Tales from the Tar Pits

First published in *Lapidary Journal*, January 1990

"Speak to the earth, and it shall teach thee." Job 12:7-8

Many a fossil collector has stared at a specimen and wished it could speak. At the world-renown Rancho La Brea "Tar Pits," paleontologists are asking relentless questions of the black-stained earth. And they are getting some interesting answers.

Two things make the asphalt deposits at Rancho la Brea unique: the unparalleled preservation of the specimens and the sheer number of late Pleistocene fossils found there. First of all, oil from the deposits has penetrated even down to the molecular structure of the bones, preserving them so perfectly, the animal might have died yesterday. Scientists can examine not only the amino acids and DNA of extinct animals, but what they had for lunch before they died. Small, microfossils of animals and plants tell them a great deal about the Ice Age environment.

Even with this kind of preservation, researchers would not be able to tell much about the Pleistocene environment, or the animals' behavior or social structure if there were only a few sample fossils. But at the George C. Page Museum which houses the La Brea specimens, the storage room holds rows of 7-foot high shelves filled with teeth, skulls, vertebrae, femurs and ulnas--approximately 4 million individual specimens altogether. With so many fossils on hand, scientists have begun to see patterns, gaining surprising insight into the social behavior of many of the extinct animals.

Teeth told George Jefferson, Assistant Curator at the Los Angeles County Museum of Natural History and head of their Rancho La Brea section, that the extinct bison (*Bison antiquus*) migrated seasonally in and out of the plains. He examined the jaws and teeth of 288 animals and noticed there were a lot of young bison, but that their ages were about a year apart. There were few fossils from the intervening age groups. If the herds had been permanent Rancho La Brea residents, there would have been more animals in intermediate age ranges.

Microscopic examination of plant material preserved in the cavities of the bison’s teeth showed they had been munching on desert grasses. "Grass fossils are unknown from La Brea," says Jefferson. "So I was kind of surprised to find grasses in these teeth." When he checked, he found the grasses were all from the margins of California deserts. His working hypothesis, he says, is that the animals moved to the best food sources, wandering into La Brea in late spring. He still doesn't know where they went from there to spend the summer and the fall.

Making a case from small clues takes patience. And not all paleontologists interpret the clues the same way. Laughs Christopher Shaw, Collections Manager at the Page

Museum, "Part of the fun of being a paleontologist is that you get to argue with people about how it really was."

One animal that excites its share of controversy and speculation is the saber-tooth cat (*Smilodon fatalis*) which has no modern counterpart among the great cats. Larger than a modern lion, the saber-tooth cat was heavily built through the chest, shoulders and forelimbs, leading at least one past researcher to conclude that its hind legs were almost useless. Because a number of fossils show signs of injury, Chester Stock, who did much of the original work at La Brea, speculated that injured animals came to the asphalt deposits because they could survive only by scavenging. Others theorize the cat used its gigantic canines to deliver a fatal throat bite to its prey.

But the portrait of the saber-tooth that Shaw and others are now painting is strikingly different. First of all, there would have too few trapped animals to support one injured, scavenging saber-tooth much less a whole population of them. Although thousands of animals have been found at La Brea, the pits trapped Pleistocene fauna for 25,000 years. Shaw estimates only about 10 animals were trapped every decade, all of them most likely victims of the same entrapment episode. (An entrapment episode occurred when a large herbivore such as a bison, camel, giant ground sloth or mammoth became trapped, drawing in a number of predators and scavengers.)

So instead of languishing at the edge of the asphalt deposits, the saber-tooth was an active and efficient predator. But unlike other cats, Shaw does not believe *Smilodon* used its sabers for stabbing into the throat. By doing so, the cat would have risked breaking a canine on its prey's neck bones. Losing its primary weapon would have reduced its ability to hunt successfully. At the very least, constant contact with bone would have worn the serrations off the canine edges. But many of the sabers in the collection are in nearly perfect condition, says Shaw, and show no unusual signs of wear.

Instead Shaw believes the saber-tooth struck at the soft belly of an animal where there would be little risk of breaking its canines. He and Fred Heald, a retired surgeon and now a volunteer at the Page Museum, think the damaged bones in the collection support this theory.

Some injuries, due to what Heald has termed "chronic misuse," occurred during the saber-tooth's day-to-day efforts to survive. Strains and pulled ligaments produce a small amount of internal bleeding. The body responds by producing bone to strengthen the weakened area. If the animal continues to put strain the same area, the repeated injuries become evident in thickened spots on the bone.

Heald found that these injuries were common in the forelimbs along the muscles used to rotate the paws and wrists; at both the front and back ends of the ribs, from impact with the prey animal; in the neck and lower back, where vertebrae fused due to constant compression and twisting; and in the hind legs along the muscles of extension, the ones the cat would use while leaping.

Heald and Shaw think that after a short run, the cat would leap onto a young mammoth or other prey, its chest slamming into the animal, its spine compressing with the impact (much like a football player's today). It would grapple with the animal, perhaps balancing on its hind legs causing its lower back to twist as the prey struggled. With its powerful

forelegs the saber-tooth would then pull the animal over exposing its belly. Using 8-inch long sabers, it would open an enormous wound in the animal's side.

