Fossil of unknown mammal discovered

A team of paleontologists working in the Kayenta Formation of Arizona has discovered a fossilized jawbone, estimated to be about 180 million years old, of a mammal previously unknown to man. The jaw, as old as any mammalian fossil yet found in the world, dates from the same period as the teeth of a known early mammal found last fall at the Arizona site. The two specimens are the first remains of early mammals found in North America.

"The new mammal increases by one-third our knowledge of early mammals in the New World," said Farish A. Jenkins, curator of vertebrate paleontology at Harvard's Museum of Comparative Zoology. He announced the finding in Washington, D. C., at the National Geographic Society, which funded the research.

The new finding is significant because it shows that mammals were more diverse than previously thought. The teeth of the new variety, still unnamed, distinguish it from the two previously known varieties of early mammals. Of the other two known varieties, the teeth of Morganucodontid are lined up in a line parallel to the jaw, while those of Kuehneotheriid are arranged in a triangular pattern that allows the teeth to occlude as those of humans do. The teeth of the new variety are arranged in a pattern similar to Morganucodontid. But, Jenkins says, the new variety differs in that the middle cusp is higher and the wear facets on the teeth are distinct.

The Morganucodontids are thought to be ancestors to the platypus and other egg-laying mammals, while the Kuehneotheriids were ancestors to the placental mammals, which include nearly every other type of animal, including man. Discovery of the new variety, Jenkins says, will require the scientists to "rethink our hypothesis about relations of the earliest mammals" to their descendants. He declined to speculate about possible descendants of the new variety because "its intermediate features complicate the story."

Fossils of mammals after the end of the Cretaceous period 65 million years ago are plentiful but the samples of early mammals, paleontologists are fond of noting, fit into a shoebox. This is in part because the animals were small: The new variety, probably an insectivore, was about the size of a small mouse, Jenkins says. When the reign of the dinosaurs ended, the "age of mammals" began. Today about 4,000 kinds of mammals, including humans, are known and many others have emerged and become extinct.

The jawbone is the kind of discovery that justifies for paleontologists the tedious hours, months, and years they spend sifting through tons of rubble. Jenkins and his colleagues spent four years studying the Kayenta Formation. In the first three years the site yielded other significant fossils, including several small dinosaurs, an advanced mammal-like reptile called a tritylodontid, and one of the earliest turtles. But still there was no trace of early mammals.

One of Jenkins's colleagues, William Downs, returned to a portion of the site that had been particularly rich in fossils from the late Triassic or early Jurassic periods of the Mesozoic era when dinosaurs also began to appear. He chopped out 300 pounds of the rocks and treated them by eroding the sediments with water and then straining the fragments through screens. In November 1980 the effort paid off: He found a set of teeth from a Morganucodontid, the first discovery of an early mammal in North America.

The jaw of the new animal surfaced late in July during a six-week extension of the regular dig. Kathleen Smith, assistant professor of anatomy at Duke University, broke a piece of rock and saw that it contained a bone about one centimeter long. Frustrated by the ceaseless, unproductive sifting of rock and tired of the heat and dust, she thrust the rock at Jenkins saying, "Here Jenkins. Here's your lousy jaw!" When he took the rock into the sunlight he realized that the fossil was different from specimens of the other two known early mammals. The discovery came on the day before the expedition ended. □

Features such as the raised middle cusp in the fossilized jaw of a recently discovered early mammal (extreme close-up, right) distinguishes it from two known varieties also dating from 180 million years ago. The fossil shown embedded in rock (above) was found in Arizona.

Photos: A. H. Coleman, Harvard University

Shuttle 2: Delayed but still counting

Since early August, NASA had been working toward an Oct. 9 liftoff for the second flight of the space shuttle Columbia, a date chosen to allow time for unforeseen delays, as well as some rest for overworked launch personnel. In the early morning of Sept. 22, however, a mis-seated connector being used to fuel the craft's steering rockets unexpectedly came loose and spilled several gallons of nitrogen tetroxide oxidizer, which overflowed along the right side of the vehicle. There, it melted the adhesive holding a number of the critical thermal-protection tiles, some of which literally fell off. A delay in the launch, said NASA, was certain, possibly by several weeks.

The shuttle's second mission, to be flown by astronauts Joe H. Engle and Richard H. Truly, has the same primary goals as last April's maiden voyage: to get safely up and down again. But there are only four such test flights in the whole shuttle program (the Apollo missions, by comparison, were preceded by unmanned tests of the spacecraft and the entire manned Mercury and Gemini programs) so they are designed to evolve — safely — by leaps and bounds.

On the initial flight, for example, all five of the shuttle orbiter's main computers worked in parallel throughout the flight, in case one should malfunction. The second time out, only three will work together, while a fourth is held back for the sole task of handling the reentry and landing, and a fifth stands by in case of emergency. Setting up the reentry is the most massive computer job of the whole flight, and where the critical software on the first flight was radioed to the ground for final confirmation just before the reentry phase began, Columbia's computer will be entrusted with its own checkout. Additionally, the craft's inertial measurement units, which are responsible for enabling the shuttle to keep itself properly oriented in

space without assistance from the ground, will be realigned one-third less frequently than they were during their initial trial.

To keep ahead of the game, Engle will also put on and remove one of the shuttle's newly designed extra-vehicular activity spacesuits. No spacewalks are planned (although they are possible if an emergency arises), but the astronauts would like to get some idea of how easily the suits can be donned and operated during weightlessness.

