DINOSAURS
of the
BRITISH ISLES

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FOREWORD BY DR PAUL M. BARRETT

With the exception of dedicated dinosaur fans, few members of the British public realise that the rocks beneath their feet have yielded one of the best dinosaur fossil records from anywhere in the world. News of the latest spectacular discoveries from China, the USA, Canada and Argentina have to some extent overshadowed the material that has been painstakingly extracted from the coastal cliffs and inland quarries of the British Isles for nearly 200 years. However, the UK can justifiably call itself the home of dinosaur studies, as discoveries made in the early part of the nineteenth century – from the mudstones, sandstones and limestones of southern and central England – were the first to reveal the former existence of these fabulous animals, which astounded scientists and the public alike. Since the early discoveries of *Iguanodon*, *Megalosaurus* and *Hylaeosaurus*, the trio of animals that formed the basis for Sir Richard Owen's concept of his terrible lizards or Dinosauria, numerous other dinosaurs have been found in the UK. Few, however, have achieved the levels of fame found by their North America cousins, whose names, like *Tyrannosaurus* and *Triceratops*, are much more familiar, not least due to their frequent appearances in Hollywood blockbusters.

It may surprise some to know that well over 100 dinosaur species have been named on the basis of discoveries from the UK, ranging from species based on single isolated bones, to those known from several complete skeletons. While it is true that the Mesozoic rocks of the UK have not provided as many complete dinosaur skeletons as those from elsewhere in the world, several British dinosaurs are genuinely among the best known, including *Hypsilophodon*, *Mantellisaurus* and *Scelidosaurus*, each of which is known from at least several complete, or almost complete, skeletons. Moreover, given the relatively small land area of the UK this record is both remarkable and amazingly diverse – it ranges from some of the earliest dinosaurs (from the Late Triassic), through to the onset of the Late Cretaceous, and is particularly rich in the remains of Middle Jurassic and Early Cretaceous dinosaurs, which have poor records elsewhere in the world (with the exception of China and, to some extent, Patagonia). Also, with the notable omission of horned and domed dinosaurs, all major dinosaur groups are represented in the UK. So, this small set of islands has had a disproportionate influence not only on the historical development of dinosaur studies, but also on what we know about their diversity and lifestyles.

Although the majority of British dinosaur material was found historically, due to the fact that all quarrying, mining, and tunnel, road, and canal construction was carried out by hand (thus giving ample opportunity to find material), new finds are still made on a regular basis. For example, the past decade has witnessed the naming of several new British dinosaurs, both on the basis of additional discoveries and from reappraisal of material in museum collections. Anyone with a keen eye in a quarry or along a coast with rocks of the right age and type stands a chance of finding a dinosaur specimen that may offer extraordinary new insights into their long lost world.

The story of UK dinosaurs is constantly changing and is still a work in progress. In this book, the authors provide an up-to-date snapshot of the animals that once roared and roamed their way across what are now the British Isles, providing a showcase for these often overlooked stars of the dinosaur firmament and demonstrating just how rich the record of these spectacular animals really is.

Dr Paul M. Barrett (The Natural History Museum, London)

FOREWORD BY THE AUTHORS

Given that dinosaurs are a 'British invention', it may seem strange to many that despite the thousands of books available on the topic, there has been no general work covering the dinosaurs of the British Isles. As a result of our work in compiling this book we would like to comment on why this may be. There were several problems encountered when considering the content for the book. First, many British dinosaurs are known from limited skeletal remains, which on the whole, may not be conducive to good visual representation in a book aimed at a broad audience, as opposed to in a scientific paper. However, advances in palaeontology, particularly our increased knowledge of dinosaur comparative anatomy, mean we are now able to depict how these organisms may have appeared in life, even based on incomplete fossils. In addition, with so many dinosaurs described worldwide, it allows for fragmentary remains from the British Isles to be put into context, which in turn facilitates better interpretations.

Palaeontology is a rather unique science, where experts and also general enthusiasts can make valuable contributions. However, unlike botany, entomology, etc, where it is usually easy to go out in the field and collect or study hundreds if not thousands of individuals relatively easily, dinosaur fossils are much harder to find. Traditionally, and quite rightly so, important discoveries have been donated or bequeathed to museums, with a view to forming a centralised repository structure for researchers, whilst at the same time allowing the creation of displays for the general public. However, this can create other problems for preparation of a book such as this, such as access to the palaeontological material itself. Only a very small portion of museum specimens are on display to the public at any one time, with the majority stored in drawers behind-the-scenes and hidden from public view. Such specimens are usually only accessible to bona-fide academic researchers. Unfortunately, access to the specimens is not the only hurdle to overcome. Permission to make and/or reproduce images of the specimens can also be a major obstacle. This is further hampered by each institution having different (sometimes ambiguous) reproduction policies and copyright rules, which some are prepared to waive to a degree under some circumstances. Similar issues arise with regard to images derived from unpublished (e.g. geological) datasets. Of course, there is also the added expense of physically travelling to many of the institutions to examine, photograph and measure specimens. Finally, there is the human element. Each collection is managed by specialist museum personnel. In some cases, a curator may refuse permission to include specimens from their collections in a work such as this. We believe this is a great shame because it does a disservice to the institution in which they work by missing an opportunity to highlight and promote the value of their collections (regionally, nationally and internationally). It also keeps their important specimens hidden from public view and hence unavailable for enthusing the next generation of British palaeontologists. In some cases this is being rectified to a degree by museums putting photographs of their collections online, but universal completion of this task is still a very long way off. Also, such online image collections rarely contextualise the fossils as well as in a dedicated book such as this. Hence, we would like to reiterate our thanks to all individuals listed in the acknowledgements for enabling the completion of this book. Your co-operation will no doubt help inspire generations of future British palaeontologists. Such positive assistance can only benefit the future of British palaeontology.

