On Statics and Balance of Theropods and the Disproof of the Metatarsus-Theory

Dr. Dipl.-Ing. Dipl.-Ing. HANS-JOACHIM ZILLMER

Two legged dinosaurs walked on their toes, which in most cases resulted in a rounded rear section of a foot print. However, especially in the area of the Paluxy River near Glen Rose in Rose, Texas some foot prints exhibiting a backwards elongated shape of an up to more than 17 inches foot length were discovered and making one think of the shape of a human foot. This manifestation has triggered some controversial discussion in the past. A hypothesis introduced by Glen Jay Kuban[1] 1986 suggests that the oblongness comes from two legged dinosaurs, which instead of walking on the fore foot (their bodies) partly walked straight on the middle foot (metatarsus). To support the body weight by the metatarsus (middle foot) instead of the fore foot armed with three claws, however, is not possible due to anatomical and static reasons.

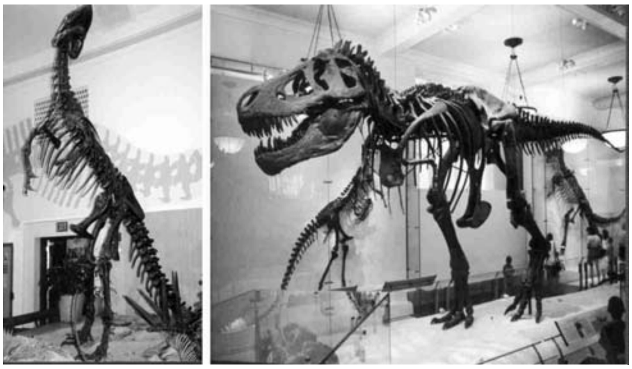

Fig.. 1. *Reconstruction of theropod dinosaurs in the past (on the left) and today (on the right). Tyrannosaurus rex was built up newly in a corresponding horizontal position in the Museum of Natural History in New York.*

Over a period of one hundred years to legged dinosaurs (Theropods) had been displayed standing on two legs with their heads high up (fig. 1 left). Thereby with the skeletons erected at the museums the tail was lying on the floor. This way the foothold of the dinosaurs was stabilized and formed a three dimensional tripod from a static point of view. As the paths with foot prints of dinosaurs never show any traces of dragged tails, recent reconstructions e.g. of carnivores like *Allosaurus* or *Tyrannosaurus rex* and herbivores such as *Iguanodon* are principally re-erected with their spinal column in a horizontal orientation.

In Germany on the plant eating *Plateosaurus* the tail bones were re-assembled in a way that this dinosaur was deprived of his possible movement as a two legged being dragging its tail over ground and being reconstructed recently as a quadruped with its tail held up high. The *Plateosaurus* at the *Paleontology Museum in Munich* was rebuilt 2002 in an entirely new configuration of the skeleton with a spinal column in horizontal orientation.

In contrast to the *Plateosaurus*, that gained greater stability by standing on its four legs, t*heropods* walking on two legs have a static problem, as the body including the head should be in balance with the tail whilst standing, thus, being balanced like a crane. This balance is established when the momenta of forces times lever arm to the left and right of the centre of rotation the point of support are equal. This point should be located on a vertical vector or rather on an axis, which the centre of gravity of the animal's weight (G) as well as the ground pressure caused by the animal's total weight as resulting support- or reaction force factor (B) is acting on. On this axis, which we may call neutral axis, the knee joint is positioned during rest posture (K) to avoid (strained) torsion in the state of balance. By maintaining these conditions the load for muscles, tendons and bands is at a minimum.

As now the lever arms for the weight of the body (GK) and the tail (GS) are known, we receive a balance relatation, if the center of gravity of the leg idealized lies on the neutral axis and generates no torque (M), as the lever arm equals zero:

$$\boldsymbol{GK} \times \boldsymbol{b} = \boldsymbol{GS} \times \boldsymbol{c} \quad \text{oder} \quad \boldsymbol{M} = \boldsymbol{0} = \boldsymbol{GS} \times \boldsymbol{c} - \boldsymbol{GK} \times \boldsymbol{b}$$

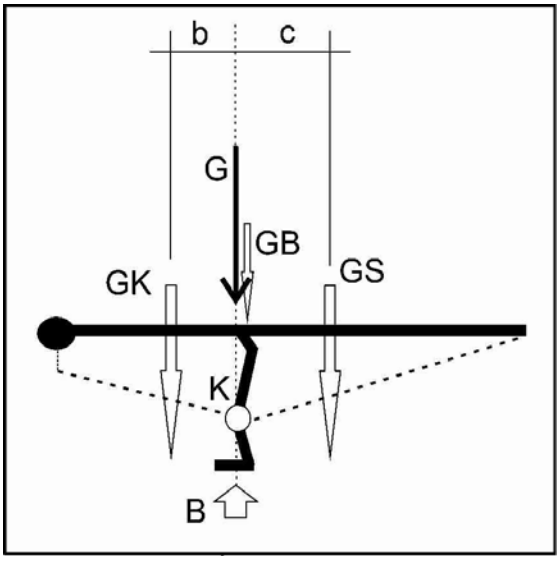

Fig. 2. *Idealized theropod dinosaur in the balanced horizontal position with heavy body and heavy tail. G = total weight, G K = weight body, GS = weight tail, GB = weight legs, K = knee joint, B = support strength size in the ground.*

