Troodon,

THE CRETACEOUS INTELLECT WITH TOO MANY NAMES

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One of the very first dinosaurs discovered in North America was *Troodon formosus*, described by J. Leidy in 1856 on the basis of a single tooth from the Upper Cretaceous beds of Montana. The small tooth was very distinctive, bearing relatively large serrations on the front and back of its sharply pointed crown. But it was also very enigmatic, and Leidy assumed it was from a lizard. At the turn of the century, two palaeontologists independently recognized that *Troodon* was a carnivorous dinosaur, and allied with the giant *Megalosaurus* . By 1924, however, Charles Gilmore took an alternative approach, and stated that the *Troodon* tooth was from a dome - headed dinosaur known as *Stegoceras*. This may seem a little peculiar in that these dinosaurs were plant eaters, but in fact their teeth are quite simple, and they are reminiscent of carnivore teeth. Gilmore was so convinced that this was the correct interpretation that he synonymized *Troodon* with *Stegoceras*, and for many years the dome-headed dinosaurs were referred to as troodontids. The great Canadian palaeontologist, Charles M. Sternberg, took exception to this two decades later. He showed that Leidy's *Troodon* tooth was from a carnivorous dinosaur, re-established the name *Stegoceras*, and created the name pachycephalosaurids ("thick headed lizards"). In 1948, Loris Russell reported the discovery of a theropod jaw with *Troodon* teeth in it, and redefined the family Troodontidae as carnivorous dinosaurs. That should have been the end of the story, but events now took some strange twists. Dale Russell (no relation to Loris Russell, although they both worked for the National Museum of Canada, albeit at different times) assigned a reasonably complete skeleton of the carnivorous dinosaur *Stenonychosaurus* to the Troodontidae in 1969. The jaw with *Troodon* teeth in it was then assigned to *Stenonychosaurus*. Are you confused yet? It gets better. Rinchen Barsbold of Mongolia recognized similarities between *Stenonychosaurus* and the Asian Saurornithoidides, but saw differences between the teeth of Saurornithoides and *Troodon* . So in 1974, he established a new family, Saurornithoididae, which included *Stenonychosaurus* but not *Troodon*, which was still in its own family, the Troodontidae. This created a rather interesting situation, because the lower jaw described by Loris Russell in 1948 was now assigned to the Saurornithoididae, while the teeth in place in the jaw were assigned to a different family of dinosaurs, the Troodontidae! In the late 1970s, I became interested in carnivorous dinosaurs and started to work on *Stenonychosaurus*. Jack Horner in Montana and I often exchange visits and ideas.

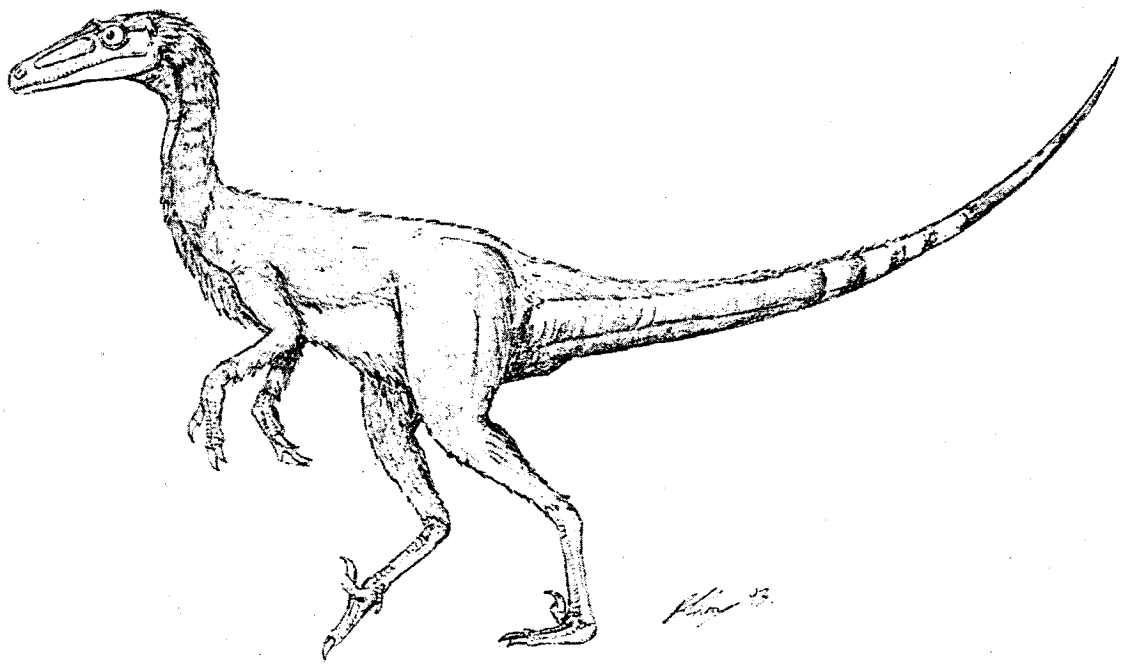
Troodon *was a small, carnivorous dinosaur*

