Feathered Bat-Like Dinosaur Discovered with Strange Finger Bone

Recently a new carnivorous theropod dinosaur has been unearthed in the Tiaojishan Formation of Hebei Province, China. This formation, near Beijing, is famous for its primitive bird fossils from the Jurassic Period. Without fail, it has yet again turned up a unique and amazing specimen, described in the May 7th issue of the journal Nature. The dinosaur, named Yi qi (meaning “strange wing”) by a team led by Xing Xu of LinYi University in Shandong, China, was discovered by a local farmer. Yi is part of the quite literally small dinosaur family Scansoriopterygidae and is one of only three species in the family. All members in this group are about the size of a pigeon or smaller. The Yi fossil, assumed to be an adult, appears to be the largest of the three species. Although incomplete and quite fragmented, the remains of this fossil are astoundingly well preserved and reveal a unique morphological feature.

The fossil find includes not only lush plumage but also remnants of a membrane believed to have stretched across the animal’s side to form a primitive wing. Yi is especially unusual because of a mysterious bone that attached somewhere on the wrist of the dinosaur (the exact positioning is unclear), projecting outward as though it were a finger. Scientists first tested the composition of the structure, and showed that it and other bones of the fossil were made up of the same material. This proved that this appendage was in fact bone and not cartilage or some other substance in the skeleton. This bone, and others of similar shapes, are referred to as “styliform” bones. Paleontologists believe that this kind of bone, together with a membrane stretching over the bone, formed a primitive wing. Many interpretations have been made suggesting how this bone might have been arranged in the hand or wrist of Yi.

Considering that the fossil is the only one of its kind, and that the skeleton was disarticulated (not in the correct anatomical position), it is difficult to say exactly where the bone connected and faced. Yet another difficulty that arose in interpreting the bone is the fact that one end is sharpened and the other is squared off. The squared off end, although clearly the end that attached to the wrist, does not appear to have been very mobile during use by the animal. On top of that, if the bone could move, it might have impeded flight by getting in the way of the main body. This lead paleontologists to believe that Yi was also not a strong flier— if at all—and was more likely a glider. Despite this, Yi might still have flown, because of structural similarities to modern animals. Modern analogs (organisms that act or function similarly to things in the past) to the proposed wing structures of Yi are likely flying squirrels and bats rather than birds. Flying squirrels do in fact have a styliform bone very similar to that in Yi, giving scientists more reason to believe that Yi was a glider and not a
flier. Nevertheless, the elongated fingers and styliform bone resemble the outspread hand of a bat, which flies and does not glide. Yi especially resembles pterosaurs (extinct flying reptiles), which share the extreme elongation of a single digit (pterosaurs did not have a styliform bone), providing a good example of convergent evolution (unrelated organisms evolving a similar feature).

Yi is not only intriguing because of this strange styliform protrusion in its wrist, but also for its heavily feathered body. It is not surprising that yet another feathered dinosaur has been found in China, because that region is the origin of many such theropods. Most of this animal’s body appears to have been covered in feathers aside from the membranous wings and head.

Because the rear of the animal, including its tail, is not well preserved, feather structures along these parts of the body are unknown. We do know that from what remains of the fossil, the dinosaur did not have primary (or “penneae”) feathers (the long ones used in flying). The feathers of Yi closely resemble those of many other kinds of theropods, although they are most similar to those of raptors (related to the famous Oviraptor). Using advanced technology involving an electron microscope, the fossil’s feathers were examined for structures at the point of attachment. This analysis showed remnants of melanosomes—tiny holes in the skin of the dinosaur. Although seemingly dull and insignificant to the lay person, to scientists they could open up a world of understanding regarding dinosaur color and anatomy.

Yi qi is certainly an interesting new find among the paleontological community, but until more specimens are found, much of its anatomy and natural history will remain unknown. It is highly probable that this theropod performed some kind of aerial locomotion, but whether that was full blown flight or just simple gliding is not yet confirmed. Our present understanding of its flying mechanism is leaning toward gliding, with the evidence of little mobility in the long styliform bone and the fact that flapping would obstruct full locomotion. It might never be known which form of movement it took, especially as an ancestor of modern birds, but paleontologists always hope that another fossil will be found and the mysteries unraveled.