The modern reconstructions however, show a different picture, because the tail is represented very slender and cannot act as a balance for the heavy body. The dashed lines show the approximate distribution of balance resulting from the modern reconstructions (Abb. 3). Respectively the total weight from GK and GS does not act upon the neutral axis, but generates a tilting momentum (neglecting the weight of the legs GB),

$$\boldsymbol{MK} = \boldsymbol{G} \times \boldsymbol{d} = \boldsymbol{GK} \times \boldsymbol{b} - \boldsymbol{GS} \times \boldsymbol{c}$$

which would affect the knee joint K and would require stabilization. The tilting momentum MK also acts upon the surfaces of the feet or rather would have to be discharged via the feet into the ground contact area or subsoil, as otherwise the theropod (without balancing action) would take a great fall. The force vector (= net force) of the weight G proceeds outside of the foot area (= contact area). Therefore in the standstill posture there is no balance. The t*heropod* would have been forced to make a sidestep in order to obtain a chance to stabilize its stand at all. This would require a permanently active muscle work with or without movement. A standstill with legs aligned and therefore without greater muscle work is not possible according to the recent skeleton setups.

In order to allow the t*heropoden* a weight wise balanced standstill the weight distribution should be arranged as shown abstractly sketched (dashed line) – in fig. 2. This means a significantly higher and thus, heavier tail. The from a static point of view wrong reconstruction of the t*heropods* results from the placement of the anal bulb. This body orifrice is generally placed above the seat bone fork, whereby there is only little height left for the tail (fig. 3).

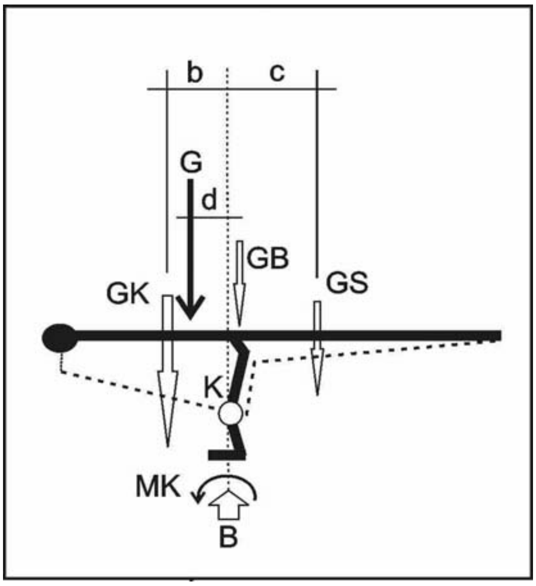

***Fig. 3**. Idealized theropod dinosaur in accordance with current reconstructions showing in textbooks and museums with massive body and thin tail: A balanced posture is not possible in any case.*

As with only a few exceptions only skeleton- but hardly soft remains and no completely fossilized animals are found, the placement of the anal bulb is speculation. It may have been located alternatively below near the lowest point of the body[2].

Thereby an overall bulkier body shape with a high tail root and therefore a higher and heavier tail can be assumed[3].

A significantly higher tail than reconstructed up to date suggest the seldomly found and with reconstructions often not considered bone extensions (chevrons), which are located underneath the tail to thus, form the tail as a stiffened disc. As a result the tail cannot deflect vertically, and therefore can only be moved in horizontal direction.

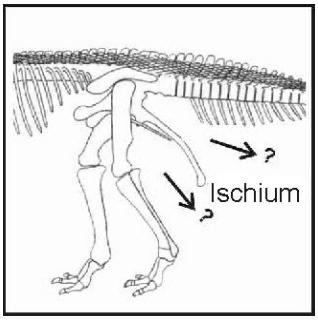

***Fig. 4**. Lay the anus bulb (?) under or over the Ischium? The backbone is strengthened by tendons which are similar like bones to hold the balance of the entire body. Cf. fig. 5).*

This stiffness of the tail is necessary to safeguard the transmission of the tail weight onto the legs as counter balance to the body weight and on the other hand to give justice to the observation, that no traces of tails being dragged while walking have been discovered.

The reconstruction of theropods as balancable swinging structure appears dubious from a static point of view alone, especially as the reconstruction of the animals' body keeps becoming more and more voluminous and therefore despite a heavy tail no balance is provided.