Dean R. Lomax & Nobumichi Tamura

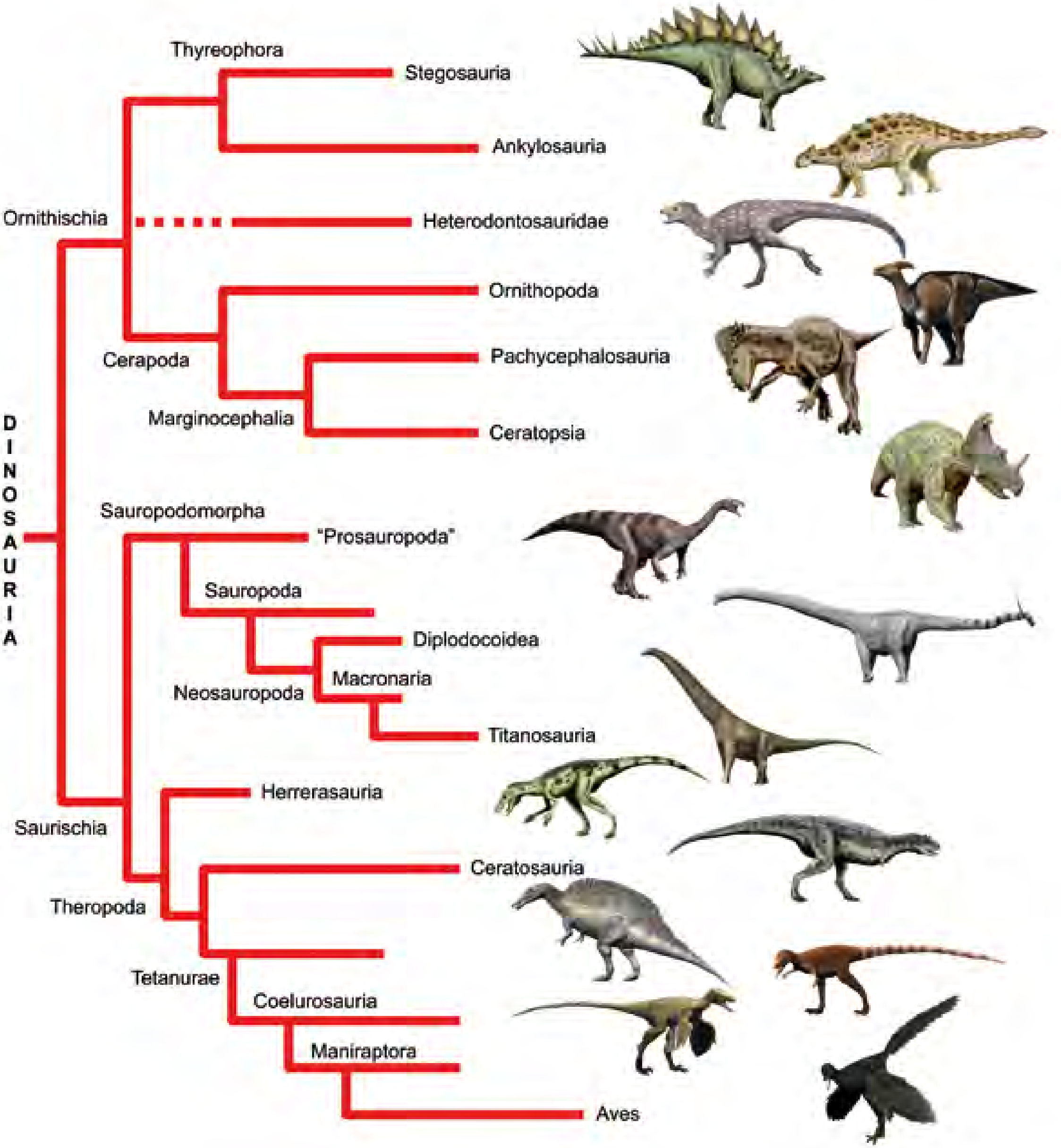


Figure 20. Simplified cladogram of the Dinosauria showing all the major groups. From top to bottom: *Stegosaurus* (stegosaur), *Ankylosaurus* (ankylosaur), *Pegomastax* (heterodontosaur), *Charonosaurus* (ornithopod), *Pachycephalosaurus* (pachycephalosaur), *Coronosaurus* (ceratopsian), *Plateosaurus* ('prosauropod'), *Barosaurus* (diplodocoid), *Futalognkosaurus* (titanosaur), *Herrerasaurus* (herrerasaur), *Carnotaurus* (ceratosaur), *Spinosaurus* (Tetanurae), *Sinosauropteryx* (coelurosaur), *Velociraptor* (maniraptoran), *Archaeopteryx* (Aves).

DINOSAUR DISCOVERIES: A BRIEF INTRODUCTION

Dinosaurs: A British 'invention'

Despite dinosaurs dominating millions of years of geological time, they are, historically speaking, a very recent 'discovery'. The name *Dinosauria*, taken from the Greek meaning 'terrible (or fearfully great) lizard', was conceived by the English anatomist Sir Richard Owen sometime between a meeting of the BAAS (British Academy for the Advancement of Science) in 1841 and publication of the name in the first fortnight of April 1842. It should be mentioned that whenever the 'dino-penny dropped' for Owen, only then was the word Dinosauria truly coined. Although the exact date this happened is unknown and near impossible to determine. Before the naming of Dinosauria, any bones or teeth previously discovered could not possibly be referred to as dinosaur, given that the name was yet to be 'invented'. In fact, the first true dinosaur bone to be described was a sacrum (known as the 'Saull specimen') collected from Brook, Isle of Wight, later regarded as *Iguanodon*. This specimen was the 'missing piece of the puzzle' for Owen, who founded his Dinosauria based on this specimen. He recognised that the fusion of vertebrae in the sacrum was unique for this odd group of animals. This allowed for the referral of three genera of large extinct reptiles, *Megalosaurus*, *Iguanodon* and *Hylaeosaurus*, unearthed in the British countryside during the 19th century, to his Dinosauria.

The systematic study of dinosaurs as a group thus started in England with Sir Richard Owen (1804–1892), who was influential in all projects related to these creatures and palaeontology in general. He was the driving force behind the creation (in 1881) of the Natural History Museum in London. Other figures of the early days of British palaeontology include Dr Gideon Mantell (1790–1852) who discovered the first fossils of *Iguanodon*, the eccentric Reverend William Buckland (1784–1856) who wrote the first full account of a dinosaur-to-be, *Megalosaurus*, and Mary Anning (1799–1847) who, in spite of not finding dinosaur remains, tirelessly searched for fossils in Dorset and made many important scientific discoveries, including the first skeleton of an ichthyosaur, a plesiosaur and of a British pterosaur. The Scot Sir Charles Lyell (1797–1875) was the foremost authority on Geology of his time, playing a key role in helping to decipher specific features of our planet. The English anatomist and vertebrate palaeontologist Thomas Huxley (1825–1895) dominated the debate on evolution after Charles Darwin (see page 53) proposed his revolutionary theory. Comparing the skeletons of *Archaeopteryx* and *Compsognathus*, Huxley was the first to recognise that birds must have evolved from theropod dinosaurs.

Figure 35. Notable early figures in dinosaur palaeontology. A. Dr Gideon Mantell. B. Reverend William Buckland. C. Sir Richard Owen. D. Thomas Huxley. Four of the most influential palaeontologists that helped sculpt and define the Dinosauria, paving the way for the future study of dinosaurs.

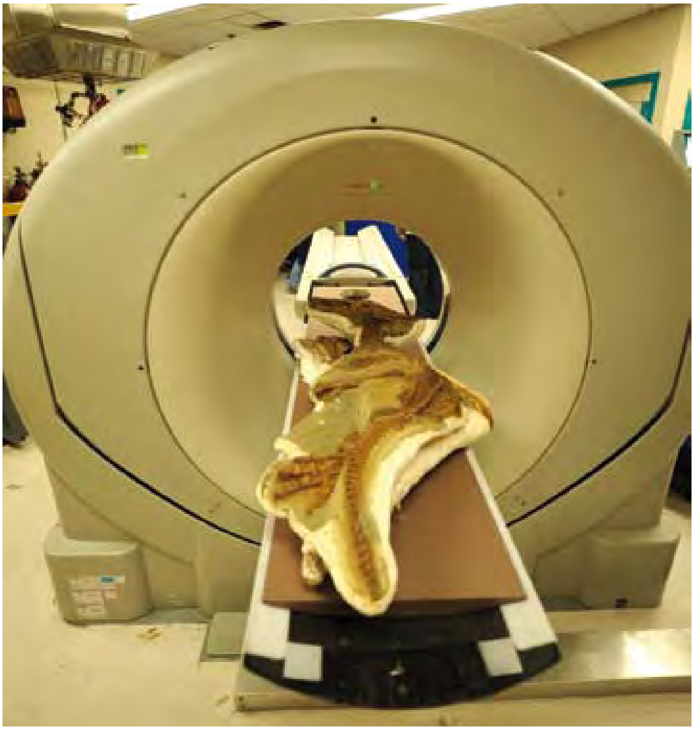


Figure 51. CT scanning of a juvenile ceratopsian dinosaur skeleton from Dinosaur Provincial Park (Late Cretaceous) in Alberta, Canada.

