Paleontology

Richard Monastersky reports from San Diego at the annual meeting of the Society of Vertebrate Paleontology

A tyrannosaur's troubled past

Tyrannosaurus rex may have been the largest carnivore ever to stalk the globe, but that doesn't mean the ferocious beast led an easy life. Paleontologists studying a *T. rex* specimen from South Dakota report that this individual suffered a number of major injuries and diseases throughout its life.

Discovered in August 1990, the specimen is the largest and most complete *T. rex* known, says Peter L. Larson of the Black Hills Institute of Geologic Research, Inc., a private company that collects and sells fossils. Several clues suggest that this animal, named Sue in honor of its finder, survived one or more attacks from other tyrannosaurs, Larson says. One rib harbors a tooth fragment within an abnormal overgrowth of bone, indicating the bone healed after a bite wound. A hole in the skull and a lump on the lower jaw could also represent healed wounds from a fight, Larson surmises.

Both the left and right fibulae show abnormal overgrowths — apparent indications that Sue recovered from two broken legs. ("We were thinking we might find the remains of a wheelchair next," Larson jokes.) The two fibulae probably fractured at separate times, because the animal could not have survived with two broken legs at once, Larson adds.

Another interesting pathology may reveal details about *T. rex* mating: Several of Sue's tail vertebrae are fused together, perhaps from an injury incurred during copulation, Larson says. Although the animal's gender remains unclear, the shape of its bones suggests it was a female, he adds.

The Black Hills paleontologists think they have also discovered the eventual cause of Sue's death. The left side of the skull shows signs of an injury — perhaps the bite of another tyrannosaur — from which the animal apparently never recovered. Before that final battle, though, Sue apparently dined on *Edmontosaurus*. Larson and his colleagues found vertebrae from this herbivore buried with the *T. rex* specimen; the bones look etched, as if by stomach acid, he says.

How to read a dinosaur's menu

Sometimes, deducing an ancient creature's diet is as simple as looking at its teeth. *Tyrannosaurus rex*, for example, brandished long, serrated fangs — ideal utensils for tearing meat. But many animals had less obvious dentition, and some had no teeth at all. In these cases, chemical clues can help scientists infer ancient eating habits.

Peggy H. Ostrom of Michigan State University in East Lansing has examined nitrogen isotopes to determine whether long-extinct creatures dined on flesh or vegetation. Scientists know that leaf-eating animals, compared with meat eaters, have relatively little nitrogen-15 in their bodies. And among the carnivores, those that eat herbivores, such as deer, have less nitrogen-15 than do those that eat other carnivores, such as wolves. Thus, the ratio of nitrogen-15 to nitrogen-14 indicates where an animal resides on the food chain.

Ostrom used this principle to study 22 animals that lived 75 million years ago. After isolating organic matter from bones, teeth and shells, she analyzed the amino acids in the material to make sure it came from the fossils and not from some contaminating source, such as bacteria or the hands of a paleontologist. Once convinced the organic material belonged to the fossils, Ostrom sent it through a mass spectrometer to determine its nitrogen isotope ratio.

For some well-known animals, the test results fit with previous interpretations. For instance, ancient crocodiles and tyrannosaurs had higher ratios of nitrogen-15 to nitrogen-14 than did turtles or the herbivorous hadrosaurs. Ostrom also used the technique to study enigmatic, ostrich-like dinosaurs, which apparently had toothless beaks. Scientists have debated whether such creatures ate grass, eggs, insects or even small vertebrates. On the basis of the nitrogen isotope ratios, Ostrom concludes that these animals were not strict herbivores. While they may have eaten grass or leaves, the new evidence indicates they also consumed something more protein-rich, she says.

Mammoths on a weight-loss diet

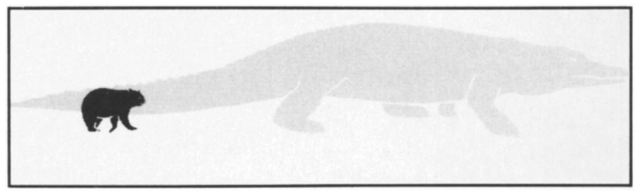
Mastodons and mammoths went extinct in North America about 11,000 years ago, and scientists still don't know why. Some experts think human hunters killed off these relatives of the elephant; others suspect the animals succumbed to environmental stress caused by a changing climate. Chemical studies of the bones left behind by these beasts may help solve the prehistoric puzzle, says Paul L. Koch of the geophysical laboratory at the Carnegie Institution of Washington (D.C.).

Koch analyzed the ratio of nitrogen-15 to nitrogen-14 in the fossils of 19 mastodons and six mammoths from the Great Lakes region. Aside from revealing what an ancient animal ate, nitrogen isotope ratios can also tell whether the animal suffered from malnutrition, Koch says. Animals facing a food shortage have higher nitrogen-15 values because they metabolize their own tissues; in a sense, they are eating themselves.

Koch found that mammoths had significantly higher nitrogen-15 ratios than the mastodons. These preliminary data, he says, suggest that mammoths in the Great Lakes region may have had a harder time finding food than did the mastodons, which are believed to have eaten a more varied diet. Koch plans to run tests on the remains of more mastodons, mammoths and other animals from various geographic regions to help unravel the cause of these extinctions.

A reptile to reckon with

Imagine a crocodile bigger than a station wagon. How about three station wagons placed end to end? That's about the size of a beast that terrorized the Amazon region more than 8 million years ago, suggest Carl D. Frailey of Johnson County Community College in Overland Park, Kan., and Kenneth E. Campbell of the Natural History Museum of Los Angeles County.



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While excavating along the border between Peru and Brazil in 1986, a crew led by Frailey found a startlingly large crocodilian skull of the genus *Purussaurus*. Last year, the scientists finished removing sedimentary deposits from that skull and a jawbone from the same genus. Frailey and Campbell now estimate that the giant crocodilian stretched 12 meters (39 feet) in length and stood 2.5 meters (8 feet) tall. *Purussaurus* may have weighed 10,000 to 12,000 kilograms, which would have made it even more massive than *Tyrannosaurus rex*, often touted as the largest terrestrial carnivore.

Frailey and Campbell note that even larger members of the *Purussaurus* genus must have existed, because a museum in Brazil has a jawbone 30 centimeters longer than the one they found. The Brazilian jawbone may have belonged to an animal as long as 13 to 14 meters, they say.

What would such a behemoth have eaten? Campbell thinks the toothy carnivore could have dined on birds, large turtles or rodents. These were no ordinary 20th-century mice, however. At that time, says Campbell, rodents could have reached the size of small cattle.