If the prey was a young mammoth, about this time its mother would be coming to the rescue. If the cat did not get out of the way quickly, it might be maimed or killed by the elephant. So it probably retreated tactfully to wait for the young one to die and the adults to move off before going in to feed.

Sometimes, though, *Smilodon* was not fast enough when its victim fought back by kicking, tossing, or stepping on it. This shows up in the collection as broken or dislocated bones, and extensive bleeding resulting in widespread bone build up. Amazingly these injuries did not always kill the animal. Although undoubtedly in a great deal of pain, they often managed to heal and survive, sometimes living as long as two or three years more. (Heald points out that bone-on-bone wear in a hip socket could result only if the animal had been using the limb for a while.) The only way these crippled animals could have survived, say Shaw and Heald, is if the saber-tooth cat lived in prides like modern lions.

If studying the saber-tooth cat is romantic, studying blowfly larvae is considerably less so. But even the lowly La Brea blowfly has a story to tell.

When visitors first look into the 13-foot depth of Pit 91, the only active excavation at La Brea, they assume the asphalt deposits were "bottomless." Even earlier scientists' conception of the pits was "kind of cartoonish," says Shaw. They envisioned pools of tar in which the animals "sunk out of sight, the bubbles coming up."

But blowfly larvae found in one of the skeletons show that the bones sat on the surface for a while before they were covered with asphalt. Eric Scott, Chief Excavator for Pit 91, explains that blowflies lay their eggs only when a carcass has reached a certain stage of decomposition.

The tar pits were in full operation at the end of the Pleistocene when larger mammals such as the mammoth, saber-tooth, American lion, and giant ground sloth became extinct. The causes of the extinction are still hotly debated, but it seems certain that one factor (the major factor, according to Jefferson) was a rapid rise in temperature of about 6ºC (approximately 10º Fahrenheit).

That it was colder and wetter in Los Angeles 11,000 years ago is confirmed by La Brea's snails. Some of the stream-dwelling snails trapped in the asphalt survive today only in the colder lakes of the surrounding mountains. Other tiny mollusks are now found in woodlands far to the north where precipitation is about 30 inches per year.

Coast redwoods and other cool, moist climate-loving trees lived in the nearby Santa Monica Mountains. Their wood and cones washed down streams into the La Brea deposits. But with the change in weather, they, too, vanished from southern California and exist now only in higher latitudes and altitudes.

Another--fainter--indication of the climatic change turned up in the course of sorting the original collection of fossils from La Brea. Laboratory Supervisor, Shelley Cox, found a bone she couldn't quite place. She gave it to Scott who identified it as a horse, and took on the project of looking for more of the same. Altogether now they have six bones from at

least three individual horses. Scott believes it may turn out to be one normally confined to the Great Plains from Mexico to Alberta, *Equus conversidens*. But studies are still underway.

E. conversidens was much smaller and slenderer than the horse normally found at La Brea (*Equus occidentalis*), although both animals were similar to modern draft horses. Some studies indicate slender-boned horses tend to come from more arid environments, while animals with heavier bones live in moister regions. However, Scott cautions that other factors, such as changes in plant life or the interaction between species, may have been contributing to the replacement of the larger horse with the smaller one.

The most recent deposit found at La Brea may pose more questions than answers. It is shallow and tabular, unlike any other deposit. Mollusks found there indicate it might have been a seasonal pond into which asphalt drained.

The specimens in it are also unusual. In the lower part of the deposit are the remains of several very young horses, but only one adult. Because they are less impregnated with asphalt than other specimens, Scott believes they may have died due to drought rather than entrapment. Drought studies show that the very young often die at sources water. Their mothers do not have enough milk for them and they are too young to eat anything else. Their mothers, however, would still be able to go on and find other sources of food, which would explain the lack of adult remains in the deposit.

In the upper part of the deposit are the semi-articulated (found together) bones of a saber-tooth cat and dire wolf. "The dire wolf was face up, laying on its back. The saber-tooth was right over the top of it face down," explains George Jefferson. "The two skeletons were actually kind of intermixed as the bodies decayed together. Now I can't think of any way that you could do that without having them in combat....What we've got here are these animals that died at each other's throats."

Scott thinks the fact that the animals were found virtually intact is further proof of drought conditions. During drought, animals die by the hundreds. Scavengers have more than enough to eat and do not eat everything or fight over bones. Undisturbed, the animals dry out instead of decomposing.

Jefferson, however, disagrees. He believes the struggle between the dire wolf and saber-tooth cat may have taken place in the thick mud of the drying pond. The two may have become mired and buried quickly, protected from predators.

Today biologists take years to piece together the complex behavior and interactions of living animals. Paleontologists can never hope to do more than open a few small windows into the lives of the extinct creatures they study. But the possibility of surprises and new discoveries is what keeps them going.

Says Chris Shaw: "I don't come to work because I have 4 million things to organize. I come to work because I want to learn some more....One of the neatest things is when things start to make sense. Sometimes it's kind of scary, but mostly it's neat."