= Plateosaurus =

Plateosaurus (probably meaning " broad lizard " , often mistranslated as " flat lizard ") is a genus of plateosaurid dinosaur that lived during the Late Triassic period , around 214 to 204 million years ago , in what is now Central and Northern Europe . Plateosaurus is a basal (early) sauropodomorph dinosaur , a so @-@ called " prosauropod " . As of 2011 , two species are recognized : the type species P. engelhardti from the late Norian and Rhaetian , and the slightly earlier P. gracilis from the lower Norian . However , others have been assigned in the past , and there is no broad consensus on the species taxonomy of plateosaurid dinosaurs . Similarly , there are a plethora of synonyms (invalid duplicate names) at the genus level .

Discovered in 1834 by Johann Friedrich Engelhardt and described three years later by Hermann von Meyer , Plateosaurus was the fifth named dinosaur genus that is still considered valid . Although it had been described before Richard Owen formally named Dinosauria in 1842 , it was not one of the three genera used by Owen to define the group , because at the time , it was poorly known and difficult to identify as a dinosaur . It is now among the dinosaurs best known to science : over 100 skeletons have been found , some of them nearly complete . The abundance of its fossils in Swabia , Germany , has led to the nickname Schwäbischer Lindwurm (Swabian lindworm) .

Plateosaurus was a bipedal herbivore with a small skull on a long , flexible neck , sharp but plump plant @-@ crushing teeth , powerful hind limbs , short but muscular arms and grasping hands with large claws on three fingers , possibly used for defence and feeding . Unusually for a dinosaur , Plateosaurus showed strong developmental plasticity : instead of having a fairly uniform adult size , fully grown individuals were between 4 @.@ 8 and 10 metres (16 and 33 ft) long and weighed between 600 and 4 @,@ 000 kilograms (1 @,@ 300 and 8 @,@ 800 lb) . Commonly , the animals lived for at least 12 to 20 years , but the maximum life span is not known .

Despite the great quantity and excellent quality of the fossil material , Plateosaurus was for a long time one of the most misunderstood dinosaurs . Some researchers proposed theories that were later shown to conflict with geological and palaeontological evidence , but have become the paradigm of public opinion . Since 1980 the taxonomy (relationships) , taphonomy (how the animals became embedded and fossilized) , biomechanics (how their skeletons worked) , and palaeobiology (life circumstances) of Plateosaurus have been re @-@ studied in detail , altering the interpretation of the animal 's biology , posture and behaviour .

= = Description = =

Plateosaurus had the typical body shape of a herbivorous bipedal dinosaur : a small skull , a long and flexible neck composed of 10 cervical vertebrae , a stocky body , and a long , mobile tail composed of at least 40 caudal vertebrae . The arms of Plateosaurus were very short , even compared to most other " prosauropods " . However , they were strongly built , with hands adapted for powerful grasping . The shoulder girdle was narrow (often misaligned in skeletal mounts and drawings) , with the clavicles (collar bones) touching at the body 's midline , as in other basal sauropodomorphs . The hind limbs were held under the body , with slightly flexed knees and ankles , and the foot was digitigrade , meaning the animal walked on its toes . The proportionally long lower leg and metatarsus show that Plateosaurus could run quickly on its hind limbs . The tail of Plateosaurus was typically dinosaurian , muscular and with high mobility .

The skull of Plateosaurus is small and narrow , rectangular in side view , and nearly three times as long as it is high . There is an almost rectangular lateral temporal foramen at the back . The large , round orbit (eye socket) , the sub @-@ triangular antorbital fenestra and the oval naris (nostril) are of almost equal size . The jaws carried many small , leaf @-@ shaped , socketed teeth : 5 to 6 per premaxilla , 24 to 30 per maxilla , and 21 to 28 per dentary (lower jaw) . The thick , leaf @-@ shaped , bluntly serrated tooth crowns were suitable for crushing plant material . The low position of the jaw joint gave the chewing muscles great leverage , so that Plateosaurus could deliver a powerful bite . These features suggest that it fed primarily to exclusively on plants . Its eyes were directed to the sides , rather than the front , providing all @-@ round vision to watch for predators .

Some fossil skeletons have preserved sclerotic rings (rings of bone plates that protect the eye) .

