PALEONTOLOGY

Dinosaur Nostrils Get A Hole New Look

When a snarling *Tyrannosaurus rex* fills the screen at your local multiplex this summer, here's a tip for remembering that the beast's not real: The nostrils are all wrong. You can even feel smug, since most paleontologists would miss the error.

Dinosaur artists have always placed the fleshy nostril relatively high and back from the tip of the snout. But Lawrence Witmer of Ohio University College of Osteopathic Medicine in Athens argues on page 850 that the sniffers ought to be farther forward and closer to the mouth. "It may appear dramatic and bizarre, but from a scientific point of view, it's a much more conservative hypothesis," Witmer says. "It basically says that dinosaurs are like almost all other animals today."

Witmer ought to know. He's been studying animal noses of all kinds for several years, as part of his DinoNose project. His interest is more than aesthetic. The position of the nostril matters, Witmer says, because something important was happening in the noses of many dinosaurs. *Triceratops*, for example, devoted half the volume of its skull to its nasal cavity, perhaps to cool its brain (*Science*, 5 November 1999, p. 1071). "It certainly is important to know where the fleshy nostril is," says Jeffrey Wilson of the University of Michigan Museum of Paleontology in Ann Arbor.

Still, locating the nostrils was a daunting prospect. Some ceratopsian dinosaurs had nasal openings in their skull, also called nostrils, more than half a meter long—and the fleshy nostril could theoretically have been anywhere along there. "The nostril project was one I was almost scared to get into," Witmer confesses.

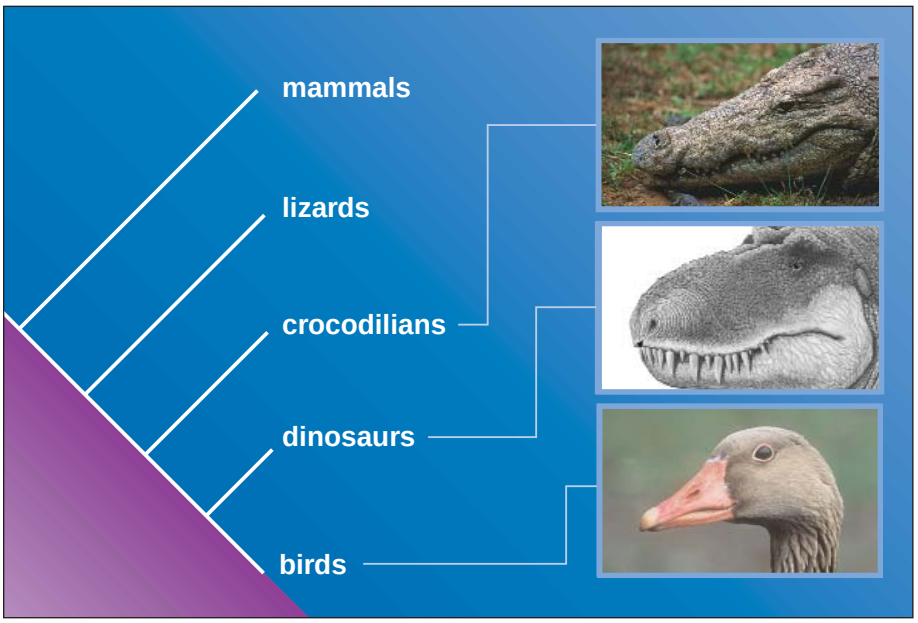
His first step was to look at the location of the fleshy nostril in birds and crocodiles—the closest living relatives of dinosaurs—as well as other animals. The challenge was to find the relation between the position of the fleshy nostril, which is not preserved in dinosaurs, and the nasal opening. To do this, Witmer painted the fleshy nostrils of modern animals with latex and barium sulfate to make them opaque to x-rays. Then he x-rayed the heads. "What was neat is that a picture started to emerge that was surprising," Witmer says. Time and again, the fleshy nostril was located toward the front of the bony nostril.

If the pattern was true of the dinosaurs' closest living relatives, it was probably also the case for the dinosaurs themselves, Witmer says. But to be sure, he looked for additional evidence preserved in the skulls. Modern crocodiles and lizards have erectile tissue inside the nose, next to the fleshy nostril. The blood vessels that feed this tissue leave distinct marks in the bone. When Witmer checked dinosaur skulls of many kinds, he found similar traces of blood vessels near the front of the bony nostril. His conclusion: "The nostrils were pretty much like everybody else's, parked out in front."

Why is that design so popular? Having fleshy nostrils positioned forward on the snout, Witmer says, might enhance the sense of smell. It would also give creatures who depend on smell, such as shrews or tapirs, more information, because the nostril would cut a wider swath as they sweep their heads from side to side. Fleshy nostrils near the mouth might also improve the sense of taste. Not least, the position of the nostril is important for determining how air flows through the nose. A nostril toward the back of the bony nostril would mean dead air in the nose.

So why did artists put dinosaurs' nostrils far backward? Witmer believes the idea dates back to the 1880s, when scientists thought that the gigantic sauropods must have lived in water to support their weight. Sauropods have large, bony nostrils that are close to the top of the skull; this seemed perfectly suited to be a sort of snorkel. But the bony nostrils actually extend farther down the sauropod's snout, and near the front, Witmer found the diagnostic marks of blood vessels.

Wilson and others say Witmer's evidence for moving the nostrils is strong and credit him with setting the record straight. "He's looking at something that a lot of us took for granted and applying some common sense to it," says paleontologist Christopher Brochu of the University of Iowa in Iowa City. "It really demonstrates the need to look at assumptions carefully and how they work in other animals." And that's nothing to sneeze at. –ERIK STOKSTAD



Pick a nose. X-rays and dissections of living relatives suggest that dinosaurs' fleshy nostrils were located at the front of a bony opening, near the end of the snout in crocodiles and dinosaurs.

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GENETIC ENGINEERING

Imperial College Fined Over Hybrid Virus Risk

HERTFORDSHIRE, U.K.—One of the United Kingdom's top research institutes has been ordered to pay almost $65,000 in fines and legal fees for risking the release of a potentially deadly hybrid virus. Government inspectors had charged Imperial College, London, with failure to follow health and safety rules in a study that involved the creation of a chimera of the hepatitis C and dengue fever viruses, both of which cause severe illness. On 23 July, a crown court judge upheld the charges and found the college guilty of failing to adequately protect laboratory workers and the public.

Hepatitis C, which infects about 200 million people worldwide, has proved difficult to study because it does not replicate well in the lab. The molecular biology group based at Imperial College's St. Mary's Hospital campus was trying to create a stable form of hepatitis C to speed research into vaccines and new drugs. The group—headed by molecular biologist John Monjardino—hoped to coax the virus to grow by splicing in a number of key dengue fever virus genes. But the experiment ended after inspectors from the Health and Safety Executive (HSE) filed a devastating report on