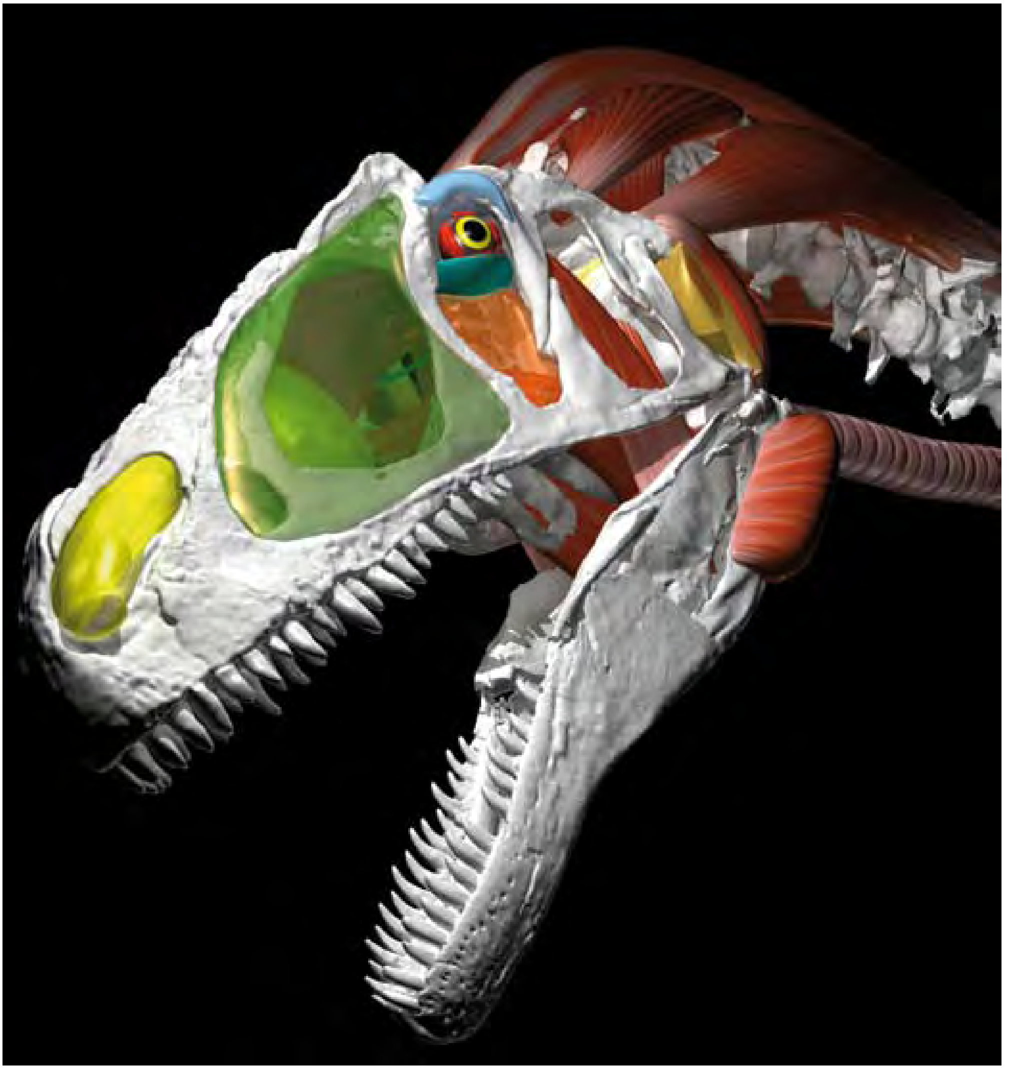


Figure 52. High resolution replicas of the skull and neck belonging to the famous *Allosaurus*, dubbed ‘Big Al’, from the Late Jurassic of Wyoming, USA, were CT-scanned. The scanning resulted in the computer generated skeleton and soft tissues of the head and neck.

As an example of scientific advancement in our understanding of dinosaurs was the revelation that the colour of some species can be reconstructed. Until very recently, the colour pattern of long extinct animals was left to the imagination of palaeoartists. However, in 2010, *Anchiornis* from China became the first dinosaur to reveal its true colours. The study focused on the preservation of fossilised pigments found within the fossilised feathers around the skeleton. This was followed by similar studies on *Sinosauropteryx*, *Caudipteryx*, *Microraptor, Confuciusornis* and the single holotype feather attributed to *Archaeopteryx*. However, a study in 2013 showed that the fossilisation process actually distorts pigment structures, raising doubts about the colour reconstructions. Future research will no doubt reveal further details about the colour of dinosaurs.

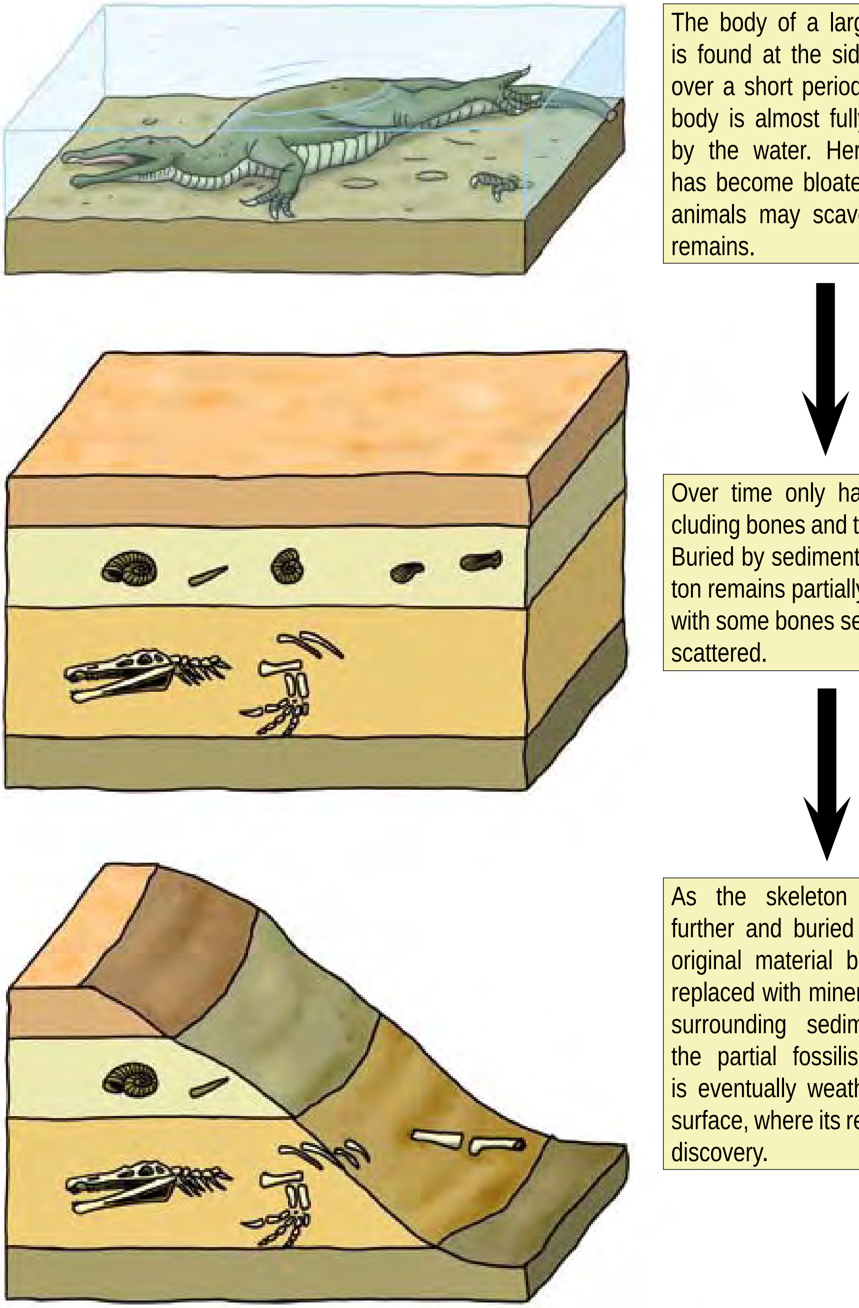
DINOSAUR BONES: THE FOSSILISATION PROCESS AND THE SCIENCE OF PALAEONTOLOGY

What are fossils and how do they form?