The ribs were connected to the dorsal (trunk) vertebrae with two joints , acting together as a simple hinge joint , which has allowed researchers to reconstruct the inhaled and exhaled positions of the ribcage . The difference in volume between these two positions defines the air exchange volume (the amount of air moved with each breath) , determined to be approximately 20 l for a P. engelhardti individual estimated to have weighed 690 kg , or 29 ml / kg bodyweight . This is a typical value for birds , but not for mammals , and indicates that Plateosaurus probably had an avian @-@ style flow @-@ through lung , although indicators for postcranial pneumaticity (air sacs of the lung invading the bones to reduce weight) can be found on the bones of only a few individuals , and were only recognized in 2010 . Combined with evidence from bone histology this indicates that Plateosaurus was endothermic .

The type species of Plateosaurus is P. engelhardti . Adults of this species reached 4 @.@ 8 to 10 metres (16 to 33 ft) in length , and ranged in mass from 600 to 4 @,@ 000 kilograms (1 @,@ 300 to 8 @,@ 800 lb) . The geologically older species , P. gracilis (formerly named Sellosaurus gracilis) , was somewhat smaller , with a total length of 4 to 5 metres (13 to 16 ft) .

= = Discovery and history = =

In 1834 , physician Johann Friedrich Engelhardt discovered some vertebrae and leg bones at Heroldsberg near Nuremberg , Germany . Three years later German palaeontologist Hermann von Meyer designated them as the type specimen of a new genus , Plateosaurus . Since then , remains of well over 100 individuals of Plateosaurus have been discovered at various locations throughout Europe .

Material assigned to Plateosaurus has been found at over 50 localities in Germany (mainly along the Neckar and Pegnitz river valleys) , Switzerland (Frick) and France . Three localities are of special importance , because they yielded specimens in large numbers and of unusually good quality : near Halberstadt in Saxony @-@ Anhalt , Germany ; Trossingen in Baden @-@ Württemberg , Germany ; and Frick . Between the 1910s and 1930s , excavations in a clay pit in Saxony @-@ Anhalt revealed between 39 and 50 skeletons that belonged to Plateosaurus , along with teeth and a small number of bones of the theropod Liliensternus , and two skeletons and some fragments of the turtle Proganochelys . Some of the plateosaur material was assigned to P. longiceps , a species described by palaeontologist Otto Jaekel in 1914 but now considered a junior synonym of P. engelhardti . Most of the material found its way to the Museum für Naturkunde in Berlin , where much of it was destroyed during World War II . The Halberstadt quarry today is covered by a housing development .

The second major German locality with P. engelhardti finds , a quarry in Trossingen in the Black Forest , was worked repeatedly in the 20th century . Between 1911 and 1932 , excavations during six field seasons led by German palaeontologists Eberhard Fraas (1911 ? 1912) , Friedrich von Huene (1921 ? 23) , and finally Reinhold Seemann (1932) revealed a total of 35 complete or partially complete skeletons of Plateosaurus , as well as fragmentary remains of approximately 70 more individuals . The large number of specimens from Swabia had already caused German palaeontologist Friedrich August von Quenstedt to nickname the animal Schwäbischer Lindwurm (Swabian lindworm or Swabian dragon) . Much of the Trossingen material was destroyed in 1944 , when the Naturaliensammlung in Stuttgart (predecessor to the State Museum of Natural History Stuttgart (SMNS)) burnt to the ground after an Allied bombing raid . Luckily , however , a 2011 study by SMNS curator Rainer Schoch found that , at least from the finds of Seemann 's 1932 excavation , " the scientifically most valuable material is still available " .

The Plateosaurus skeletons in a clay pit of the Tonwerke Keller AG in Frick , Switzerland , were first noticed in 1976 . While the bones are often significantly deformed by taphonomic processes , Frick yields skeletons of P. engelhardti comparable in completeness and position to those of Trossingen and Halberstadt .

In 1997 , workers of an oil platform of the Snorre oil field , located at the northern end of the North Sea , were drilling through sandstone for oil exploration when they stumbled on a fossil they

believed to be plant material . The drill core containing the fossil was extracted from 2 @,@ 256 metres (7 @,@ 402 ft) below the seafloor . Martin Sander and Nicole Klein , palaeontologists of the University of Bonn , analysed the bone microstructure and concluded that the rock preserved fibrous bone tissue from a fragment of a limb bone belonging to Plateosaurus , making it the first dinosaur found in Norway . Plateosaurus material has also been found in the Fleming Fjord Formation of East Greenland .

Plateosaurus gracilis , the older species , is found in the Löwenstein Formation (Lower Norian) . P. engelhardti stems from the upper Löwenstein Formation (Upper Norian) , the Trossingen Formation (Upper Norian) , and equivalently aged rock units . Plateosaurus thus lived probably from approximately 214 to 204 million years ago .

