Intelligent dinosaurs

DARREN NAISH recalls the debate over hypothetical big-brained dinosaurs and looks at the feathery new kid on the smart dino block...

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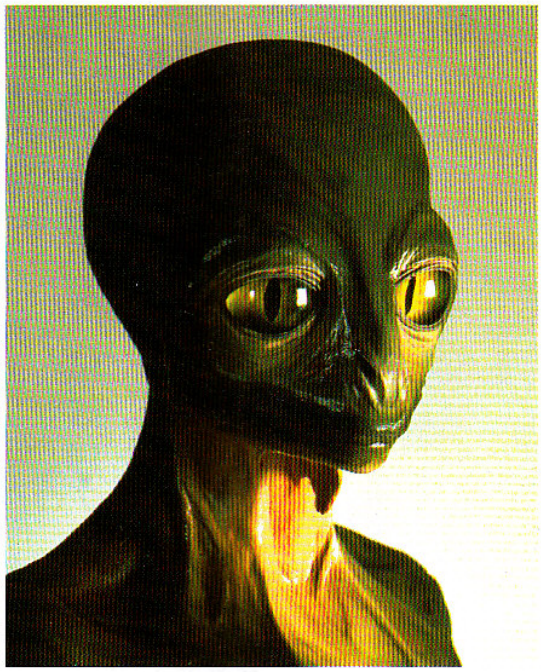
Our fascination with dinosaurs, those remarkably successful reptiles of the Mesozoic Era, shows no signs of abating. While many developments in dinosaur science routinely appear in the mainstream media, far more obscure is the arcane yet popular subculture in which diverse authors have considered the 'dinosaurs that might have been' – the ones that could have evolved in parallel timelines where the end-Cretaceous extinction event never occurred. If just one hypothetical dinosaur were to serve as the poster-child for this genre, it would be the big-brained dinosauroid, a humanoid dinosaur hypothesised to have evolved 60-odd million years after the end of the Cretaceous from humble dinosaurian ancestors, the troodontids.

Troodontids are part of Theropoda, the dinosaur group that includes the mostly predatory, bipedal forms such as the tyrannosaurs and *Velociraptor*. Together with the parrot-headed oviraptors, the birds, and the sickle-clawed dromæosaurs, troodontids belong to a theropod group called Maniraptora. Today, our questions about troodontids concern where they fit within the maniraptoran radiation, what they looked like in life, and what their sensory abilities were like (they had asymmetrically positioned ears, a feature seen elsewhere only in owls). But back in the 1970s and early 1980s, the big deal was that troodontids were big-brained, clever dinosaurs, intellectually superior to the mammals of the time and perhaps hinting at the possible evolution of braininess and sentience in these animals, had they not become extinct at the end of the Cretaceous 65 million years ago.

It was the 1969 description of a new Canadian specimen of the Upper Cretaceous troodontid *Troodon formosus* by Dale Russell, then of the National Museums of Canada in Ottawa, that kicked things off. New skull material allowed Russell to show that *Troodon* had a reasonably large brain for a dinosaur, suggesting that it was – relatively speaking – intelligent. Furthermore, the relatively big brain was combined with bipedality and (supposedly) opposable fingers. Other scientists noticed the significance of this: in *The Dragons of Eden* (1977), Carl Sagan speculated that, had troodontids not become extinct, they might have developed the dominant intelligence on the planet. Quickly, things got out of hand, with popular books and articles eventually describing troodontids as possessing a primate-like intelligence.



ABOVE: Dale Russell and Ron Séguin's visualisation of what a dinosaur decendent with human-like intelligence might look like, from their 1982 paper.

Inspired by the possibility that troodontids might have evolved even bigger brains had they survived beyond the end of the Cretaceous, Russell, working with taxidermist and model maker Ron Séguin, decided to undertake a speculative experiment and reconstruct a hypothetical big-brained, post-Cretaceous troodontid. The result was a life-sized model of a humanoid dinosaur, the dinosauroid, and the reasoning behind it appeared in a technical research paper that Russell and Séguin published in 1982. While some palæontologists thought that this exercise had little value – and in fact ruined an otherwise worthy article on troodontid anatomy – others regarded it as a useful line of inquiry.