Most dinosaurs are also reconstructed with ribs only, but not with the necessary abdominal ribs, which extremely seldom remain intact fossilized. Without the attachment of abdominal ribs the body of *theropods* appears slimmer and the fore feet are attached above the shoulder belt (*scapula* and c*oracoid*) on top of the ribs

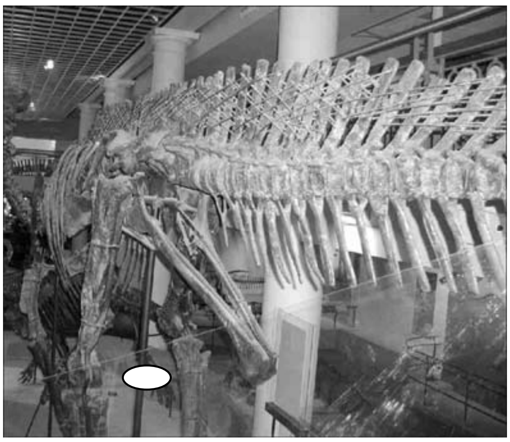

***Fig. 5**. Tendon eyesight similar to bones strengthen statically the tail (as a pulling force belt) and strengthen this against bending vertically. The Chevrons hang under the backbone, as in the case of this Corythosaurus, and cause a high cross-section of the tail. Oval = anus bulb.*

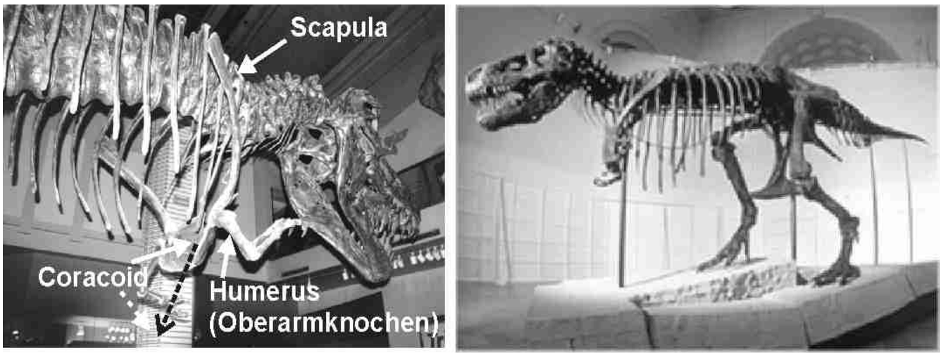

Fig. 6*. Theropode reconstructed without lower ribs enclosing the belly with too highly positioned complete shoulder (Humerus, Caracoid, Scapula) and as a consequence thereof with too highly positioned arms which are for that reason to short to handle something.*

near the vertebrae (fig. 6). For that reason the *Tyrannosaurus rex* gets especially short arms seemingly without any function.

At the National Museum of Natural History, Washington D. C. the alleged predator *Allosaurus fragilis*, an early relative of the Tyrannosaurus was reconstructed *completely with abdominal ribs*, creating a clumsier appearance (fig. 7). In this case the shoulder belt was not attached on top of the ribs, but underneath at the abdominal ribs. Only this way a traction compound of the forearms with the skeleton is provided, which is absent in the arrangement of the arms according fig. 6.

Also when considering abdominal ribs according fig. 7 the short forearms are hanging far beneath the belly and in horizontal posture of the spine almost reach the floor. Thus, almost a quadruped evolves, which at least when needed could support itself with its fore feet, to avoid tilting forward or rather to balance the tilting force (MK).

Fig. 7*. Allosaurus arms hanging down under the lower belly ribs near enough to drag on the ground.*
Realistic reconstruction in the Natural History Museum Washington D. C.

Or were theropods quadruped as well, as much as Iguanodon and Corythosaurus, which until not long ago were reconstructed as two legged animals[4]?

If *theropods* however should be two legged, they could not have been speedy predators due to their enormous body weight, as these dinosaurs for both static and dynamic reasons must have been busy maintaining their balance.

Two legged dinosaurs were walking on their toes, as fossilized tracks reveal. Especially by and in the Paluxy River near Glen Rose, Texas several foot prints with an elongated shape were discovered, which resemble humanlike foot prints, with a total length of more than 17 inches. Glen Jay Kuban explained, that two legged dinosaurs walked partly on the middle foot (*metatarsus*) which consists of *hollow bones*[1]. Without further investigation or research this explanation served as evidence against any »human foot prints« discovered since 1908, and those to be discovered in the future[5].

Fig. 2. *Leg of Tyrannosaurus rex.*
Ruheachse = axis of body balance.

Can a theropod walk on its metatarsus, and therefore on the fore foot and middle foot (fig. 8), to create the elongated foot prints this way? Analogous to the static reflection up to this point the knee should be located on the neutral axis (fig. 2), even at the momentum of total shifting of weight from one foot onto the other, to reduce the stress of muscles, tendons and bones to a minimum.

For a biped the weight has to be transmitted from the knee joint through the lower leg and foot onto the ground. The divergences of the joints to the neutral axis should be as little as possible (fig. 2 cp. fig. 8). Even the joint between fore-, and middle foot should be located near the neutral axis. When these conditions are met, additional torque (torsions) in this joint as well is avoided or reduced to a minimum.