= = Classification and type material = =

Plateosaurus is a member of a group of early herbivores known as " prosauropods " . The group name is obsolete , as " Prosauropoda " is not a monophyletic group (thus given in quotation marks) , and most researchers prefer the term basal sauropodomorph . Plateosaurus was the first " prosauropod " to be described , and gives its name to the family Plateosauridae Marsh , 1895 as type genus . Initially , when the genus was poorly known , it was only included in Sauria , being some kind of reptile , but not in any more narrowly defined taxon . In 1845 , von Meyer created the group Pachypodes (a defunct junior synonym of Dinosauria) to include Plateosaurus , Iguanodon , Megalosaurus and Hylaeosaurus . Plateosauridae was proposed by Othniel Charles Marsh in 1895 within Theropoda . Later it was moved to " Prosauropoda " by von Huene , a placement that was accepted by most authors . Before the advent of cladistics in paleontology during the 1980s , with its emphasis on monophyletic groups (clades) , Plateosauridae was defined loosely , as large , broad @-@ footed , broad @-@ handed forms with relatively heavy skulls , unlike the smaller " anchisaurids " and sauropod @-@ like " melanorosaurids " . Reevaluation of " prosauropods " in light of the new methods of analysis led to the reduction of Plateosauridae . For many years the clade only included Plateosaurus and various junior synonyms , but later two more genera were considered to belong to it : Sellosaurus and possibly Unaysaurus . Of these , Sellosaurus is probably another junior synonym of Plateosaurus .

The type series of Plateosaurus engelhardti included " roughly 45 bone fragments " , of which nearly half are lost . The remaining material is kept in the Institute for Palaeontology of the University of Erlangen @-@ Nuremberg , Germany . From these bones , German palaeontologist Markus Moser in 2003 selected a partial sacrum (series of fused hip vertebrae) as a lectotype . The type locality is not known for certain , but Moser attempted to infer it from previous publications and the colour and preservation of the bones . He concluded that the material probably stems from the " Buchenbühl " , roughly 2 kilometres (1 @.@ 2 mi) south of Heroldsberg .

The type specimen of Plateosaurus gracilis , an incomplete postcranium , is kept at the Staatliches Museum für Naturkunde Stuttgart , Germany , and the type locality is Heslach , a suburb of the same city .

= = = Etymology = = =

The etymology of the name Plateosaurus is not entirely clear . Moser pointed out that the original description contains no information , and various authors have offered differing interpretations . German geologist Hanns Bruno Geinitz in 1846 gave " (?????? , breit) " [English : broad] In the same year , Agassiz offered Ancient Greek ????? (platê - " paddle " , " rudder " ; Agassiz translates this as Latin pala

= " spade ") and ?????? (sauros - " lizard ") . Agassiz consequently renamed the genus Platysaurus , probably from Greek ?????? (platys - " broad , flat , broad @-@ shouldered ") , creating an invalid junior synonym . Later authors often referred to this derivation , and the secondary meaning " flat " of ?????? , so that Plateosaurus is often translated as " flat lizard " . Often , claims were made that ?????? is supposed to have been intended as a reference to flat

bones , for example the laterally flattened teeth of Plateosaurus , but the teeth and other flat bones such as the pubic bones and some skull elements were unknown at the time of description .

In 1855 , von Meyer published a detailed description of Plateosaurus with illustrations , but again gave no details on the etymology . He repeatedly referred to its gigantic size (" Riesensaurus " = giant lizard) and massive limbs (" schwerfüssig ") , comparing Plateosaurus to large modern land mammals , but did not describe any important features that fit the terms " flat " or " shaped like an oar . "

= = Taxonomy = =

= = = Valid species = = =

The taxonomic history of Plateosaurus is " long and confusing " , a " chaotic tangle of names " . As of 2011 , only two species are universally accepted as valid : the type species P. engelhardti and P. gracilis , previously assigned to its own genus Sellosaurus . British palaeontologist Peter Galton showed clearly that all cranial material from Trossingen , Halberstadt and Frick pertains to one species . Moser performed the most extensive and detailed investigation of all plateosaurid material from Germany and Switzerland , concluding that all Plateosaurus and most other prosauropod material from the Keuper stems from the same species as the type material of Plateosaurus engelhardti . Moser considered Sellosaurus to be the same genus as Plateosaurus , but did not discuss whether S. gracilis and P. engelhardti belong to the same species . Palaeontologist Adam Yates of the University of the Witwatersrand cast further doubt on the generic separation . He included the type material of Sellosaurus gracilis in Plateosaurus as P. gracilis and reintroduced the old name Efraasia for some material that had been assigned to Sellosaurus . In 1926 , von Huene had already concluded the two genera were the same .