2000-Year-Old Algae Uncovered in Tropical Regions at a Mountain’s Icy Peak

A team of researchers from Rice University, the University of Nebraska-Lincoln, and Ohio State University recently published a paper in the May 2015 issue of *Arctic, Antarctic and Alpine Research* about algae discovered in frozen ice cores (long tubes drilled into frozen ice or soil). The researchers were traveling in the Andes mountaintops of Peru, collecting cores and ice samples to examine carbon content. Many Arctic and other cold-climate scientists use ice cores and frozen soil to see what the environment was like thousands of years ago. This is where much of what we know about ice age and prehistoric climates comes from. This particular team, although looking for carbon, instead found an abundance of preserved microscopic algae in their samples. These algae are a specific type of protist known as diatoms.

Diatoms are single-celled photosynthetic algae that are usually transparent because most of their composition consists of the element silicon, the main component in glass. So diatoms are effectively “glass organisms.” Silicon is also virtually non-degradable; diatom bodies are easily preserved and do not readily decompose. Being such small and simple organisms, diatoms often form the basis of many ecosystems and food chains. They are commonly found in soil and aquatic ecosystems and are one of the most abundant kinds of organisms found on the planet. By obtaining their nutrients and energy from water and sunlight, they have managed to live in almost any climate containing water. Although their discovery in the Peruvian Andes was previously unknown, it was not altogether surprising.

These extraordinary protists were discovered on a Peruvian mountain peak called the Quelccaya Ice Cap. Although Peru is currently tropical, the peak of this mountain is frozen and glaciated. Frozen diatoms have also been found in the glaciers of Greenland and Antarctica, but their
presence doesn’t always mean that the organisms once lived in that particular location. Antarctica is known to have been almost entirely tropical in times when the continents formed Pangea, so its diatoms probably originated in place when Antarctica’s water was liquid. Greenland’s diatoms however, came from far away, transported by global air circulation that picked up dust from North America. A good example of a similar circulation pattern occurring today is the dust from the Sahara Desert traveling across the Atlantic and over the Americas. The question then becomes how the newly discovered Peruvian diatoms came to rest at this ice cap.

Further investigation showed that although global dust was also present in the core, it made up such a small percentage that dust was ruled out as a mode of transport. Also, many of the diatoms are so well preserved that it was judged that they could not have traveled a long distance before freezing at the mountain summit. The ice cores date from about 2,000 years ago and the species composition correlates well with living diatom communities in nearby lakes and ponds at the base of the mountain. This suggests that the top of this mountain was once tropical, and included liquid water with diatoms similar to those found today at the base. It’s truly amazing to think that such small and seemingly insignificant organisms can tell us so much about the Earth’s past only solely through their presence.


The Sixth Mass Extinction. Poor Documentation Blamed for Its “Sudden” Appearance

It is well known that many species of large mammals and birds have been rapidly depleting since humans began expanding their cities and populations. Many of these human-influenced factors are indirect (without intent to cause species declines), such as pollution and the introduction of non-native species. Others are more direct, such as hunting and habitat destruction. Although familiar species such as the rhino, tiger, and many rainforest parrots are critically endangered or extinct, they are not the main source of extinction happening today. In fact, these large, charismatic species account for less than 2% of the total 7% of non-marine species thought to have gone extinct since the Industrial Revolution (late 1700s through the 1800s). The majority of these extinctions are invertebrates, most of which are land snails and other mollusks.

Although we don’t often think about snails, they play an important role in ecosystem processes. Many pond and forest snails are vital to the decomposition of plants, such as leaves and fallen sticks. Those same snails serve as the base of their ecosystem’s food web. With research revealing that many species of snails and other invertebrates are rapidly going extinct, one group of scientists became concerned that an animal with such a vital role was declining, and they wanted to find out why.

This group of scientists, led by Claire Régnier at the National Museum of Natural History in Paris, conducted a study of 200 species of non-marine snails. The results have been published in the June 2015 issue of Proceedings of the National Academy of Scientists. Their goals were to find out why so many species were dying off so quickly, and, more importantly, to show that the official endangered/extinct species list does not begin to account for the massive losses suffered by invertebrates.
The endangered species lists are controlled and “ranked” by the International Union for the Conservation of Nature (IUCN). The IUCN is responsible for determining the risk of every recorded species for probability of extinction, and placing them on what is known as the “Red List.” After undergoing intense study by scientists and the IUCN board, species are ranked as extant, not threatened, threatened, endangered, critically endangered, or extinct. Another important category is “unable to assess.” When the IUCN finds little to no data on a species believed to be declining, it can be placed on the Red List as such. Species are also placed in this category when their habitat is either destroyed or inaccessible.

The Paris Museum team began by looking at IUCN records, then supplementing these records with museum specimens, shell collections, and actual field work. Of the 200 snails investigated, only nine were previously listed at all on the Red List, all as “endangered.” Most of the other 191 species had either never been recorded again after their first discovery or had not been recorded in over 50 years. Of these, several were endemic species (those that live only in one particular place), making accessing the species for collection quite difficult.