At a normal posture of the foot the middle foot (metatarsus) and the ground surface constitute an angle of approximately 70 degrees. If the theropod would press the middle foot against the ground horizontally, then, if the knee remains on

the original neutral axis, an angle of approximately 135 degrees is formed (cp. fig. 10). An overexpansion of tendons and fracture of the joint between middle foot and lower leg would be the result.
The three toed foot prints at *Paluxy River* are supposed to originate from an Acrocanthosaurus. As the long foot prints have a length of 18–22 in and the normal toe prints of the fore foot of 12–13 in, a minimal lever arm of ***k***= (55–35) + 35/2 = 37,5 cm (fig. 9) is possible, if the resulting ground pressure B acts on the middle of the fore foot.
Acrocanthosaurus ellegedly weighed two to three tons. An additional momentum from the total weight times lever arm of at least if the animal should stand in balance

$$\boldsymbol{MG} = \boldsymbol{G} \times \boldsymbol{k} > 20.000 \times 0{,}375 = 7.500 \text{ Nm}.$$

This acts in addition to the total weight on the joint between middle foot and lower leg and should be transmitted via the middle foot. Converted or rather resolved into a pair of forces of pressure- (D) and pulling force (Z) at an assumed effective lever arm at the joint of von 0,2 m – as fossilized tendons are not available:

$$\boldsymbol{Z} = -\boldsymbol{D} = \boldsymbol{M} / \boldsymbol{n} = 7.500 / 0{,}2 = 37.500 \text{ N}.$$

Assuming a cross section of the not preserved muscle or rather the tendon of 50 cm^2, results in a stress S from force divided by surface F of

$$\mathbf{S} = \mathbf{F} / \mathbf{A} = 37.500 \text{ N} / (50 \times 10^{-4}) \text{ m}^2 = 7.500.000 \text{ N/m}^2 = 75 \text{ bar}$$

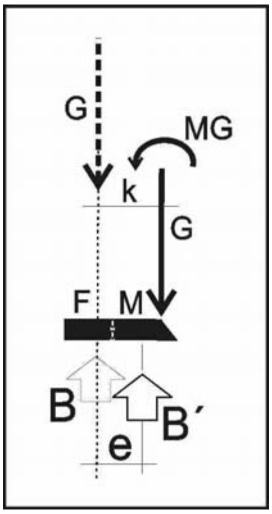

Fig. 3*. On the ground standing leg of a theropod dinosaur with forefoot (F) and Metatarsus (M). The counteracting force in the ground (B) laying in the axis of entirely horizontally body balance (cf. fig. 8) can not be activate if the dinosaur step on the Metatarsus reacting a different position of the counter-force (B ').*

This stress adds to the pre-tension of the muscle, which originates from the overtwist of the joint to between 135 and 140 degrees (fig. 10). The transmission of pulling forces and pressures of this magnitude, in addition to the total weight of the animal G transmittable by the joint, is inconceivable. Joints can naturally transmitt no or just relatively littlest momenta (force x lever arm) through the muscles, tendons and bands. In case of a footfall on the middle foot M (m*etatarsus*) in contrast to the standstill on the fore foot F (fig. 9) almost the threefold (or more) than the normal load would have to be transmitted. If the *theropode* moved additional enormous inertia forces would add to that.
Futhermore the joint between middle foot and lower leg and also the middle foot consisting of hollow bones (*metatarsus*) are by design not capable of transmitting great forces onto the ground. Hollow bones are lengthways indeed very sustainable, similar to oak wood, with stress in lateral direction, however, as it would be the case of a footfall on the middle foot (*metatarsus*), load capacity would be much lower, as the bone then would be stressed with torque.
Looking at the other option alternatively, that, in order to avoid an overtwist and over load of the joint between middle foot and lower leg, it would be feasible not to bring the knee onto the neutral axis during the metatarsus-footfall, but to leave it in a steeper angle of 100 instead of 135 degrees. The knee then assumes the posture K´ instead of K (fig. 10). If the knee joint for example would be located on the support axis B´, additional momenta (deadweight times lever arm) would again occur, which cannot be transmitted (fig. 10):

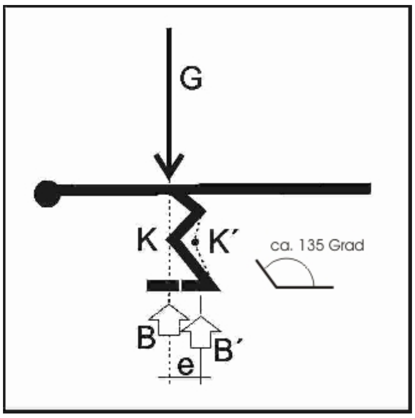

Fig.10*. The posture of the theropod dinosaur if standing on the forefoot and middle foot (Metatarsus).*

$$\boldsymbol{M} = \boldsymbol{G} \times \boldsymbol{e} > \text{maximum size of M}$$

In motion further inertia forces add up to the distribution of forces at standstill by which additionally even horizontally effective forces occur and act. Regardless of the additional load on bones and muscles with the footfall on the middle foot (Metatarsus) a greater tilting momentum than with the footfall on the forefoot would occur, because the counteracting force of the body weight in the ground (B) in case of entirely horizontally body balance (G) without locomotion is different to the axis of centre of gravity in case of locomotion at the moment of stepping on Metatarsus. In this moment a lever arm e (fig. 10) appears between centres of total weight and therefore a tilting momentum is created. These overturning moment cannot be transmitted via the contact area of the feet, because the centre of gravity of the load lies far outside, way in front of the contact area of the feet (= the surface contact area supporting the animal's weight on the ground).