Yates has cautioned that P. gracilis may be a metataxon , which means that there is neither evidence that the material assigned to it is monophyletic (belongs to one species) , nor that it is paraphyletic (belongs to several species) . This is the case because the holotype of P. (Sellosaurus) gracilis has no skull , and the other specimens consist of skulls and material that overlaps too little with the holotype to make it certain that it belongs to the same taxon . It is therefore possible that the known material contains more species belonging to Plateosaurus .

Some scientists regard other species as valid as well , for example P. erlenbergensis . Such works , however , ignore Moser (2003) , the publication that shows the type series of P. engelhardti to be diagnostic , and other material to be referable to it .

= = = Invalid species = = =

All named species of Plateosaurus except the type species and P. gracilis have turned out to be junior synonyms of the type species or invalid names . Von Huene practically erected a new species and sometimes a new genus for each relatively complete find from Trossingen (three species of Pachysaurus and seven of Plateosaurus) and Halberstadt (one species of Gresslyosaurus and eight of Plateosaurus) . Later , he merged several of these species , but remained convinced that more than one genus and more than one species of Plateosaurus was present in both localities . Jaekel also believed that the Halberstadt material included several plateosaurid dinosaurs , as well as non @-@ plateosaurid prosauropods . Systematic research by Galton drastically reduced the number of genera and species . Galton synonymised all cranial material , and described differences between the syntypes of P. engelhardti and the Trossingen material , which he referred to P. longiceps . Galton recognized P. trossingensis , P. fraasianus and P. integer to be identical to P. longiceps . Markus Moser , however , showed that P. longiceps is itself a junior synonym of P. engelhardti . Furthermore , a variety of species in other genera were created for material belonging to P. engelhardti , including Dimodosaurus poligniensis , Gresslyosaurus robustus , Gresslyosaurus torgeri , Pachysaurus ajax , Pachysaurus giganteus , Pachysaurus magnus and Pachysaurus

wetzelianus . The skull of AMNH FARB 6810 , the best @-@ preserved skull of Plateosaurus that has been taken apart during preparation and is thus available as separate bones , was described anew in 2011 . The authors of that publication , palaeontologists Albert Prieto @-@ Márquez and Mark A. Norell , refer the skull to P. erlenbergensis , a species erected in 1905 by Friedrich von Huene . If the P. erlenbergensis holotype is diagnostic (i.e. , has enough characters to be distinct from other material) , it is the correct name for the material assigned to P. longiceps Jaekel , 1913 . However , according to the last detailed study of the holotype material of P. engelhardti by Markus Moser , P. erlenbergensis is a junior synonym of P. engelhardti .

Aside from fossils clearly belonging to Plateosaurus , there is much prosauropod material from the German Knollenmergel in museum collections , most of it labeled as Plateosaurus , that does not belong to the type species and possibly not to Plateosaurus at all . Some of this material is not diagnostic ; other material has been recognized to be different , but was never sufficiently described .

= = Taphonomy = =

The taphonomy (burial and fossilization process) of the three main Plateosaurus sites ? Trossingen , Halberstadt and Frick ? is unusual in several ways . All three sites are nearly monospecific assemblages , meaning that they contain practically only one species , which requires very special circumstances . However , shed teeth of theropods have been found at all three sites , as well as remains of the early turtle Proganochelys . Additionally , a partial " prosauropod " skeleton was found in Halberstadt that does not belong to Plateosaurus , but is preserved in a similar position . All sites yielded almost complete and partial skeletons of Plateosaurus , as well as isolated bones . The partial skeletons tend to include the hind limbs and hips , while parts of the anterior body and neck are rarely found in isolation . The animals were all adults or subadults (nearly adult individuals) ; no juveniles or hatchlings are known . Complete skeletons and large skeleton parts that include the hind limbs all rest dorsal (top) side up , as do the turtles . Also , they are mostly well @-@ articulated , and the hind limbs are three @-@ dimensionally preserved in a zigzag posture , with the feet often much deeper in the sediment than the hips .