First of all, it should be established that the fossil record is very incomplete, although well represented. Only a very small fraction of the plants and animals that once inhabited the planet are preserved as fossils. Thus, with each new fossil described, palaeontologists attempt to understand the past by piecing together an immense prehistoric jigsaw puzzle. In comparison with the sheer number of animals alive today, only a few dinosaurs have been discovered across millions of years, and assigned to distinct species. The lack, and fragmentary nature, of dinosaur specimens does not mean that only a few dinosaur species existed. Rather, it demonstrates how extremely rare and perfect the conditions needed to be in order for such large, terrestrial organisms to become preserved as fossils.

Fossils can form in a variety of ways, but the preservation potential depends on the composition and habitat of a specific organism, in addition to the circumstances under which it perished. The most common mode of preservation involves an organism, or parts of it, that became buried in sediment. The organic material that makes up the organism is replaced slowly by minerals from the surrounding sediment matrix. This turns the organism into a fossil through the process of permineralisation or petrification. Besides hard parts such as teeth, bones and shells, fossils can exceptionally preserve traces of the soft parts of the animal, such as skin, hair and internal organs. Even animals like jellyfish have been preserved as impressions on very rare occasions. This can occur due to rapid burial of the organism in soft sediments. In other occurrences some individual fossil species (or very few species) can occur in large concentrations. The corresponding deposits are called "bone beds" and often represent the death of many animals, in a short period of time, due to a catastrophic event such as a flood. Such occurrences are termed Lagerstätten. There are two main types of Lagerstätten: concentration Lagerstätten, which consist of large concentrations of fossils found together and conservation Lagerstätten, where the defining feature is the preservation of quality rather than (but often as well as) the sheer quantity of fossils. There are numerous types of fossil Lagerstätten found across the world.

Even though there are many types of fossil preservation, the way in which certain fossils form may not favour the formation of others. For example, the conditions in which some dinosaur remains (hard parts) are preserved would not favour the preservation of certain soft-bodied organisms. As an extreme comparison, the earliest multicellular life forms, documented within the famous Ediacaran biota of the Precambrian, consist of soft-bodied organisms that are found as impressions. Their preservation potential would be extremely low in many scenarios. A fine example of exceptional preservation are the so-called "dinosaur mummies", whereby impressions of dinosaur soft tissues, skin, scales and even muscles have (in very rare occurrences) been found with some dinosaur fossils. In order for a dinosaur 'mummy' to be formed, certain processes need to have occurred before fossilisation. In this process, when a dinosaur died, its skin must have been thoroughly dehydrated (removal of water), which must have occurred in the absence of oxidation and bacterial activity. The desiccated remains were then fossilised, preserving incredible detailed impressions of the soft tissues. Insects and other small organisms (even microbes) can be found preserved with incredible life-like fidelity in amber (fossilised tree resin), including occasionally within the British Isles. In 2011 it was reported that feathers, probably belonging to a theropod dinosaur, were found encased in amber collected from the Late Cretaceous of Alberta, Canada.



The body of a large *Baryonyx* is found at the side of a lake, over a short period of time the body is almost fully enveloped by the water. Here the body has become bloated and other animals may scavenge at the remains.

Over time only hard parts including bones and teeth remain. Buried by sediments, the skeleton remains partially articulated, with some bones separated and scattered.

As the skeleton is covered further and buried deeper, the original material begins to be replaced with minerals from the surrounding sediments. Here the partial fossilised skeleton is eventually weathered to the surface, where its remains await discovery.

Figure 56. The fossilisation process of a dinosaur: One of few scenarios in which a dinosaur may potentially become a fossil.

A GEOLOGICAL HISTORY OF DINOSAURS FROM THE BRITISH ISLES

In the following section, dinosaurs found in the British Isles are treated according to their geological age and stratigraphic occurrence. We believe this provides a sense of which dinosaurs lived together and a glimpse of the ecosystems in which they existed, by providing brief additional information on some of the other animals and plants that were found alongside their remains. The sections are arranged in chronological order starting from the Late Triassic and ending with those from the Late Cretaceous. Like nearly all Triassic dinosaur deposits worldwide, the remains of Triassic dinosaurs in the British Isles are not particularly abundant. Nonetheless, numerous specimens have been documented, with a moderate-sized collection of dinosaurs described from Wales and western-central England. The Jurassic and Lower Cretaceous rocks of England are the most productive dinosaur-bearing deposits. Diverse dinosaur remains have been discovered and described, including sauropods, theropods, thyreophorans and ornithopods.

Discussed throughout this entire section are key dinosaur-bearing formations and groups found in the British Isles. It is not within the scope of this book to describe every single dinosaur bone ever found in the British Isles. We have carefully selected a representative sample in order to provide a good general overview of the variety of dinosaurs that have been found. Please note, some dinosaurs have an affiliated ‘text box’ that lists some of the basic information regarding that species.

Late Triassic

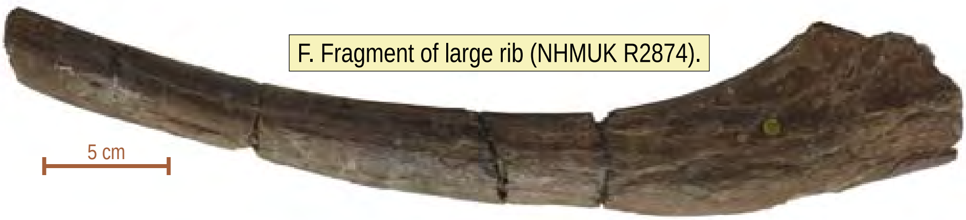
The Late Triassic was an important period of time for the evolutionary development of dinosaurs. It is divided into three stages, named from the oldest to the youngest as Carnian, Norian and Rhaetian.

The first records of dinosaurs date from the beginning of the Late Triassic, or even perhaps from the end of the Middle Triassic. The earliest definitive dinosaurs were discovered in the famous Ischigualasto Formation of Argentina, and include forms that can already be classified within the two main divisions of the class Dinosauria: the Saurischia and the Ornithischia. One of the earliest known dinosaurs is the small two-legged saurischian *Eoraptor lunensis* which was found at the base of the Ischigualasto Formation and dates from the middle–late Carnian. *Eoraptor* had a number of primitive features that make it difficult to classify within Saurischia. It was first placed within the theropods but in recent years it was found to have closer affinities with the sauropodomorphs.

At the beginning of the age of dinosaurs, they were not the dominant terrestrial vertebrates. The Carnian was populated with a variety of reptiles occupying various ecological niches. Dominant predators included the large armoured rauisuchians and the freshwater crocodile-like phytosaurs. Smaller predators included two-legged animals such as the ornithosuchians, running and agile animals related to crocodiles. Herbivores were represented by forms such as the stocky rhynchosaurs, the armoured aetosaurs and slender dinosauriformes such as *Silesaurus* from Poland.

B–D. B. (NHMUK R2873, both vertebrae). C. Dorsal vertebrae (NHMUK R2877). D. Three caudal vertebrae (NHMUK R2876).