Balance, regardless of the knee position, is impossible with the footfall on the middle foot (Metatarsus). This could only be achieved by a compensation movement, whereby the timing to lift one leg with the forward movement and the necessary shifting of weight forward would be dangerous for the animal, because a further *additional* tilting momentum occurs.

It also has to be considered, that the entire separate arrangement of fore- and middle foot is meant, besides the mobility, to provide damping for the locomotor's system through the muscles and tendons, so that jerky charges of the skeleton are avoided, like with the suspension of car wheels.

If the theropod directly steps on his middle foot, the impact jolt of a step without damping is transmitted to the whole animal. The *theropod* dinosaur would therefore not step on its middle foot voluntarily. Furthermore an enormous expenditure of energy is needed to bring the middle foot (m*etatarsus*) back from its backward (horizontal) posture against the deadweight at about 70 degrees (see fig. 8) and re-establish the normal posture (standstill).

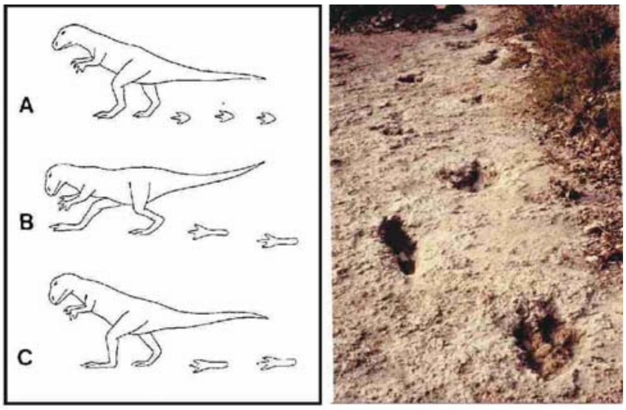

Fig. 11. *A theropod dinosaur in locomotion in according to Glen Kuban[1]: A = normal stepping on forefoot, B and C =f unnatural locomotion with stepping on the middle foot (Metatarsus) which causes great expenditure of energy and great distortions of the joints. The right picture shows a dinosaur path with one longish track (the second one left). Out of Kuban[1].*

If we examine the long foot prints, which allegedly were created by the step on the middle foot (Metatarsus), it becomes obvious, that they can only be found very few and far between within an existing path of several tracks. The author has visited many a fossil site and never, except for at the Paluxy River, saw such longish foot prints of a total length of more than 17 inches. Even if they existed at other places of discovery, they are rare findings.

According to Kuban[1] the print documented in fig. 12 (left), exhibits, superficially evaluated, a human shape. But it is supposedly a metatarsus-foot print A more in depth explanation is not offered. The narrow shape was allegedly formed when the original soft mud came to flow back after being displaced.

No trace of the three toes is visible. Kuban[1] claims: »On a muddy ground a backflow of the mud over the front section of a track could even fill and cover the toe prints again. After the hardening the upper layer must erode at first, before the toe prints become visible[6]«. Why this happened only to the second print in fig. 11, but not to the others? Why were the claws covered completely just with this print and with the others not at all? If the mud around the print would flow into it, this should be visible by the shape of the surface of the ground, as a small sink or a crack in the ground surface should occur. As this is not described, it can be assumed, that – as recognizable in figure 11 (right) and 12 (left) – no alteration of shape of the surface surrounding the print ever happened. Using optical methods like the application of a temperature card differences can be made more distinct. The

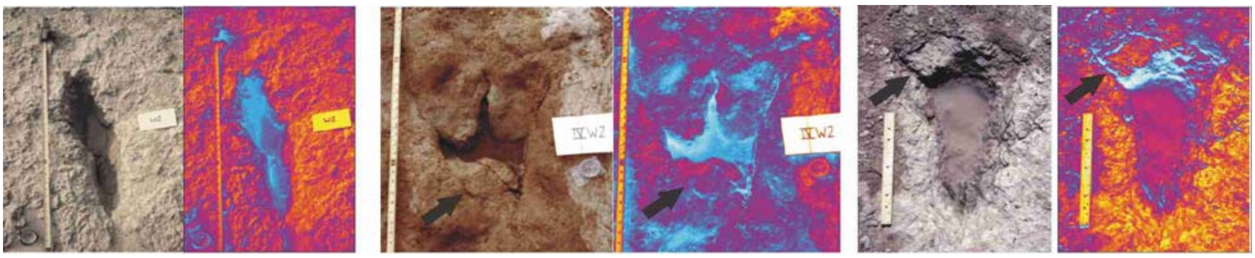

Fig. 12. *The track on the left hand side shall be a Metatarsus track without a visible forefoot seal which was pressed together by the mud allegedly in according to Kuban[1] .Instead of this statement it is clearly to recognize the destroyed floor structure in front of the track before floating back of the mud like to see in the right and middle illustrations. This is not an isolated track of a metatarsal bone without the forefoot because one can see the claws clearly which are now replaced with mud. The not eye-visible imprinted claws in the ground are clearly to see in the false colour pictures made by Zillmer. Original photos: Kuban. False colour processing: Zillmer*

print in fig. 12 (left) shows a homogeneous structure of the surrounding rock, whereas the print in fig. 12 (middle) shows a broken ground structure in the area, where indeed the mud did flow into the rear section of the print. Corresponding evidence is recognizable in the right picture of fig. 12, where