Before the paper appeared, Russell discussed the dinosauroid at a 1981 conference, and coverage of his views in the *San Francisco Chronicle* resulted in a storm of media interest. Russell has admitted that he was overwhelmed and amazed by all of this, and that his concern over how the dinosauroid would be received by the world at large even led him to consider aborting the project and destroying the model before its completion. In recent years, the dinosauroid model itself has been hidden away in the Canadian Museum of Nature (Gatineau, Quebec) and, the last I saw, it was wearing a tie (patterned with zeta reticulans) and some garish boxer shorts.

Some of the reasoning that Russell and Séguin used when creating the dinosauroid has not been repeated outside of their 1982 paper. They assumed that a big brain would result in a shortened, human-like face and, because they regarded troodontids as having a reduced number of teeth relative to other theropods, they reasoned that dinosauroids had ended up losing teeth entirely. They further assumed that a big-brained head would have to be supported vertically above the body, and as a result imagined a vertical, human-like body.

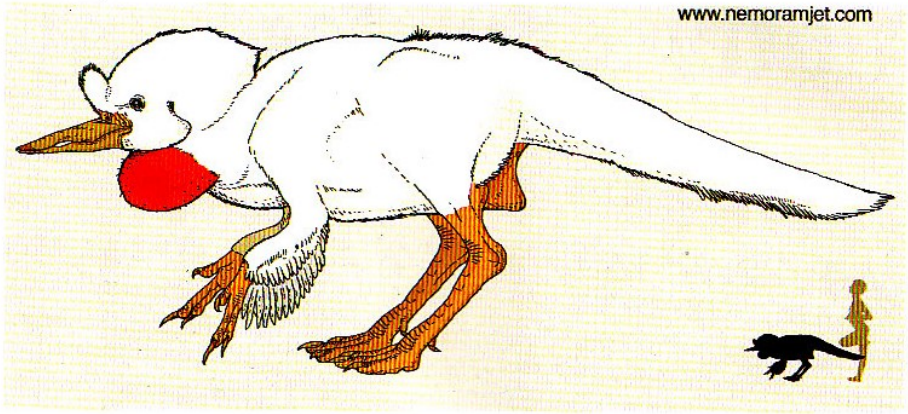
In a 1987 article, Russell noted that quadrupedal animals – when forced to grow in a bipedal posture – have ended up with shallow, human-like chests (in quadrupedal mammals, the chest is normally deep and narrow, not shallow and wide as it is in humans), and he mentioned in particular the case of the goat born without forelimbs, described in 1942 by Dutch anatomist Everhard J Slijper. Forced to adopt a bipedal gait, Slijper's goat grew extra muscles and tendons around its hips, grew a specially reinforced pelvis and strongly bent hind limbs, and also possessed a human-like shallow chest. On the basis of the mutant goat, the vertical-bodied dinosauroid was also given a shallow chest. It was also reasoned that the dinosauroid's vertical posture would remove the need for a tail (though it is not entirely tailless, still being equipped with a short stump), and the need to give birth to big-headed babies led Russell and Séguin to give the dinosauroid a broad, human-like pelvis. Its feet are not three-toed and clawed as usually thought, but

four-toed, with nails rather than claws (the feet were actually based on those of tree kangaroos).

While there was some obvious logic behind all of the decisions made about the dinosauroid, in the end it all seemed oh-so-predictable, the result being a scaly green humanoid that could have stepped out of any number of sci-fi movies (or Ickeian conspiracy theories, for that matter). And was there ever any reason to take seriously the idea that troodontids were evolving increasing intelligence? While reasonably big for a dinosaur, the brain of a troodontid would have been roughly on a par with that of an emu or an opossum. Were troodontids alive today, they could perhaps walk through open doors and learn to scavenge around picnic benches, but 'clever' they were not. Recent work has also shown that the opposable digits thought to be present in the troodontid hand were not opposable at all, but that the three-fingered hands of these animals, held with the palms parallel and facing inwards, best functioned as clawed grabbers that could be brought rapidly together to secure small animal prey.