E. Part of right foot (pes) including phalanx and claw (NHMUK R2872).



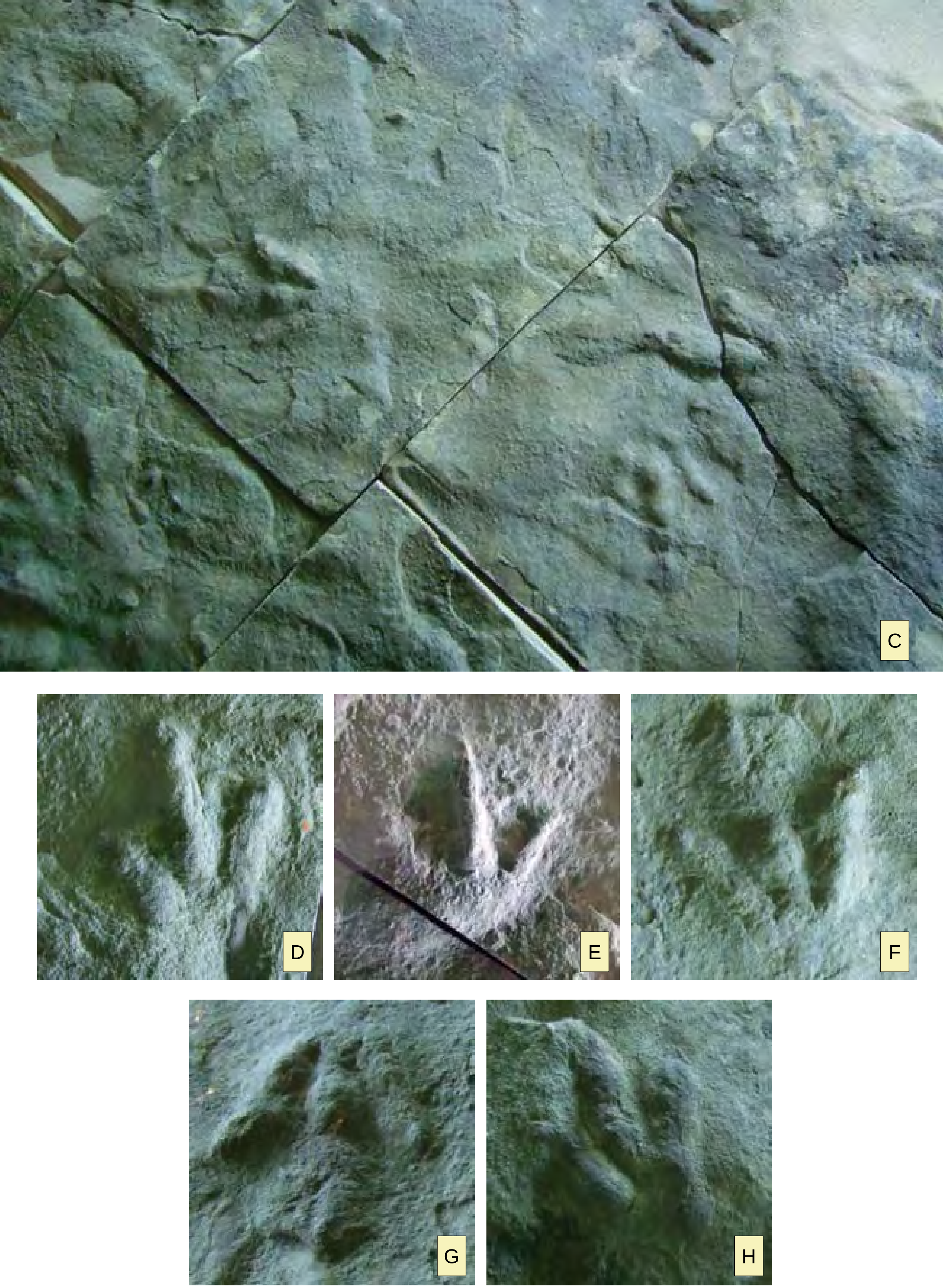
F. Fragment of large rib (NHMUK R2874).

Figure 101. Theropod tooth of *Avalonianus sandfordi*, from Wedmore Hill, Somerset (Holotype: NHMUK R2869).

Figure 102. Theropod tooth of *Picrodon herveyi*, from Wedmore Hill, Somerset (Holotype: NHMUK R2875).

by the sea. As a result, the specimen is now more than 80% complete though unfortunately lacking both hind feet and the end of the tail. The skeleton features two small osteoderms resembling horns on the back of the skull, and the back, sides and tail are largely covered in scutes arranged in rows, particularly large and densely packed around the neck. Remnants of what may be its last meal are preserved in the gullet and stomach regions. The specimen is currently part of a private collection and is on loan to the Bristol Museum and Art Gallery where it is on public display.

Figure 117. A–H. A juvenile specimen of *S. harrisonii* from Charmouth, Dorset (CAMSM X 39256). A. Six articulated cervical vertebrae. B. Five dorsal vertebrae. C. Humerus. D. Partial femur. E. Ribs. F. Both coracoids. G. Both scapulae, left positioned below. H. Osteoderms.


C
D
E
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B. Left dentary (OUMNH J.12143/1a).

C. Left tibia (OUMNH J.12143/2).

D. Left femur (OUMNH J.12143/7).

E. Right femur (OUMNH J.12143/6).

F. Shaft of right pubis (OUMNH J.12143/3).

G. Proximal portion of left pubis (OUMNH J.12143/11).

H. Proximal caudal vertebra, front and side views (OUMNH J.12143/8).

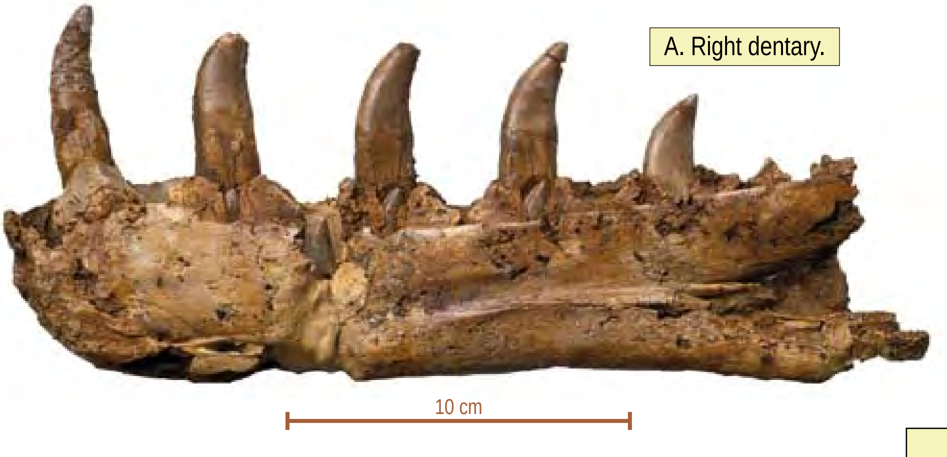
Species	*Duriavenator hesperis* (Waldman, 1974)
Meaning of name	Western Dorset hunter
Horizon	Upper part of the Inferior Oolite Group, Middle Jurassic (late Bajocian)
Locality	Greenhill, Sherborne, Dorset, England
Size	5 m long
Notable specimens	Holotype (NHMUK R332): Partial skull with teeth
Classification	Dinosauria: Saurischia: Theropoda: Megalosauridae
Synonyms	*Megalosaurus hesperis* Waldman, 1974

Figure 143. Life reconstruction of *Duriavenator hesperis*.