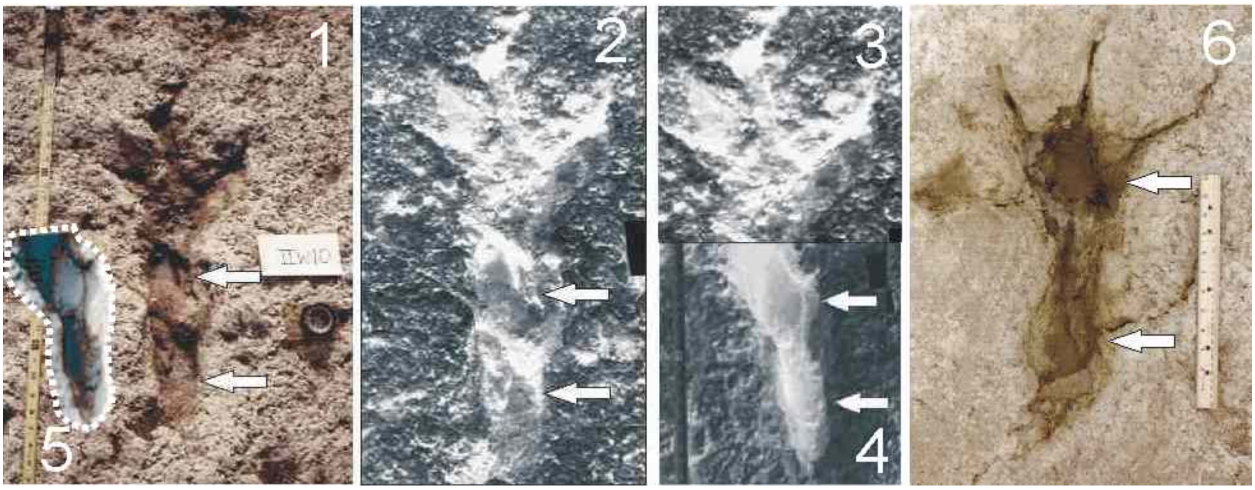

Fig. 13. *This long shaped imprint (photo 1) is regarded as a textbook example for a joint track caused of forefoot and middle foot (Metatarsus); photo 1 and its photographic negative as picture 2). But these longish track contains two different imprints (picture 1 or 2 upper half and photo 5 or 4 as the bottom half of photo 3), which lies one behind the other perchancly; see photo 3 as a combination of photo 1 (upper half) and the photographic negative of photo 5 (= photo 4)at the bottom half. The original complete longish track as displayed on photo 1 and as a photographic negative at photo 2 is instead of one long track a composition of two different imprints as one foot track and one arm track overlapping each eather coming across; cf. arrows in photo 6, 4 and 2 below. Original pictures taken from Kuban, additions and photographic negatives: Zillmer.*

the section at the upper left section of the print, which actually should show the claws, detached and this way the resulting crack simulates the print of a single claw.

Neither in the left nor in the right picture of fig. 12 anything like claw prints can be detected. Are the left and right pictures of fig. 12 metatarsus-foot prints without the fore foot? Can theropods on the one hand snap off the middle foot, and on the other hand even bend the fore foot of the leg in such unnatural posture, that it would not leave a trace?

Are the left and right pictures of fig. 12 showing different, isolated prints? Looking at an alleged prime example for a metatarsus-foot print created together with a print of the fore foot (fig. 13/1), then this long print seems to consist of two smaller ones: in the front a normal one with three toes and behind it a longish print consisting of two slots with a higher positioned bridge in between. Fig. 13/2 is an inverted magnification of the left picture. Details can here be recognized more clearly.

The print in fig. 12 (left) was cut by the author, to enhance the structures electronically by false colour processing and to compare, set beside the alleged metatarsus-foot print, the rear section of the long print in fig. 13/1. It is clearly recognizable, that there is the same basic structure, as described earlier. Fig. 13/3+4 is a combination of the print of the fore foot from fig. 13/1, combined with the print from fig. 12 (left) or fig. 13/5.

Obviously compared to fig. 13/2 (= inverted fig. 13/1) the same basic structures are evident again. The alleged long foot prints, which supposedly came from the footfall of the theropods on their middle- and fore foot, turn out to be two isolated prints, documented in fig. 12 as isolated prints. In fig. 13/1 those two prints are accidentally aligned, whereas in fig. 13/6 they even merge: The front section of the alleged metatarsus-foot print lies in the midst of the three toed print (upper arrow in fig. 13/6).