= = = Earlier interpretations = = =

In the first published discussion of the Trossingen Plateosaurus finds , Fraas suggested that only miring in mud allowed the preservation of the single complete skeleton then known . Similarly , Jaekel interpreted the Halberstadt finds as animals that waded too deep into swamps , became mired and drowned . He interpreted partial remains as having been transported into the deposit by water , and strongly refuted a catastrophic accumulation . In contrast , von Huene interpreted the sediment as aeolian deposits , with the weakest animals , mostly subadults , succumbing to the harsh conditions in the desert and sinking into the mud of ephemeral water holes . He argued that the completeness of many finds indicated that transport did not happen , and saw partial individuals and isolated bones as results of weathering and trampling . Seemann developed a different scenario , in which Plateosaurus herds congregated on large water holes , and some herd members got pushed in . Light animals managed to get free , while heavy individuals got stuck and died .

A different school of thought developed almost half a century later , with palaeontologist David Weishampel suggesting that the skeletons from the lower layers stemmed from a herd that died catastrophically in a mudflow , while those in the upper layers accumulated over time . Weishampel explained the curious monospecific assemblage by theorizing that Plateosaurus were common during this period . This theory was erroneously attributed to Seemann in a popular account of the plateosaurs in the collection of the Institute and Museum for Geology and Palaeontology , University of Tübingen , and has since become the standard explanation on most internet sites and in popular books on dinosaurs . Rieber proposed a more elaborate scenario , which included the animals dying of thirst or starvation , and being concentrated by mudflows .

= = = Mud @-@ miring trap = = =

A detailed re @-@ assessment of the taphonomy by palaeontologist Martin Sander of the University of Bonn , Germany , found that the mud @-@ miring hypothesis first suggested by Fraas is true : animals above a certain body weight sank into the mud , which was further liquefied by their attempts to free themselves . Sander 's scenario , similar to that proposed for the famous Rancho La Brea Tar Pits , is the only one explaining all taphonomic data . The degree of completeness of the carcasses was not influenced by transport , which is obvious from the lack of indications for transport before burial , but rather by how much the dead animals were scavenged . Juveniles of Plateosaurus and other taxa of herbivores were too light to sink into the mud or managed to extract themselves , and were thus not preserved . Similarly , scavenging theropods were not trapped due to their lower body weights , combined with proportionally larger feet . There is no indication of herding , or of catastrophic burial of such a herd , or catastrophic accumulation of animals that previously died isolated elsewhere .

= = Palaeobiology = =

= = = Posture and gait = = =

Practically every imaginable posture has been suggested for Plateosaurus in the scientific literature at some point . Von Huene assumed digitigrade bipedality with erect hind limbs for the animals he excavated at Trossingen , with the backbone held at a steep angle (at least during rapid locomotion) . In contrast , Jaekel , the main investigator of the Halberstadt material , initially concluded that the animals walked quadrupedally , like lizards , with a sprawling limb position , plantigrade feet , and laterally undulating the body . Only a year later , Jaekel instead favoured a clumsy , kangaroo @-@ like hopping , a change of heart for which he was mocked by German zoologist Gustav Tornier , who interpreted the shape of the articulation surfaces in the hip and shoulder as typically reptilian . Fraas , the first excavator of the Trossingen lagerstätte , also favoured a reptilian posture . Müller @-@ Stoll listed a number of characters required for an erect limb posture that Plateosaurus supposedly lacked , concluding that the lizard @-@ like reconstructions were correct . However , most of these adaptations are actually present in Plateosaurus .

From 1980 on , a better understanding of dinosaur biomechanics , and studies by palaeontologists Andreas Christian and Holger Preuschoft on the resistance to bending of the back of Plateosaurus , led to widespread acceptance of an erect , digitigrade limb posture and a roughly horizontal position of the back . Many researchers were of the opinion that Plateosaurus could use both quadrupedal gaits (for slow speeds) and bipedal gaits (for rapid locomotion) , and Wellnhofer insisted that the tail curved strongly downward , making a bipedal posture impossible . However , Moser showed that the tail was in fact straight .

The bipedal @-@ quadrupedal consensus was changed by a detailed study of the forelimbs of Plateosaurus by Bonnan and Senter (2007) , which clearly showed that Plateosaurus was incapable of pronating its hands . The pronated position in some museum mounts had been achieved by exchanging the position of radius and ulna in the elbow . The lack of forelimb pronation meant that Plateosaurus was an obligate (i.e. unable to walk in any other way) biped . Further indicators for a purely bipedal mode of locomotion are the great difference in limb length (the hind limb is roughly twice as long as the forelimb) , the very limited motion range of the forelimb , and the fact that the centre of mass rests squarely over the hind limbs .

