

= Compsognathus =

Compsognathus ( / kʰɒpˈsɒɡnəθəs / ; Greek kompsos / ?????? ; " elegant " , " refined " or " dainty " , and gnathos / ?????? ; " jaw " ) is a genus of small , bipedal , carnivorous theropod dinosaurs . Members of its single species Compsognathus longipes could grow to the size of a turkey . They lived about 150 million years ago , the Tithonian age of the late Jurassic period , in what is now Europe . Paleontologists have found two well @-@ preserved fossils , one in Germany in the 1850s and the second in France more than a century later . Today , C. longipes is the only recognized species , although the larger specimen discovered in France in the 1970s was once thought to belong to a separate species and named C. corallestris .

Many presentations still describe Compsognathus as " chicken @-@ sized " dinosaurs because of the small size of the German specimen , which is now believed to be a juvenile . Compsognathus longipes is one of the few dinosaur species for which diet is known with certainty : the remains of small , agile lizards are preserved in the bellies of both specimens . Teeth discovered in Portugal may be further fossil remains of the genus .

Although not recognized as such at the time of its discovery , Compsognathus is the first theropod dinosaur known from a reasonably complete fossil skeleton . Until the 1990s , it was the smallest known non @-@ avialan dinosaur ; earlier it was incorrectly thought to be the closest relative of Archaeopteryx .

= = Description = =

For decades , Compsognathus were famed as the smallest dinosaurs known ; the first specimen collected was around 1 m ( 3 ft ) in length . However , dinosaurs discovered later , such as Caenagnathasia , Microraptor and Parvicursor , were even smaller . The largest Compsognathus specimen is estimated to have weighed somewhere between 0 @.@ 83 and 3 @.@ 5 kg ( 1 @.@ 8 and 7 @.@ 7 lb ) .

Compsognathus were small , bipedal animals with long hind legs and longer tails , which they used for balance during locomotion . The forelimbs were smaller than the hindlimbs and featured three digits equipped with solid claws suited for grasping prey . Their delicate skulls were narrow and long , with tapered snouts . The skull had five pairs of fenestrae ( skull openings ) , the largest of which was for the orbit ( eye socket ) . The eyes were large in proportion to the rest of the skull .

The lower jaw was slender and had no mandibular fenestra , a hole in the side of the lower jawbone commonly seen in archosaurs . The teeth were small but sharp , suited for its diet of small vertebrates and possibly other small animals , such as insects . Its frontmost teeth ( those on the premaxilla ) were unserrated , unlike those further back in the jaw which were flattened and more strongly recurved . Scientists have used these dental characteristics to identify Compsognathus and its closest relatives . Reisdorf and Wuttke ( 2012 ) described the taphonomical phenomena of the German specimen of Compsognathus .

The Compsognathus specimen discovered in Germany in the 19th century featured only two digits on each forelimb , leading scientists to conclude that this was how the creature appeared in life . However , the fossil discovered later in France revealed the manus ( hands ) to have had three digits , similar to other members of compsognathid genera . The fossilization of the German Compsognathus had simply failed to preserve the specimen 's hands completely . Bidar supposed that the French specimen had webbed hands , which would look like flippers in life . In the 1975 book The Evolution and Ecology of the Dinosaurs , L. B. Halstead depicts the animal as an amphibious dinosaur capable of feeding on aquatic prey and swimming out of reach of larger predators . Ostrom debunked this hypothesis by showing conclusively that the French specimen was nearly identical to the German specimen in every aspect but its size . Peyer confirmed these conclusions .

= = = Integument = = =

Some relatives of *Compsognathus*, namely *Sinosauropteryx* and *Sinocalliopteryx*, have been preserved with the remains of simple feathers covering the body like fur, promoting some scientists to suggest that *Compsognathus* might have been feathered in a similar way. Consequently, many depictions of *Compsognathus* show them with coverings of downy proto-feathers. However, no feathers or feather-like covering have been preserved with *Compsognathus* fossils, in contrast to *Archaeopteryx*, which are found in the same sediments. Karin Peyer, in 2006, reported skin impressions preserved on the side of the tail starting at the 13th tail vertebra. The impressions showed small bumpy tubercles, similar to the scales found on the tail and hind legs of *Juravenator*. Additional scales had in 1901 been reported by Von Huene, in the abdominal region of the German *Compsognathus*, but Ostrom subsequently disproved this interpretation; in 2012 they were by Achim Reisdorf seen as plaques of adipocere, corpse wax.