Jack had recovered *Troodon* teeth from his egg site in Montana, as well as the jaws with teeth of the primitive plant eaters known as hypsilophodontids, the most common type of the dinosaur recovered by Tom Rich at Dinosaur Cove. The front teeth of hypsilophodonts are simple, recurved crowns with serrations on the front and back margins. Jack felt that *Troodon* was probably a hypsilophont, so it was gratifying when on a visit to Alberta he found the jaw of a *Stenonychosaurus* with *Troodon* teeth in it! In 1987, 131 years after Leidy described *Troodon,* I published a paper showing that *Troodon* and *Stenonychosaurus* were one and the same. The name *Troodon* had finally found a home.

"If dinosaurs had not become extinct, what would they have become?"

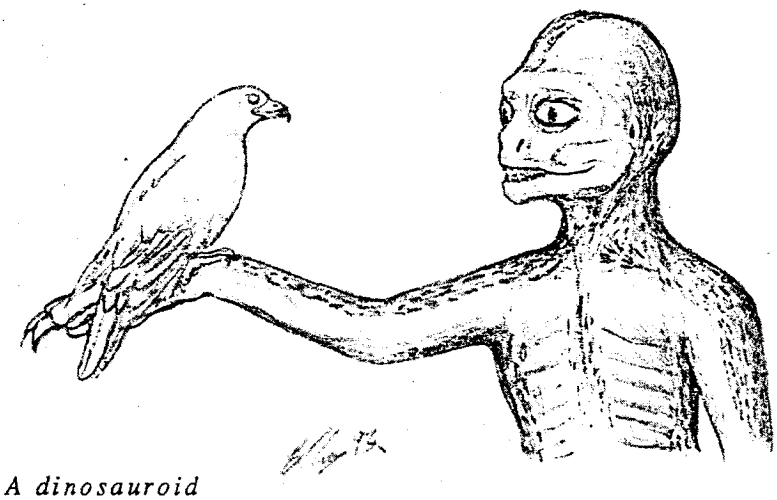
Troodon is a very remarkable dinosaur. It is a small carnivorous animal that was close to three metres in total length and weighed about 75 kilograms. Like the dromaeosaurids *Deinonychus* and *Velociraptor* , the inner toe on the foot had developed into an enlarged raptorial claw that was held off the ground. Keeping it off the ground would have kept the claw razor-sharp, making it all the more effective when it was attached to prey. For a long time, dromaeosaurids and troodontids were classified together (as deinonychosaurs) because of the presence of this specialized toe. However, they are very different types of carnivores. In almost all characters dromaeosaurs are very primitive compared to other Late Cretaceous theropods, whereas troodontids are possibly the most sophisticated of theropods. Troodontids were gracile animals that almost certainly were very agile. The feet of troodontids are highly specialized, elongated to give the animal perhaps as much speed as some of the ornithomimids, and spring-loaded to absorb the shock of impact with the ground. In the skull, the teeth are relatively small, even though the serrations on those teeth are as large as those of *Tyrannosaurus* ! The huge eyes were turned forward, and *Troodon* had binocular vision.

