genus *Stegosaurus*, but Galton *et al.* (1980, p. 41) disputed this referral and suggested that the plates were probably the sacral ribs of a sauropod. However, later, Galton and Powell (1983) and Galton (1985b), in their reviews of Bathonian stegosaurs from England, provisionally reassigned the specimens to the Stegosauridae. They noted that the plates were reasonably massive when compared with the complete series of plates of *Stegosaurus* and the few known plates of *Lexovisaurus*, and tentatively referred them to *Lexovisaurus ?vetustus* (Huene, 1910). The New Park stegosaur must have been large, since the plates are 0.25 m high.

Stegosaurs have been reported from higher in the British Mid Jurassic, from the Lower Oxford Clay (Callovian) of the Peterborough area. Hulke (1887) noted remains of a stegosaur which he termed *Omosaurus* (= *Dacentrurus*), believing it to come from the Kimmeridge Clay; these represent *Lexovisaurus durobrivensis* (Galton, 1985b). Hulke also reported armour plates, but these turn out to be from the giant teleost fish *Leedsichthys* (Martill, 1988). Stegosaur armour plates were later found in the area. A second Oxford Clay stegosaur was '*Stegosaurus*' *priscus* from Fletton (Nopsca, 1911), synonymized by Galton (1985b) with *L. durobrivensis*. Other isolated remains of this species have been reported from the Lower Oxford Clay of Whittlesey and Weymouth.

Comparison with other sites

The fossil reptile sites nearest in age to New Park are Oakham Quarry [SP 279 306], which has produced remains of *Megalosaurus* and *Cetiosaurus*, Longborough Road Quarry [SP 171 296], which has yielded *Steneosaurus*, Sharps Hill Quarry [SP 338 358], which has yielded *Lexovisaurus* and Hornsleasow Quarry [SP 131 322], which has yielded a variety of crocodylian and dinosaur remains. Oakham Quarry lies in the Chipping Norton Formation (*zigzag* Zone) and Longborough Road Quarry is in the Inferior Oolite (Aalenian, Bajocian) (Richardson, 1911a, pp. 227–8; Arkell and Donovan, 1952, pp. 248–9). Sharps Hill Quarry is dated as *tenuiplicatus* Zone and Hornsleasow as *zigzag* Zone, both Early Bathonian.

Richardson (1929, p. 88) recorded a vertebra of *Megalosaurus* (BGS(GSM) 37523) from a quarry in the Chipping Norton Formation in a field near the Fosse Way [SP 193 271]. Richardson (1929, p. 95) also mentioned that bones had been found in the Chipping Norton Formation of a quarry ENE of Swell Buildings ([SP 164 264]). Only Oakham Quarry and Hornsleasow Quarry come near to New Park for the abundance and diversity of their reptile remains, but better comparisons may be made with the richer faunas of the White Limestone Formation (e.g. Eyford, Chipping Norton, Stonesfield, Slape Hill, Enslow Bridge, Kirtlington). Hornsleasow has proved extremely productive as a result of recent studies (Metcalf *et al.*, 1992), and has yielded thousands of microvertebrate remains, scales and teeth of fishes, and teeth and bones of a diverse array of amphibians (frogs, salamanders), reptiles (turtles, 'lizards', choristoderes, crocodylians, dinosaurs, pterosaurs, tritylodontids) and rarer mammals (Figure 6.5). However, that site has been essentially worked out, since the bulk of the fossiliferous clay containing fossils has been removed from the site.