Anyway, even *if* a huge brain appeared within the group, there doesn't seem to be any good reason to expect troodontids (or, indeed, any non-human animals) to evolve an erect-bodied, human-like shape. So far as we can tell, we have the body shape we do because of our group's specific evolutionary history, not because our body shape is the 'best' one for a big-brained animal. While a few dinosaur experts have said nice things about the dinosauroid – in a few cases even regarding it as 'plausible' – most have denounced it as too human-like and biased by the assumption that the humanoid shape is an evolutionary inevitability. I note that the people who regard the humanoid shape as somehow inevitable often hold religious convictions.

In fact, the inference that big-brained animals should end up looking humanoid is demonstrably false, as there are other vertebrates that overlap with hominids in brain size, yet certainly don't share our body shape. Exhibit A: the Elephantnose fish *Gnathonemus petersii*, a bony-tongued fish from the Lower Niger Basin. It is an electrogenic fish, generating a weak electric field used in navigation and communication. Its brain is *proportionally bigger than that of humans*. Ok, its brain isn't devoted to higher reasoning or tool-use (so far as we know) – but then, neither were the brains of troodontids (again, so far as we know). And then we come to birds, some



Primate-like birds are the real big-brained dinosaurs

ABOVE: A hypothetical big-brained dinosaur descendent, *Avisapiens saurotheos*, as imagined by artist Nemo Ramjet, with indication of scale in lower right corner.

of which overlap in proportional brain size with hominids: not with humans, but with the other Great Apes – orang-utans, gorillas and chimps.

Anatomical and palæontological evidence has demonstrated that birds are maniraptoran theropods, closely related to troodontids and dromæosaurs. Indeed, not only did *Velociraptor* and other bird-like theropods share an impressive list of skeletal details with birds, they also possessed long, complex feathers (dubbed remiges) on their arms and hands, a fan-like array of complex feathers (dubbed rectrices) on the tail, and a covering of simpler, more filamentous feathers on the head, neck, body and hind limbs. So if dinosauroids were to evolve from troodontids, they would be feathery rather than scaly. But the fact that birds are living maniraptoran theropods also brings us to the point that, in a few bird lineages, we can see the convergent evolution of primate-like big brains. In fact, it is primate-mimicking birds that are the real big-brained dinosaurs.

Usually thought of as the most primate-like of birds are the parrots: a mostly arboreal group of brightly coloured, fruit-eating animals that have dextrous, opposable digits (albeit on their feet rather than hands), sophisticated social lives, and complex, proportionally large brains. The parrot neocortex is very primate-like, and of course the incredible ability of some species to learn and imitate human speech, and even in exceptional cases to formulate their own sentences, is well known (see **FT56:9, 230:28**). But less familiar is the suggestion that a very different group of birds are primate-like, and in fact not just primate-like, but downright hominin-like in many of their details and attributes. They are the ground hornbills, and in them we have a group of birds that are slow-breeding, terrestrial, ground-feeding, carnivorous savannah-dwellers; they are the descendants of mostly arboreal, forest-dwelling frugivores (fruit-eaters). Accordingly, hornbill specialist Alan Kemp noted in 1996 that ground hornbills seem to have followed a similar evolutionary path to us hominins: they are the birds most similar to humans in terms of evolutionary history.

In a 2006 article, I combined various of these thoughts, arguing that big-brained troodontids would be more likely to look like feathery, horizontal-bodied maniraptorans than scaly green humanoids, and that ground hornbills were the 'real' dinosauroids: the dinosaurs whose evolution had most closely paralleled those of our own lineage. These ideas appealed to Nemo Ramjet, an artist specialising in the portrayal of other-worldly organisms. Working on the idea that big-brained dinosaurs should still look, well, like dinosaurs, and using ground hornbills for inspiration, Nemo created *Avisapiens saurotheos*, a smart, tool-using big-brained feathery maniraptoran that has the bird-like hind limbs, long tail and horizontal body posture typical of its ancestors. In striking contrast to the humanoid monstrosity imagined by Russell and Séguin, this is an animal with an obvious dinosaurian heritage and, if I may say so, an element of biological plausibility. FT