Plateosaurus shows a number of cursorial adaptations , including an erect hind limb posture , a relatively long lower leg , an elongated metatarsus and a digitigrade foot posture . However , in contrast to mammalian cursors , the moment arms of the limb extending muscles are short , especially in the ankle , where a distinct , moment arm @-@ increasing tuber on the calcaneum is missing . This means that in contrast to running mammals , Plateosaurus probably did not use gaits with aerial , unsupported phases . Instead , Plateosaurus must have increased speed by using

higher stride frequencies , created by rapid and powerful limb retraction . Reliance on limb retraction instead of extension is typical for non @-@ avian dinosaurs .

= = = Feeding and diet = = =

Important cranial characteristics (such as jaw articulation) of most " prosauropods " are closer to those of herbivorous reptiles than those of carnivorous ones , and the shape of the tooth crown is similar to that of modern herbivorous or omnivorous iguanas . The maximum width of the crown was greater than that of the root for the teeth of most " prosauropods " , including Plateosaurus ; this results in a cutting edge similar to those of extant herbivorous or omnivorous reptiles . Paul Barrett proposed that prosauropods supplemented their herbivorous diets with small prey or carrion .

So far , no fossil of Plateosaurus has been found with gastroliths (gizzard stones) in the stomach area . The old , widely cited idea that all large dinosaurs , implicitly also Plateosaurus , swallowed gastroliths to digest food because of their relatively limited ability to deal with food orally has been refuted by a study on gastrolith abundance , weight , and surface structure in fossils compared to alligators and ostriches by Oliver Wings . The use of gastroliths for digestion seems to have developed on the line from basal theropods to birds , with a parallel development in Psittacosaurus .

= = = Growth , metabolism and life span = = =

Similar to all non @-@ avian dinosaurs studied to date , Plateosaurus grew in a pattern that is unlike that of both extant mammals and birds . In the closely related sauropods with their typical dinosaurian physiology , growth was initially rapid , continuing somewhat more slowly well beyond sexual maturity , but was determinate , i.e. the animals stopped growing at a maximum size . Mammals grow rapidly , but sexual maturity falls typically at the end of the rapid growth phase . In both groups , the final size is relatively constant , with humans atypically variable . Extant reptiles show a sauropod @-@ like growth pattern , initially rapid , then slowing after sexual maturity , and almost , but not fully , stopping in old age . However , their initial growth rate is much lower than in mammals , birds and dinosaurs . The reptilian growth rate is also very variable , so that individuals of the same age may have very different sizes , and final size also varies significantly . In extant animals , this growth pattern is linked to behavioural thermoregulation and a low metabolic rate (i.e. ectothermy) , and is called " developmental plasticity " . (Note that is not the same as neural developmental plasticity) .

Plateosaurus followed a trajectory similar to sauropods , but with a varied growth rate and final size as seen in extant reptiles , probably in response to environmental factors such as food availability . Some individuals were fully grown at only 4 @.@ 8 metres (16 ft) total length , while others reached 10 metres (33 ft) . However , the bone microstructure indicates rapid growth , as in sauropods and extant mammals , which suggests endothermy . Plateosaurus apparently represents an early stage in the development of endothermy , in which endothermy was decoupled from developmental plasticity . This hypothesis is based on a detailed study of Plateosaurus long @-@ bone histology conducted by Martin Sander and Nicole Klein of the University of Bonn . A further indication for endothermy is the avian @-@ style lung of Plateosaurus .

Long @-@ bone histology also allows estimating the age a specific individual reached . Sander and Klein found that some individuals were fully grown at 12 years of age , others were still slowly growing at 20 years , and one individual was still growing rapidly at 18 years . The oldest individual found was 27 years and still growing ; most individuals were between 12 and 20 years old . However , some may well have lived much longer , because the fossils from Frick and Trossingen are all animals that died in accidents , and not from old age . Due to the absence of individuals smaller than 4 @.@ 8 metres (16 ft) long , it is not possible to deduce a complete ontogenetic series for Plateosaurus or determine the growth rate of animals less than 10 years of age .

= = = Daily activity patterns = = =

Comparisons between the scleral rings and estimated orbit size of Plateosaurus and modern birds and reptiles suggest that it may have been cathemeral , active throughout the day and night , possibly avoiding the mid @-@ day heat .