It appears, that some scientists since 1986 have embraced the metatarsus-explanation of the long foot prints at the Paluxy River as a »natural« explanation for the speaking likeness of these prints with human foot prints and without any further examination, and definitely not on site! On the online encyclopaedia *Wikipedia* it is consequentially claimed, that science had

Fig. 14*. The author inspects a longish imprint besides a three towed dinosaur track in Barkhausen near the town Bad Essen in Lower Saxony(Germany).* These two separate tracks if lie behind each other by chance, yield an alleged Metatarsus imprint (cf. fig. 13).

no problem with the human like foot prints from the time of the dinosaurs.
It was shown, however, that *theropods* like the *Arcocanthosaurus*, *Allosaurus* or *Tyrannosaurus rex* due to static-, and also anatomic reasons could *not* walk on the middle foot (m*etatarsus*). the long foot prints turned out to be consistent of two different prints.
Human foot prints were documented in layers from the Mesozoic – and even older periods – not just since 1908 at the Paluxy River, but also in several US-states at different times[7]. Thereby sporadically not only prints in a rudimentary shape of a human foot, but even with the print of toes were documented[8].

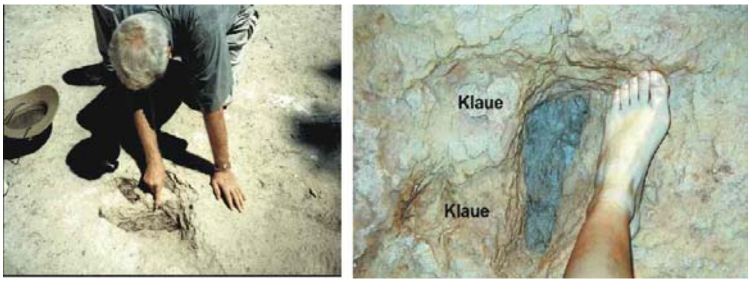

Fig. 15. *In the year 2001three new human tracks were discovered below a limestone layer. These trail consisting three tracks is laying by 90 degrees rotated to the dinosaur path. The right picture shows an extension with the foot of the daughter of the author in comparison to the fossil human track[9].*

The *author does not claim*, that e.g. all longish traces atypical for dinosaurs (cp. fig. 14) come from humans. In addition to human foot prints without doubt prints in longish and sometimes rather round shape next to three toed foot prints are found, whose origin *cannot* be explained scientifically. The author suggests as a solution to the problem to consider a prop up of the theropods with the fore legs due to static reasons (cp. fig. 7), so that the body during movement could be kept in balance as needed. This was done using the inward curved fore hands (= feet?). The isolated prints therefore represent prints of the back of the hand, which sometimes are located within, behind or beside the prints of the hind legs.
In some cases respective hand prints were created with an open hand as well, giving the impression of a young walking with its mother, assuming theropods only left prints of their feet.

Abb. 16. *Fossilised imprints of hands and feet of theropod dinosaurs in the sea floor of ancient Hopi Lake near Tuba City. H = hand track (on the left: open hand, on the right: back of the closed hand). F =foot track.*

Despite this »static« aid of propping up with the arms, it seems to be questionable, whether the big (allegedly) two legged carnivor-dinosaurs could keep balance at all. Were the big dinosaurs probably water-, or swamp inhabitants, as it was the scientific opinion earlier? Because at excavations in Colorado in a kind of mass grave the author could unearth turtles and crocodiles besides remains of dinosaurs. In the West of America this diversity-layer can be found in many fossil (allegedly small) »water holes«, like e.g. in the *Cleveland-Lloyd Dinosaur Quarry* near Price, Utah.
Also the German expedition 1909 in Tanzania (East Africa) found exuviated of Barosaurus (before: Gigantosaurus) together with shells, snails, belemnites and fish at the Tendaguru, in sediments of a coastal ocean from the Cretaceous. There are even altogether three layers deposited by the ocean of 20 to 30 centimetres thickness with remains of dinosaurs lie on top of each other (»Deutsches Kolonial-Lexikon«, 1920, volume III, p. 475 f.; cp. Fraas, 1909).
The nature of several imprints found 1980 reveals, that the carnivore Megalosaurus must have been able to swim, as only toes and claws, but not the foot itself are clearly recognizable. Thus, the opinion, that herbivore dinosaurs (*Sauropoden*) were able to escape an alleged threat by fleeing into water could be revised (Mossmann/Sarjeant 1997[10]).
Did dinosaurs mainly live in swamps and lakes – also or even because of their enormous size? I that case these animals had no problem with their balance. If we consider in contrast to fig. 18 but