Upon final analysis, it was obvious that there were serious differences from the IUCN data. Forty-five percent of the 200 snails selected for this analysis were not threatened at all, and another 40% were unable to be assessed based on a complete lack of data (both in physical collections and in records of field study). The remaining snails were either endangered or extinct. Twenty species were found to be extinct. This is a shocking increase over the Red List’s 9 endangered snail species.

The most important result from this analysis is that there has been a rapid decline of many species and taxa over the past 300 years that has gone virtually undocumented. Snails do play an important role in their ecosystems, but it is more important to note that insufficient data can cause massive underestimates about what is truly going on in our world today. The IUCN has developed an amazingly meticulous method to assess large mammals, but lacks similar efforts for smaller species, such as invertebrates. Although mammals, birds, and reptiles are interesting, attractive, and easier to locate, conservation efforts need to be more evenly distributed across all forms of life if we wish to prevent the sixth mass extinction from progressing further.


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**Amazing New Insight about Tooth Growth in the Saber Teeth of Smilodon**

Saber toothed tigers are some of the most famous and plentiful prehistoric fossils found today, yet little is known about how they actually lived. Sabers, also known by their scientific name *Smilodon fatalis*, are second only to the dire wolves as the most common animal found in the La Brea Tar pits in Los Angeles, California. Other species of saber toothed cats existed all over the world, but this particular species of the big cat prowled the southwestern United States until about 10,000 years ago. *Smilodon* and its relatives are most famous for their massive fangs that can stretch to a length exceeding 7 inches. A recent study in *PLoS One* investigated all ages of *Smilodon* skulls found in the tar pits, and has uncovered surprising data into the rate at which these big saber teeth grew.

It is common knowledge that as kids grow up, they lose baby teeth that are then replaced by adult teeth that had grown in underneath them. Unsurprisingly, the same happens with most mammals, including the prehistoric *Smilodon*. The big cats’ molars, and shredding teeth called
carnassials, are replaced in the same fashion as other mammals, but their canines (the saber teeth) have a unique way of erupting.

In most big cats, such as tigers and lions, the baby teeth grow inside the womb and under the gums. This is also assumed to be the same in Smilodon. The differences in these animals starts after birth when the teeth begin to emerge from the gums. In big cats the deciduous teeth, what we call baby teeth, grow in fully before most of these animals are 3 months of age. In Smilodon the deciduous teeth, excluding the canines, grow in at 4-7 months but the canines don't fully emerge until 11-18 months of age. When we move onto the adult teeth the same large gap between not only species but types of teeth is also seen in Smilodon. Modern cats of the same size were again used for the adult teeth and it was found that molars and carnassials are finished growing in at 24 months, while canines finished fully developing at a maximum age of 36 months. The growth of the adult carnassials and molars in Smilodon are finished by 22 months. The canines took an extra 3 or more months to grow in and a further 20 to become full sized at around 40 months or age. This shocking difference in tooth growth between the canines compared to the molars and carnassials was investigated further using specimens of Smilodon with a wide variety of canine growth stages.

Another curiosity that the research team stumbled upon while looking into the specimens of Smilodon was that there was an age cut off of about 7 months in the records. Very young animals such as cubs appear very seldom or not at all in the pits. La Brea is known to be a death trap for predators who try to attack animals stuck in the tar and in turn cause their own deaths. The cats that are found caught in these pits are usually adults or sub adults. This suggests that the cats hunted away from dens or sites where the cubs were kept and brought food back to them, much like the big cats of today do. It also supports the theory that the deciduous canines remained in place while the adult teeth grew in. Why? Because with the saber teeth being weakened while growing in, the young cat would be unable to hunt on its own for risk of breaking the teeth. Maternal or pack care would ensure that little possibility of injury could be risked to
the young by bringing the carcass to the cubs, instead of bringing the cubs to the carcass. If the latter were true the likelihood of finding cubs in the tar would have risen. By bringing food to the cubs while they were young it gave the cubs enough time for their saber teeth to grow in before they hunted alone.

The growth of these unique saber teeth was both fast for the length of the teeth but slow in comparison to modern felines of similar size and build. It’s also amazing to think that just by cubs not being present in a tar pit that scientists can conclude behavioral aspects of the Smilodon’s maternal care. All of these new discoveries have led to a different view of this big cat that could, in turn, lead to further investigation into how they lived. This American saber tooth may not be around anymore, but that hasn’t stopped scientists from wanting to learn more about them.


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