From the Upper Inferior Oolite Group of late Bajocian age comes *Duriavenator hesperis* (originally *Megalosaurus hesperis*). This megalosaurid is known from very fragmentary cranial bones and teeth, including a beautiful right maxilla with well-preserved and defined teeth, found at Greenhill, Sherborne in Dorset. Although it is hard to say anything certain from these relatively scrappy remains, it appeared to be a medium-sized theropod measuring perhaps five metres in length.

Figure 144. A–E. The skull remains of *Duriavenator hesperis*, from Greenhill, Sherborne, Dorset (Holotype: NHMUK R332).

A. Right dentary.



Species	*Cetiosaurus oxoniensis* Phillips, 1871
Meaning of name	Oxford's whale lizard
Horizon	Rutland Formation, Early Jurassic (Bajocian) Forest Marble Formation, Early Jurassic (Bathonian)
Locality	Rutland, Leicestershire and Bletchingdon Station, Enslow Bridge, Oxfordshire, England (see text for additional locality information)
Size	20 m long
Notable specimens	Lectotype (OUMNH J.13605–13613, 13615–13616, 13619–13688, 13899): Partial skeleton belonging to adult individual; (LCM G468.1968): Partial skeleton including vertebrae and pelvic elements
Classification	Dinosauria: Saurischia: Sauropodomorpha: Sauropoda: Cetiosauridae
Synonyms	None

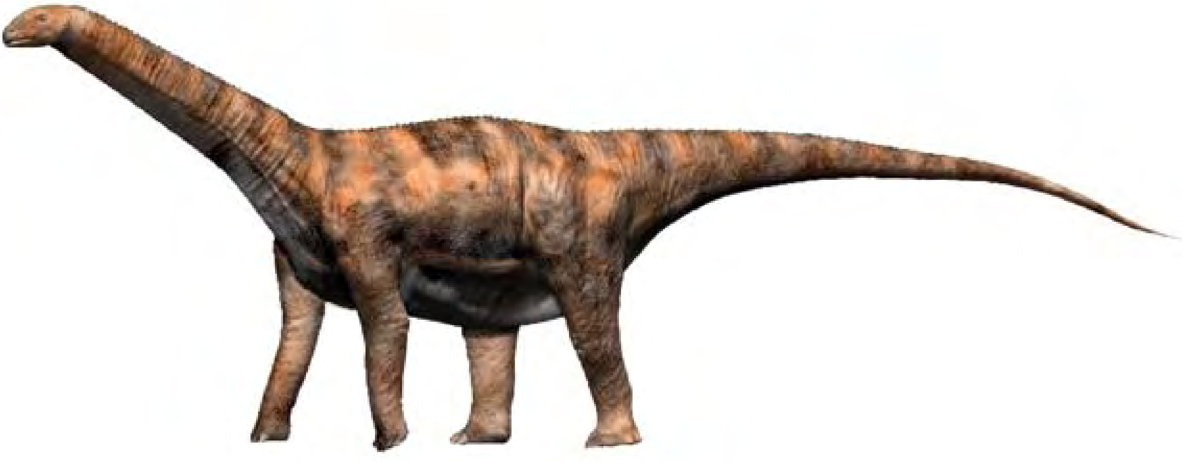


Figure 175. Life reconstruction of *Cetiosaurus oxoniensis*.

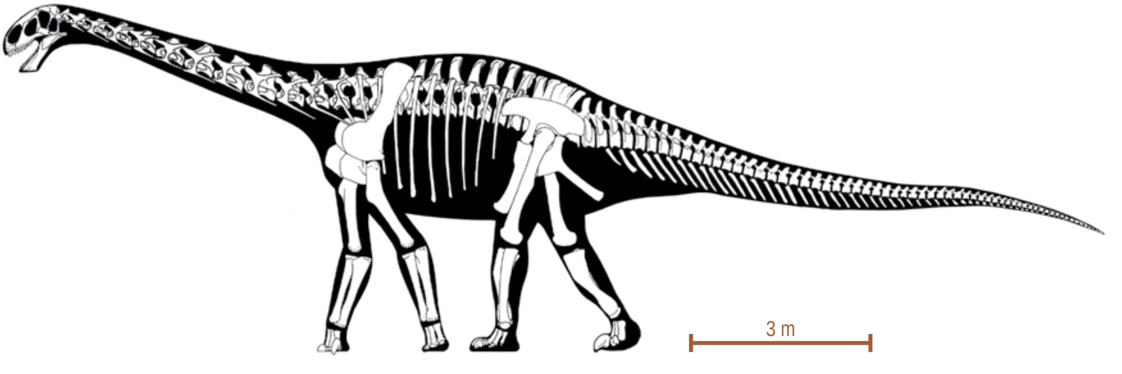


Figure 176. Skeletal reconstruction of *Cetiosaurus oxoniensis*.

A large collection of bones is known from the Forest Marble Formation. The most famous fossil from this formation is the primitive sauropod *Cetiosaurus*, the first sauropod to be discovered and described in the scientific literature. *Cetiosaurus* is one of the earliest dinosaurs to receive a name and, as happened to many genera described in the early days of palaeontology, it became a wastebasket taxon. The genus name *Cetiosaurus* (which means 'whale lizard') was first made available in 1841 by Owen, though he did not assign a species name, and originally identified the remains as that of a marine crocodile. During the 1840s, other specimens of *Cetiosaurus* were described and given a species name, though not designated as the type specimen for the genus. As many as 13 species were described as belonging to *Cetiosaurus* in the British Isles alone, ranging temporally from the Middle Jurassic to the Early Cretaceous. It was not until 1871 that *C. oxoniensis* was described from a large series of remains belonging to several individuals (including adult and juvenile remains) discovered at Bletchingdon Station, near Enslow Bridge in Oxfordshire. It was based on this discovery that *Cetiosaurus* was identified as a dinosaur. As this latter material was more complete and diagnosable, it was used as the defining species for *Cetiosaurus*. The material includes remains of at least three individuals, one of which represents a partial skeleton of a large individual. Current understanding is that only *Cetiosaurus oxoniensis* from the Forest Marble is a valid species. A dinosaur braincase was found at the same location and first described in 1906. The braincase is partially complete, three-dimensionally preserved and well detailed. It was originally described as belonging to a theropod and likely *Megalosaurus*, although later studies suggested it belonged to a sauropod, possibly *C. oxoniensis*. The specimen was also collected from the Bletchingdon Station Quarry, and thus, it is possible that the braincase may have belonged to one of the several *Cetiosaurus* specimens, probably the large individual.

Figure 177. A–P. A selection of material belonging to an adult individual confidently assigned to *C. oxoniensis*, from Bletchingdon Station, Oxfordshire (Lectotype).

A. Right scapula (OUMNH J.13605).

B. Sternal plate (OUMNH J.13607).

C. Right humerus (OUMNH J.13612).

D. Partial right ulna (OUMNH J.13611).

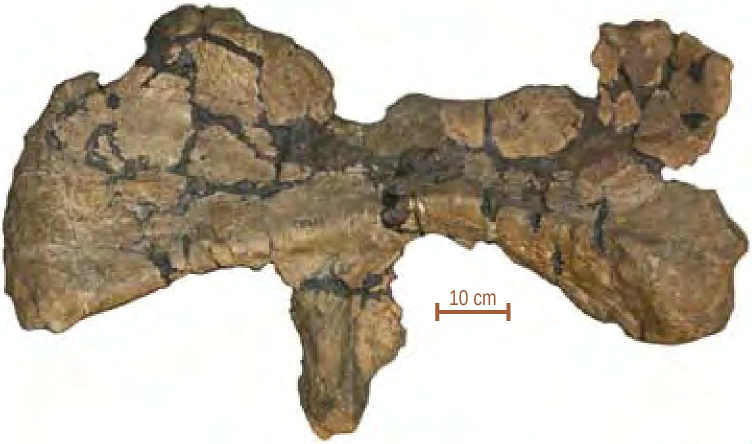
E. Left humerus (OUMNH J.13613).