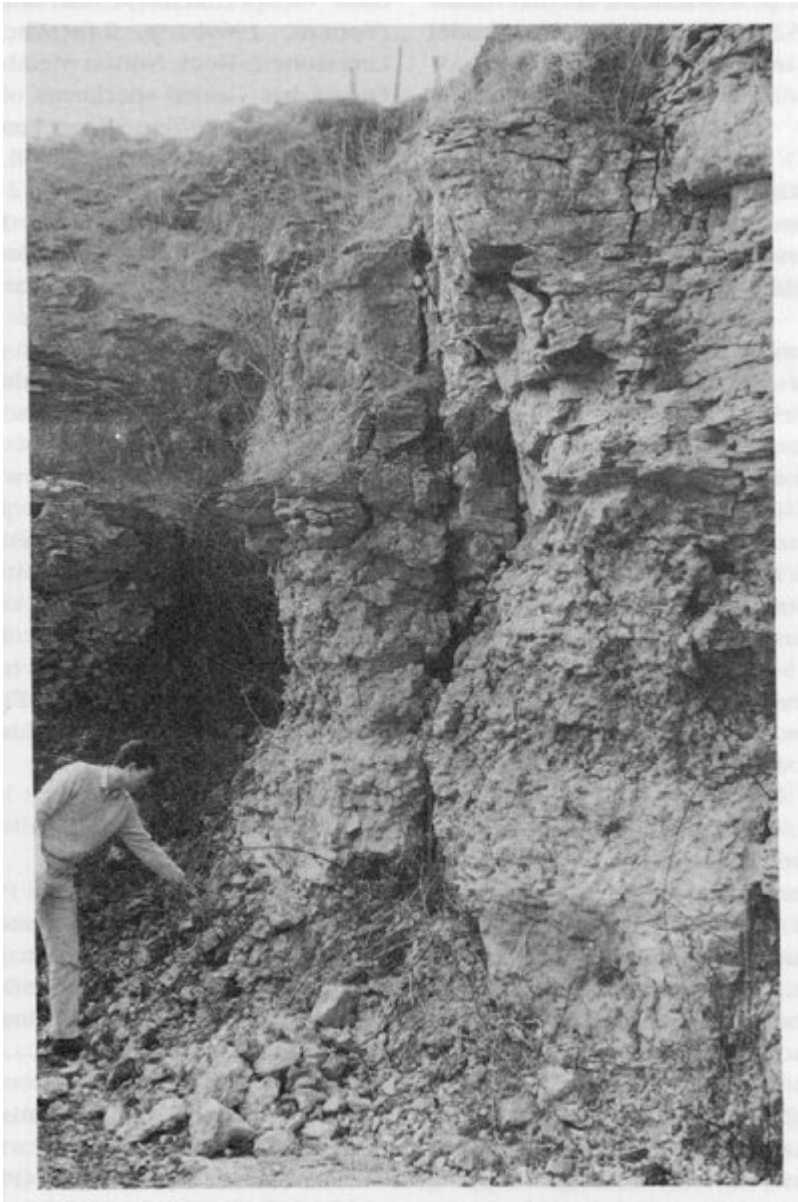
The New Park stegosaur (*Lexovisaurus? vetustus*) is also known from isolated remains in the Lower Cornbrash (*discus* Subzone, Late Bathonian of Oxfordshire) and from the Sharps Hill Formation, Oxfordshire (*tenuiplicatus* Zone; latest Early Bathonian) (Galton, 1985b).

Elsewhere, the crocodiles are comparable with those from the Fuller's Earth of Caen and Calvados, Normandy (?Early/Mid Bathonian), and the megalosaur and cetiosaur with remains of these forms from the Bathonian of El Mers in the Moyén Atlas of Morocco (Steel, 1970, pp. 36, 64–5).