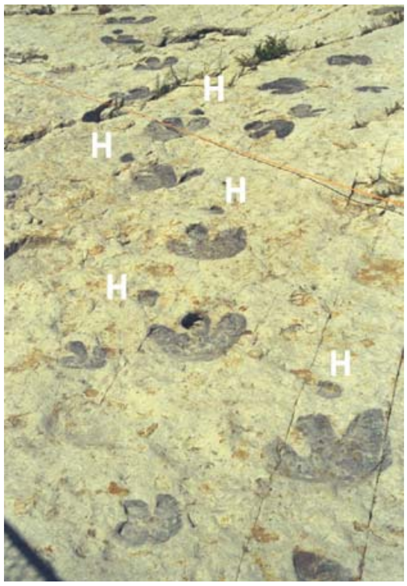

Fig. 17. *Tracks of feet and hands (H) side by side near Morrison,*

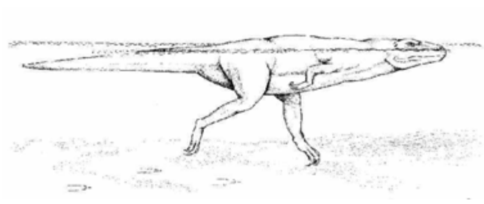

Fig. 19*. Swimming Megalosaurus*[10].

analogous to fig. 7 longer fore arms hanging almost down to the ground, a swimming style probably like that of dogs would come into question. This could explain why prints of hind- und forelegs were found isolated in-, or next to each other.

Due to continuous erosion the author was unable to examine the old dinosaur-path shown in fig. 11 on site in Glen Rose. However, the second print of this lot seems to originate from the arm (=foreleg?), while the print of the hind leg is obviously missing. If the animal moved swimming in water this phenomenon would be explicable, whereas otherwise we will have an unresolved problem, if this Acrocanthosaurus should have moved on land.

By land these animals would also have had difficulties to keep balance on the muddy slippery ground. Prints evidencing the slipping of the foot are very rare. Were the many preserved fossilized tracks really preserved on shore and in *layers of mud* ?

Under water there is naturally more likely a layer of mud and the water protects these tracks even against erosion, while tracks left behind on land normally tend to slur (erode) very quickly, by all means faster than the fossilization can occur! The best dinosaur-foot prints in the whole world can probably still today be admired after all under water *in the* river bed of the *Paluxy River*. Dinosaur-foot prints were in fact also found at the ceiling of coal mines in various mines in great numbers. These animals sank deep into the then still soft coal and it is imagined, that the soft coal was located at the bottom of swamps.

Fig. 19. *Three towed dinosaur tracks at the ceiling of a coal seam in the Mine Castle Gate in Utah (left track found in 1924). The coal was shapeable as the dinosaur walked over these.*

This official explanation appears to be reasonable. Imagining this scenario without the soft coal, but with a muddy chalk bed at the bottom of the waters, several mysteries could be solved: The theropods did not have any balance problems, because the movement was statically supported by the water.

Some human like foot prints of dinosaurs are in fact from the hands (=fore feet) of these primeval giants. These imprints (foot prints) were however not cited as evidence for the coexistence of dinosaurs and humans by the author, as those are single isolatedly scattered prints, shown by Kuban himself (fig. 11).

Besides these single prints, erroneously referred to as metatarsus-foot prints of dinosaurs there are others in human length of step lying paths of prints[11] and sometimes showing even details like human toes[8].

Some human like foot prints of dinosaurs are in fact from the hands (=fore feet) of these primeval giants. These imprints (foot prints) were however not cited as evidence for the coexistence of dinosaurs and humans by the author, as those are single isolatedly scattered prints, shown by Kuban himself (fig. 11).

Besides these single prints, erroneously referred to as metatarsus-foot prints of dinosaurs there are others in human length of step lying paths of prints[11] and sometimes showing even details like human toes[8].

Literaturhinweise

1 Kuban, G. J. (1986): *Elongate Dinosaur Tracks*. This was a paper presented at the First International Conference on Dinosaur Tracks and Traces, held in Albuquerque, NM in 1986, and was subsequently published in the book *Dinosaur Tracks and Traces*, 1989, Gillette, D.D., and Lockley, M.G., eds., Cambridge University Press, p. 428-440.

2 Scheven, J. (1995): *Leben*, Nr. 6, *Deutsches Schöpfungsmagazin*

3 Zillmer, H.-J. (2002): *Dinosaurier Handbuch. Fakten, Funde, Kontroversen,* München, S. 95 ff.

4 ebd. S. 97 und Foto 2–4

5 Scherer, S. und Wiskin, R. (1986): „Menschliche Fußabdrücke“ in der Kreide: Ein Lehrstück für die Schöpfungsforschung, Arbeitsblatt WORT UND WISSEN, Nr. 15, Mai 1986

6 Ebd. S. 5

7 Zillmer, H.-J. (2005): *Die Evolutionslüge*, München 2005, S. 145 ff. vgl. Cremo/Thompson (1993): *Forbidden Archaeology*, Badger 1993

8 Zillmer, H.-J. (1998): *Darwins Irrtum*, München 1998 (Foto 72-77) bzw. *Darwin´s Mistake*, Enkhuizen 2003

9 Zillmer, H.-J. (2002): *Dinosaurier Handbuch*, München

10 *Spektrum der Wissenschaft*, Digest 5, S. 55

11 *Zillmer, H.-J. (2001*): *Irrtümer der Erdgeschichte*, München, 2001. 2. Aufl. 2003, Fotos 42-51