F. Left ulna (OUMNH J.13608).

G. Right femur (OUMNH J.13615).

H. Right fibula (OUMNH J.13619).

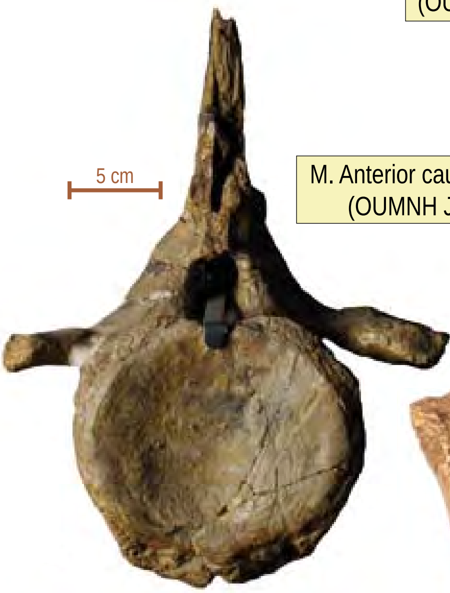
I. Left femur (OUMNH J.13616).



J. Fragmentary left ilium (OUMNH J. 13622).

K. Right ischium (OUMNH J.13626).

L. Dorsal vertebra (OUMNH J.13647).



M. Anterior caudal vertebra (OUMNH J.13634).

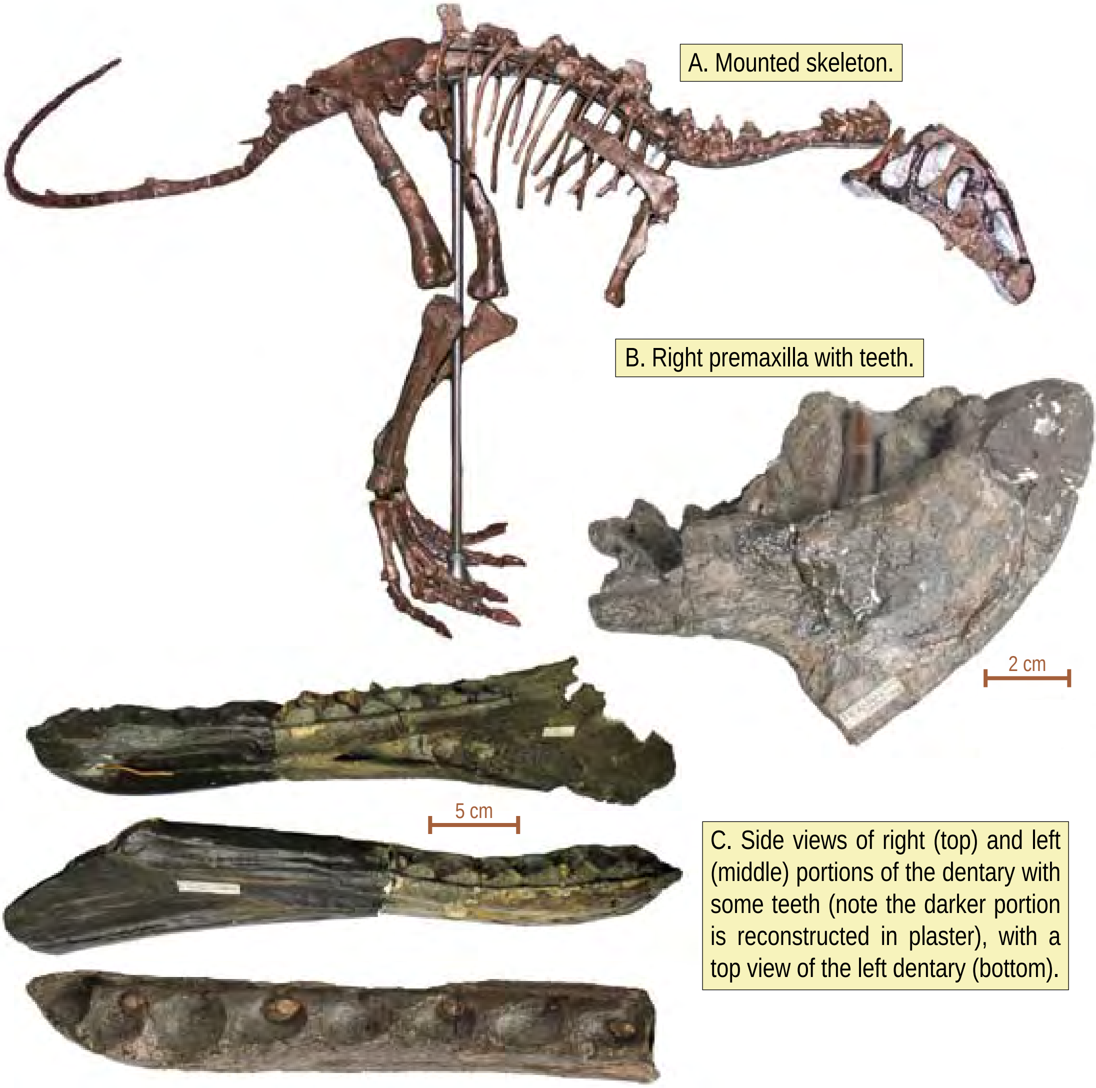
N. Anterior caudal vertebra (OUMNH J.13628).

O. Middle distal caudal vertebra (OUMNH J.13674).

P. Single chevron (OUMNH J.13661).

During this time there lived a megalosaurid named *Eustreptospondylus oxoniensis*. It remains constitute the most complete Middle Jurassic theropod from Europe. This theropod is known from a single disarticulated partial skeleton (most probably belonging to a juvenile) that was found at the bottom of the Oxford Clay Formation at Webb's Pit, Summertown, in Wolvercote, Oxfordshire. It was probably discovered in 1870. As the specimen was discovered in marine sediments, it has been suggested that *Eustreptospondylus* may have been a coastal predator. It was possibly around five metres in length. A reassessment of *Eustreptospondylus* indicated that this megalosaur was closely related to the Cretaceous fish-eating spinosaurids, and may be an early ancestor of this group of peculiar theropods (see *Baryonyx*). Other remains collected in France were once regarded as *Eustreptospondylus*, but were later determined to belong to other theropods. Therefore, the type specimen of *E. oxoniensis* is the only known example.

Figure 210. A–N. Remains of *Eustreptospondylus oxoniensis*, from Summertown, Oxford, Oxfordshire (Holotype: OUMNH J.13558).



A. Mounted skeleton.

B. Right premaxilla with teeth.

C. Side views of right (top) and left (middle) portions of the dentary with some teeth (note the darker portion is reconstructed in plaster), with a top view of the left dentary (bottom).

Figure 240. Palaeogeographic map reconstruction of Europe during the Early Cretaceous, with the position of the British Isles outlined. Courtesy of Ron Blakey.

Early Cretaceous

The Cretaceous is often seen as the beginning of the end for the non-avian dinosaurs, but in reality it was only the evolutionary beginning for certain types of dinosaurs. Cretaceous forests were beginning to look a lot more colourful due to the presence of the first angiosperms (flowering plants). Along with the first flowers came a plethora of insects to pollinate them.

