Evolution

Whale of a change for cetacean history

A new study of DNA sequences has badly shaken the standard family tree of cetaceans, suggesting intriguing new twists in whales' evolutionary history.

Taxonomists divide living whales and dolphins into two suborders: the Odontocetes, which have teeth, and the Mysticetes, whose mouths have banks of comb-like baleen used to filter small fish and crustaceans from the water. Odontocetes, which include the sperm whale, can track prey through the remarkable evolutionary adaptation of "echolocation" – a sonar system that emits sounds and senses the echoes bouncing off objects. Mysticetes, such as the blue whale, lack the ability to echolocate.

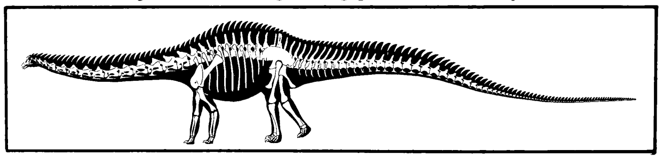
Paleontologists have long thought that Mysticetes and Odontocetes represent separate evolutionary lines that split from a group of ancestral toothed whales some 40 million years ago. But Michel C. Milinkovitch of Yale University and his colleagues uncovered a different story by studying the genes of 16 species of living whales, a cow, a sloth, and a human. Because natural mutations over the millennia change DNA sequences, scientists can use these sequences to sort out which animals are most closely related to which.

Unexpectedly, Milinkovitch and his co-workers found that sperm whales did not group with the other Odontocetes. Rather, this particular toothed whale seems more closely related to the baleen whales, despite noticeable outward differences, they report in the Jan. 28 NATURE.

The new findings suggest that Odontocetes and Mysticetes are not true evolutionary lines. They also indicate that baleen whales lost the ability to echolocate, whereas their close cousin, the sperm whale, retained it. Milinkovitch explains that baleen whales may have dropped their sonar because the evolutionary changes involved in developing the huge baleen structures radically changed the shape of their skulls.

Sauropod dinosaurs get spiky new look

New discoveries of dinosaur skin fossils are repainting the old picture of the largest beasts to ever walk the Earth. Researchers and artists alike have long envisioned sauropod dinosaurs with smooth skin that lacked any spiky protrusions. But dinosaur artist Stephen A. Czerkas reports finding evidence that at least one type of sauropod had scaly skin with formidable spines running along part of its body.



Czerkas

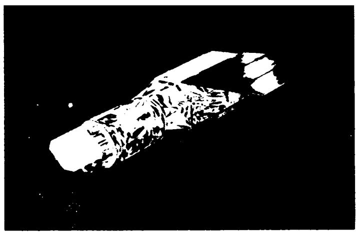
Fossilized skin impressions show that a row of spines ran along the tail of this dinosaur and perhaps continued along the length of its body.

While collecting in a Wyoming quarry in 1990, Czerkas uncovered fossilized skin impressions belonging to a new species of dinosaur related to the well-known *Diplodocus*. The impressions clearly show that the skin was pebbled with large bumps about 3 centimeters in diameter. Czerkas also found impressions of many cone-shaped fossils, some of which were connected to the tail. The smallest "spines" appear at the end of the tail, whereas larger ones occur farther up the tail. The largest of the spines would have measured around 18 centimeters high, Czerkas reports in the December GEOLOGY.

The fossils indicate that this animal had spiny growths along its tail and possibly along its entire length, says Czerkas, who proposes that other types of sauropods may have sported similar spines.

Space Science

A new X-ray eye in the sky



NASA

The X-ray observatory Astro-D

By the end of this month, Japanese scientists expect to launch an X-ray observatory that promises to shed new light on some of the more intriguing denizens of the universe: supernovas, neutron stars, and black holes. Using a suite of four telescopes, each with its own spectrometer, the Japanese-U.S. satellite will image medium-energy X-ray emissions from 300 to 12,000 electron-volts. In addition, the spectrometers will analyze the energy and intensity of the X-ray light by separating the radiation into its component wavelengths.

Two of the spectrometers feature electronic photon detectors known as charged-coupled devices, the first time that astronomers have used these sensitive detectors to analyze medium-energy X-ray emissions, notes the observatory's deputy project scientist, Nicholas White of NASA's Goddard Space Flight Center in Greenbelt, Md.

Known as Astro-D until launch, when it will be renamed, the observatory is expected to operate for five years. In recording radiation from atoms of iron, silicon, sulfur, and oxygen, the observatory will chart the course of stellar violence. These atoms are produced in the cosmic cauldron created when massive stars die an explosive death as supernovas. Thus, detecting X-ray emissions from iron may help track the evolution of supernovas and detail what happens when a supernova's expanding blast wave slams into its surroundings.

Astro-D will also gather data to "weigh" the mass of suspected black holes, says White. As material spirals into a black hole, it emits a last gasp of X-rays. These X-rays appear redshifted – shifted to longer wavelengths – because of the gravitational tug exerted on the photons by the massive black hole. Indeed, the more massive the hole, the greater this gravitational redshift. So if the observatory's spectrometers can accurately measure the gravitational redshift of X-rays emitted near a black hole, astronomers will be able to calculate the mass of the compact object that lurks there.

Astronomers also hope to use the satellite to more accurately infer the amount of dark matter – invisible material that doesn't glow like ordinary matter, yet exerts a gravitational force – among clusters and small groups of galaxies. By mapping the temperature and amount of X-ray-emitting gas in a galaxy cluster, the satellite enables researchers to calculate the total amount of mass that the cluster must possess in order to hold the gas in place. If the visible mass of the cluster isn't enough to do the job, then the cluster must contain a large percentage of hidden, or dark, matter, researchers reason.

Such measurements have already been performed with a lower-energy X-ray satellite called ROSAT. Researchers headed by Richard F. Mushotzky of Goddard reported last month that, based on the size and energy of its X-ray-emitting gas, the small galaxy group NGC 2300 contains 10 to 20 times as much dark matter as visible matter, one of the highest ratios ever inferred (SN: 1/9/93, p.20).

The researchers hope to use the newly launched satellite to improve their measurements of this galaxy group. In addition, Astro-D can study X-ray emissions in fainter, more distant collections of galaxies, White says. If the observatory finds an equally high ratio of dark matter in many other small groups, then such collections may represent repositories for much of the dark matter in the universe, Mushotzky notes.

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