Like *Compsognathus*, and unlike *Sinosauropteryx*, a patch of fossilized skin from the tail and hindlimb of the possible relative *Juravenator starki* shows mainly scales, though there is some indication that simple feathers were also present in the preserved areas. This may mean that a feather covering was not ubiquitous in this group of dinosaurs.

= = Discovery and species = =

*Compsognathus* is known from two almost complete skeletons, one from Germany that is 89 cm (35 in) long and another from France that is 125 cm (49 in) long. The physician and fossil collector Joseph Oberndorfer acquired the German specimen (BSP AS I 563) in 1859, discovered about the same year in the lithographic limestone deposits in the Riedenburg-Kelheim region of Bavaria, in the Jurassic part of a lagoonal region known as the Solnhofen archipelago. The limestone of this area has also yielded such well-preserved fossils as *Archaeopteryx* with feather impressions and some pterosaurs with imprints of their wing membranes. The German *Compsognathus* fossil itself most likely came from the Painten Formation of the Kapfelberg locality, specifically dated to the uppermost Kimmeridgian stage (150 to 8 million years ago); however, alternative possibilities include quarries near Jachenhausen or Goldberg, both from the Tithonian, to which stage *Compsognathus* has traditionally been dated. Johann A. Wagner discussed the specimen briefly in 1859, when he coined the name *Compsognathus longipes*, and described it in detail in 1861. In early 1868, Thomas Huxley compared the two species and, following earlier suggestions by Karl Gegenbaur and Edward Drinker Cope, concluded that, apart from its arms and feathers, the *Archaeopteryx* skeleton was closely similar to *Compsognathus*, and that the proto-bird was related to the dinosaurs. In 1896, Othniel Marsh recognized the fossil as a true member of the Dinosauria. John Ostrom thoroughly redescribed the species in 1978, making it one of the best-known small theropods at that time. The German specimen is on display at the Bayerische Staatssammlung für Paläontologie und historische Geologie (Bavarian State Institute for Paleontology and Historical Geology) in Munich, Germany, which bought the fossil from Oberndorfer in 1865.

The larger French specimen (MNHN CNJ 79) was discovered by quarry owner Louis Ghirardi around 1971 in the Portlandian lithographic limestone of Canjuers near Nice in southeastern France. It dates to the lower Tithonian. Although Alain Bidar originally described the specimen as a separate species called *Compsognathus corallestris*, Ostrom, Jean-Guy Michard and others have since relabeled it as another example of *Compsognathus longipes*. Quimby identified the smaller German specimen as a juvenile of the same species. In 1983, the National Museum of Natural History in Paris acquired the French *Compsognathus* fossil; Michard thoroughly studied it there.

Collector Heinrich Fischer had originally labeled a partial foot, from the Solnhofen area, as belonging to *Compsognathus longipes*. Though this identification was rejected by Wilhelm Barnim Dames in 1884, Friedrich von Huene nevertheless in 1925 provisionally referred the specimen to *Compsognathus*. However, Ostrom's study of 1978 has disproven this. Jens Zinke in 1998 assigned forty-nine teeth from the Kimmeridgian Guimarota formation of Portugal to the genus. These were not identical to those of *C. longipes*, having serrations on the front edge, but were

because of general similarities in form referred to a *Compsognathus* sp .

In 1997 Virginia Morell renamed a related Chinese form , *Sinosauropteryx prima* , into a *Compsognathus prima* ; this has found no general acceptance .

#### = = Classification = =

The genus *Compsognathus* gives its name to the family *Compsognathidae* , a group composed mostly of small dinosaurs from the late Jurassic and early Cretaceous periods of China , Europe and South America . For many years it was the only member known ; however in recent decades paleontologists have discovered several related genera . The clade includes *Aristosuchus* , *Huaxiagnathus* , *Mirischia* , *Sinosauropteryx* , and perhaps *Juravenator* and *Scipionyx* . At one time , *Mononykus* was proposed as a member of the family , but this was rejected by Chen and coauthors in a 1998 paper ; they considered the similarities between *Mononykus* and the *compsognathids* to be an example of convergent evolution . The position of *Compsognathus* and its relatives within the *coelurosaur* group is uncertain . Some , such as theropod expert Thomas Holtz Jr. and co @-@ authors Ralph Molnar and Phil Currie in the landmark 2004 text *Dinosauria* , hold the family as the most basal of the *coelurosaurs* , while others as part of the *Maniraptora* .