The brain has given *Troodon* its greatest fame, however. It is almost six times the size expected of a reptile of its size, which puts it into the lower range of brain size of modern mammals and birds. But 75 million years ago, even mammals and birds did not have brains that large. Looking at dinosaur evolution, it is quite clear that these were not resting on their laurels. They were constantly evolving, and improving on their form. The Late Cretaceous



Reconstruction of Troodon

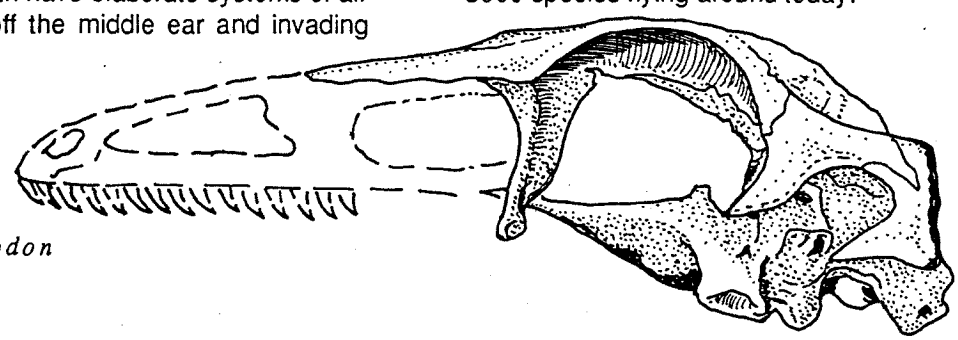
species were far more sophisticated than their ancestors in the way they processed food, in their abilities to run and walk, and in their behaviour. Brain size also was showing a trend towards increasing, and it is generally assumed that increased brain size meant increased intelligence. Dale Russell asked himself, "If dinosaurs had not become extinct, what would they have become?" With an artist (Roger Seguin) from the National Museum of Canada, he created the dinosauroid, a vision of what *Troodon* might have become. The model, which looks like a humanoid creature from outer space, attracted tremendous international attention, and even made it to the tabloids as a space creature invading the Earth! Many scientists ridiculed the work, and criticized it for specific reasons. But controversy is good, and Dale very effectively made the point that dinosaurs were changing. If they had not died out, we would not be here to think about it.



A dinosauroid

My own interest in *Troodon* ties in with an interest in the origin of birds. Although *Troodon* was more than 90 million years too late to be a bird ancestor itself, it does have characters that have been used to "prove" birds could not have come from dinosaurs. Birds and crocodiles, for example, have teeth with constrictions between the crowns and roots, in contrast with the evenly tapered teeth of theropods. And they lack interdental plates, extra bones used by theropods to support the bases of their teeth. In both these characteristics, *Troodon* is much closer to birds and crocodiles than it is to other theropods. But the most startling similarities are in the walls of the braincase. Birds and crocodiles are often thought to be related because they both have elaborate systems of air canals coming off the middle ear and invading the insides of the bones around the brain. No dinosaur was known to have such a system until several well-preserved braincases of *Troodon* were found in Alberta. These were so bird - like that at one point I had to re-evaluate the evidence to show that *Troodon* really was a dinosaur, not a bird! The bird-like characters in *Troodon* do not prove that birds evolved from dinosaurs, but they do show that there are no specializations which would preclude them from the ancestry of our feathered friends. Troodontids are so bird-like that I suspect they are the closest family of dinosaurs to birds. One of the nicest specimens found by the Canada-China Dinosaur Project expeditions was a beautifully preserved Early Cretaceous troodontid skeleton. Although it is still too late to be a bird ancestor, it is already highly specialized as a troodontid and unquestionably had a long family line behind it. It is just a matter of time before troodontids are found that will predate the appearance of *Archaeopteryx*.

There are well over a hundred specialized characters that are shared uniquely by birds and dinosaurs, which suggests to many of us that dinosaurs did not die out completely at the end of the Cretaceous. There are still more than 8000 species flying around today!



Skull of Troodon