The Early Cretaceous is divided into six stages named from the oldest to the youngest as Berriasian, Valanginian, Hauterivian, Barremian, Aptian and Albian. In the Northern Hemisphere, North America was firmly separated from Europe and Asia, while in the Southern Hemisphere, Gondwana had started to break up into South America, Africa, Antarctica–Australia and India. The breakup of the continents led to the opening of new ecological niches ready to be filled by new and diverse groups of animals. With the increasing isolation of the various dryland areas, the floras and faunas of these regions began to look very different.

In England, two very important geological divisions yield the majority of the Early Cretaceous dinosaur fauna. They are the Wealden Group and the Cambridge Greensand; the former has yielded a high diversity of dinosaur remains, representing several species. It is quite common within both of these groups to find isolated dinosaur fragments. In the Wealden, the thyreophorans are well represented with two of the most renowned ankylosaurs from Europe and a few isolated stegosaurian bones. The ornithopods show a high diversity, with forms such as *Iguanodon*, perhaps Britain's most famous dinosaur. The theropods are represented by a number of different types, including the fish-eating *Baryonyx*, while several distinct types

Species	*Nuthetes destructor* Owen, 1854
Meaning of name	Destroyer monitor (lizard)
Horizon	Lulworth Formation (Cherty Freshwater Member), Early Cretaceous (Berriasian)
Locality	Isle of Purbeck, Dorset (exact locality unknown)
Size	Unknown. Anterior portion of a left mandible (dentary) 37.5 mm long
Notable specimens	Holotype (DORCM G.913): A portion of the left lower jaw (dentary)
Classification	Dinosauria: Saurischia: Theropoda: Dromaeosauridae
Synonyms	*Megalosaurus destructor* (Owen, 1854)

Figure 246. *Nuthetes destructor* was probably similar to *Velociraptor mongoliensis* from the Early Cretaceous of Mongolia.

Figure 247. Skeletal reconstruction of *Velociraptor mongoliensis*.

We know from teeth that dromaeosaurs were probably already present in England during the Middle Jurassic (see pages 154 & 176). More evidence of this highly derived group of theropods comes from the Isle of Purbeck, Dorset, as a small portion of a mandible with teeth was collected during the mid-1800s and described in 1854 as *Nuthetes destructor*. In a further description of *Nuthetes* in 1861, Richard Owen identified it as a type of lizard, but later (1879) changed his mind and listed it as a crocodilian. At one point it was even identified as a mammal. It was not until 1934 that *Nuthetes* was first recognised as a dinosaur, and was first regarded as a dromaeosaurid in 2002. Incidentally, despite the original incorrect identification, *Nuthetes* represents the first scientifically described dromaeosaurid in the world. Additional remains belonging to *Nuthetes*, including bones and numerous teeth, have been found at other locations on the Isle of Purbeck and from the Purbeck Limestone Group of Buckinghamshire, Sussex and Wiltshire. All of this material likely represents juvenile animals. The Berriasian age of *Nuthetes* makes it one of the oldest definitive dromaeosaurids from anywhere in the world. The species was possibly related to the famous *Velociraptor* of Mongolia.

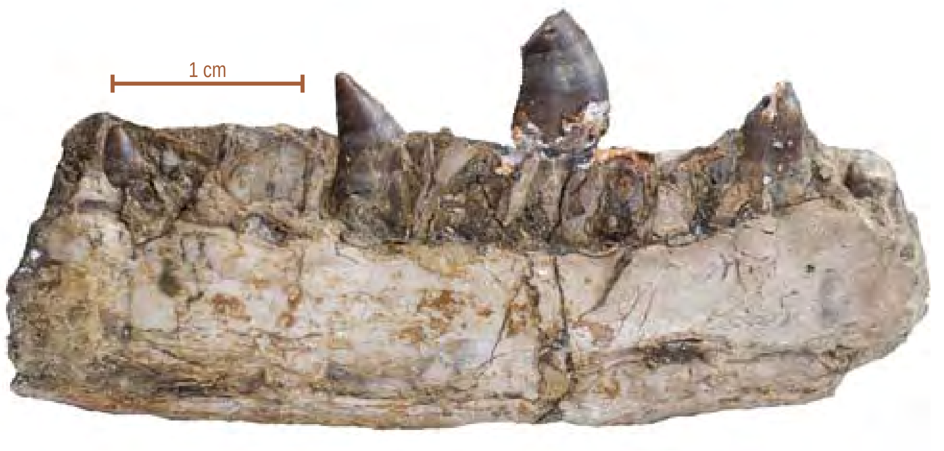


Figure 248. Partial left dentary with teeth, belonging to *Nuthetes destructor*, from the Isle of Purbeck, Dorset (Holotype: DORCM G.913).


Figure 360. Life reconstruction of *Aristosuchus pusillus*.

Species	*Aristosuchus pusillus* (Owen, 1876)
Meaning of name	Very small noble lizard
Horizon	Wessex Formation, Early Cretaceous (Barremian)
Locality	Isle of Wight, England
Size	2 m long
Notable specimens	Holotype (NHMUK R178): Pubis and a sacrum consisting of five vertebrae
Classification	Dinosauria: Saurischia: Theropoda: ?Compsognathidae
Synonyms	None

Compsognathids were small carnivorous theropods, which sported feathers on their body. *Aristosuchus pusillus* is the Wealden compsognathid representative, measuring about two metres in length. It is known only from a sacrum and a pubis (both pubes), the latter displays a well-preserved 'pubic boot' (the large projection at the end of the pubis), collected from an unknown location on the Isle of Wight. In the past there has been some confusion with the material belonging to *Aristosuchus*; it was also regarded by Owen, in 1876, to be a crocodilian. Other remains including an ungual phalanx (claw) and a few vertebrae were suggested to belong to the same individual, but later determined to represent other indeterminate theropods. Two isolated vertebrae from Romania were assigned to *Aristosuchus*, but their identification has been deemed inaccurate. In life, *Aristosuchus* may have looked quite similar to the Late Jurassic *Compsognathus* from Germany and France.

COLLECTIONS OF BRITISH DINOSAURS AND THE ROLE OF MUSEUMS

Museums are created to house artefacts and objects of scientific or historic importance to allow people to learn about the world we inhabit. The roles of museums in the curation of fossils (including dinosaur remains) are extremely important to the science, history and further advancement of palaeontology. Museums have palaeontological collections ranging from hundreds to millions of specimens. Usually, a collection consists of local material, but depending on the type of museum, e.g. regional or national, the collections may be far broader in scope. Some museum collections have been around for several centuries. Such collections contain fossils that may have derived from locations that are now inaccessible (such as many of the historic dinosaur-bearing localities within the British Isles), and thus identify these collections as extremely rare and important. Specialists visiting museums can sometimes stumble upon undescribed and extremely rare fossils. For a palaeontologist, searching in a museum's collection can be equally as exciting as fossil hunting in the field.

Museums have limited amounts of space, so it is never possible to display everything they hold. After all, collections continually expand over the years as a result of fieldwork and public donations. Eventually, space becomes a premium and additional storage facilities are required to store the natural heritage of the British Isles. Fossils, as for all other objects, are curated by specialist staff. Specimens are documented, checked and assessed to ensure there is no damage or decay, and are kept in controlled environments to conserve them for future generations to enjoy and understand.

Figure 406. A single draw of dinosaur teeth stored in the palaeontology collections of the Oxford University Museum of Natural History.

Figure 413. The large theropod *Neovenator salerii* charges across a mud flat, panicking a herd of *Mantellisaurus atherfieldensis*. A flock of pterosaurs (*Istiodactylus latidens*) rises in alarm, while brachiosaurs can be seen among the forest trees in the background. Crocodiles (*Goniopholis crassidens*) look on from the banks of the waterhole. Wessex Formation, Early Cretaceous (Barremian: approximately 125 million years ago), Isle of Wight.