The major new event of the upcoming flight, however, will be the first tests of the shuttle's Remote Manipulator System (RMS), a 15.3-meter grappling arm designed for lifting payloads out into space from the orbiter's huge payload bay, as well as for retrieving objects such as damaged satellites. No such operations will be carried out during this mission, but numerous tests are scheduled, such as checks of the arm's response to the astronauts' computer-relayed commands and measurements of any distortions that may result from temperature changes as the arm (simply "parked") passes from sunlight into shadow and back. The mission is scheduled to last 5 days, 4 hours and 8 minutes, but so important is the RMS to future shuttle plans that the major tests have been packed into the first two days in case the mission has to be ended early.

The arm will not be the only cargo in the payload bay, which on the first flight held only some Developmental Flight Instrumentation (DFI) to evaluate the orbiter's responses to launch, ascent, weightlessness, reentry and landing. The DFI will be along again, as will a package of instruments sent along by NASA's Office of Space and Terrestrial Applications for earth-resources studies (SN: 5/9/81, p. 292). A synthetic-aperture radar antenna will collect high-resolution "images" of land surfaces below, while other devices monitor ozone, ocean chlorophyll, lightning and other phenomena.

The suite of instruments (five on a pallet in the payload bay and two more in the crew cabin) marks the shuttle's first formal foray into science, although its objectives lean considerably more toward "applications" than basic research.

Another item on the manifest is an Induced Environmental Contamination Monitor (SN: 8/8/81, p. 93), dedicated to finding out how much pollution from rocket exhausts, outgassing, adsorbed atmospheric constituents and other sources may be present to affect delicate sensors on future payloads such as the Space Telescope and the European Space Agency's Spacelab research module. At one point, the RMS arm will be guided to grasp a contact point on the contamination monitor, just as a test of the arm's capabilities; on the subsequent flight, however, it will be used to pick up the monitor and move it around outside the payload bay, recording possible contamination in nearby space. □

Yolky mating signal from blood to skin

The female red-sided gartersnake has a surprising lure for potential mates. It is a chemical related to yolk material, and during courtship the compound passes from the snake's blood to its skin surface. Many other animals release sex attractants in their urine, feces, vaginal contents and glandular secretions. But the gartersnake is the first instance to be discovered of a pheromone carried in the blood.

To demonstrate the presence of the blood-borne sex attractant, William R. Garstka and David Crews of Harvard University apply blood serum from a female snake to a male's back. Other males then court the treated animal, rubbing their chins along the back. The same behavior is elicited by lipids, but not proteins, extracted from skin of females.

The source of the blood-borne pheromone appears to be the liver of the female snake. Homogenates of female liver elicit courtship behavior when applied to the backs of males. Garstka and Crews find that treating males with estrogen makes their livers produce the female sex attractant too. Because estrogen also induces in males production of the circulating precursor of yolk, a compound called vitellogenin, the scientists suspected the sex attractant to be this or a related chemical. When they applied to the backs of males yolk taken from ovarian follicles, the yolk-smeared males were courted by other males. However, although vitellogenin is present in all egg-laying animals, yolk from other snake species, chicken and lizard is not effective as a gartersnake sex attractant.

Crews

Males rub their chins on the back of a large female snake (head furthest to right) in a natural "mating ball" in the field.

Microscopic examination of female gartersnake skin shows lipid-filled vesicles in the deep layers adjacent to the bed of blood vessels, especially in the regions between the snake's scales. Male snakes lack this lipid localization, unless they have been given estrogen.

Garstka and Crews believe that the female passes the pheromone to the outer surface during courtship by filling its lungs with air. The resultant surface expansion moves adjacent scales apart, allowing the lipid to pass through the thin skin in between. The scientists point out that in several species of reptile poison is forced through these thin regions. Whether the vitellogenin is changed chemically as it passes from blood to vesicle to surface remains to be determined. □

Three labs isolate cancer genes

The key to cancer is thought to lie somewhere in a cell's genetic material. Experiments in the past few months have pinned down in each of several types of cancer individual genes responsible for initiating a cancerous state.

Three years ago scientists demonstrated that large pieces of DNA removed from certain cancerous cells, including some human tumors, could transform into a cancerous state normal mouse cells growing in laboratory culture. Now scientists in three laboratories have pared down the DNA they need to transfer in order to trigger cancer characteristics in normal cells. "We needed to find out which parts of DNA were pertinent," says Robert A. Weinberg of the Massachusetts Institute of Technology. He explains that he and others have isolated, using molecular cloning techniques, stretches of DNA consisting of 5,000 to 30,000 paired nucleotides. "This is the range of sizes normally associated with a gene," he says.

Weinberg and colleagues report they have isolated part or all of human leukemia, bladder and colon carcinoma genes. Working independently at the Cold Spring Harbor Laboratory on Long Island, Michael Wigler and associates isolated a cancer-triggering gene from human bladder tumors. They also found evidence of a gene common to colon and lung cancers. Another gene, one for chicken leukemia, was isolated by Geoffrey Cooper and coworkers at the Sidney Farber Cancer Research Institute in Boston.

The newly isolated genes should be useful in answering questions about cancer. Many scientists believe cancer involves genes that are altered versions of normal cellular DNA. Weinberg says that with some cancer genes in hand, it should be simple to find and isolate related normal genes for comparison. A more distant goal would be to determine what proteins the cancer genes encode and how the genes' products act in a cell. Weinberg suggests the work may eventually lead to diagnostic tools for cancer. And even further in the future, such studies may suggest ways to protect normal cells and to force cancer cells to revert to normal functioning. □