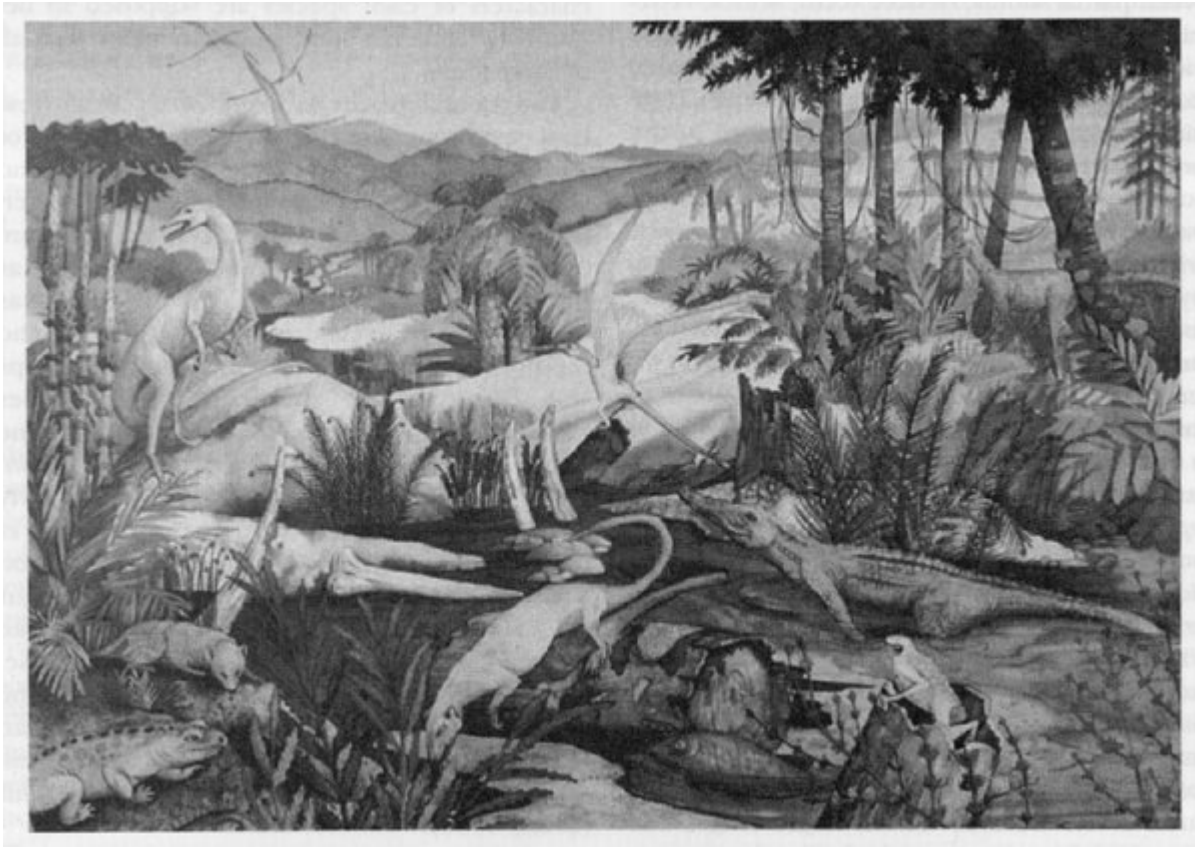
Conclusions

New Park Quarry is a very important site for terrestrial fossil reptiles, especially in view of its age. Several other sites in the Chipping Norton Limestone have yielded isolated reptile remains, but the fauna from New Park Quarry is by far the richest for large-sized reptile remains. It is comparable to many of the younger and better known sites in the Mid and Late Bathonian north of Oxford and at Eyford, Gloucestershire. The preservation of the reptiles from New Park Quarry is excellent. They will be of great value in assessing the relationships of early theropods and sauropods. The dermal plates from New Park may be the oldest remains of true stegosaurids in the world. The fact that the fossils were discovered this century suggests that more may be forthcoming if the site is excavated and enhances the conservation value.

[References](#)



(Figure 6.4) Exposure of the Chipping Norton Limestone Member in New Park Quarry. Reptile bones were recovered from the top of the underlying Hook Norton Limestone Member, in the floor of the quarry. (Photo: M.J. Benton.)



*(Figure 6.5) Scene in Early Bathonian times, showing a small lake in Gloucestershire surrounded by seed ferns and conifers. Fishes (*Lepidotus*) live in the water, and frogs (*Eodiscoglossus*) disport themselves around the sides. Dinosaurs include some of the earliest stegosaurs and maniraptorans (?), plated and small carnivorous dinosaurs respectively. A carcass of the large sauropod, *Cetiosaurus*, is rotting in the water, and *Megalosaurus* scavenges. Lizard-like animals, crocodiles, pterosaurs, mammals and tritylodont mammal-like reptiles complete the scene. Based on a restoration painting by Pam Baldaro, showing the scene at Hornsleasow Quarry, Gloucestershire. Reproduced with permission of the University of Bristol.*