For almost a century , *Compsognathus longipes* was the only well @-@ known small theropod species . This led to comparisons with *Archaeopteryx* and to suggestions of an especially close relationship with birds . In fact , *Compsognathus* , rather than *Archaeopteryx* , piqued Huxley 's interest in the origin of birds . The two animals share similarities in shape and proportions , so many in fact that two specimens of *Archaeopteryx* , the " *Eichstätt* " and the " *Solnhofen* " , were for a time misidentified as those of *Compsognathus* . Many other types of theropod dinosaurs , such as *maniraptorans* , are now known to have been more closely related to birds .

Below is a simplified cladogram placing *Compsognathus* in *Compsognathidae* by Senter et al. in 2012 .

#### = = Paleobiology = =

In a 2001 study conducted by Bruce Rothschild and other paleontologists , nine foot bones referred to *Compsognathus* were examined for signs of stress fracture , but none were found .

#### = = = Diet = = =

The remains of a lizard in the German specimen 's thoracic cavity show that *Compsognathus* preyed on small vertebrates . Marsh , who examined the specimen in 1881 , thought that this small skeleton in the *Compsognathus* belly was an embryo , but in 1903 , Franz Nopcsa concluded that it was a lizard . Ostrom identified the remains as belonging to a lizard of the genus *Bavarisaurus* , which he concluded was a fast and agile runner owing to its long tail and limb proportions . This in turn led to the conclusion that its predators , *Compsognathus* , must have had sharp vision and the ability to rapidly accelerate and outrun the lizard . The *Bavarisaurus* is in a single piece , indicating that the *Compsognathus* must have swallowed its prey whole . The French specimen 's gastric contents consist of unidentified lizards or *sphenodontids* .

#### = = = Possible eggs = = =

The plate of the German *Compsognathus* shows several circular irregularities 10 mm ( 0 @.@ 39 in ) in diameter near the skeletal remains . Peter Griffiths interpreted them as immature eggs in 1993 . However , later researchers have doubted their connection to the genus because they were found outside the body cavity of the animal . A well @-@ preserved fossil of a *Sinosauropteryx* , a genus related to *Compsognathus* , shows two oviducts bearing two unlaidd eggs . These proportionally larger and less numerous eggs of *Sinosauropteryx* cast further doubt on the original identification of the purported *Compsognathus* eggs . In 1964 German geologist Karl Werner Barthel had explained

the discs as gas bubbles formed in the sediment because of the putrefaction of the carcass .

= = Paleoecology = =

During the late Jurassic , Europe was a dry , tropical archipelago at the edge of the Tethys Sea . The fine limestone in which the skeletons of Compsognathus have been found originated in calcite from the shells of marine organisms . Both the German and French areas where Compsognathus specimens have been preserved were lagoons situated between the beaches and coral reefs of the Jurassic European islands in the Tethys Sea . Contemporaries of Compsognathus longipes include the early avialan Archaeopteryx lithographica and the pterosaurs Rhamphorhynchus muensteri and Pterodactylus antiquus . The same sediments in which Compsognathus have been preserved also contain fossils of a number of marine animals such as fish , crustaceans , echinoderms and marine mollusks , confirming the coastal habitat of this theropod . No other dinosaur has been found in association with Compsognathus , indicating that these little dinosaurs might in fact have been the top land predator in these islands .

= = In popular culture = =

Children 's dinosaur books commonly feature Compsognathus . For a long time they were unique in their small size , as most other small dinosaurs were discovered and described a century or more later . These animals have appeared in the movies The Lost World : Jurassic Park and Jurassic Park III . In The Lost World : Jurassic Park , one of the characters incorrectly identifies the species as " Compsognathus triassicus " , combining the genus name of Compsognathus longipes with the specific name of Procompsognathus triassicus , a distantly related small carnivore featured in the Jurassic Park novels .