Paleontology

Richard Monastersky reports from Lawrence, Kan., at the fiftieth annual meeting of the Society of Vertebrate Paleontology

Reining in a galloping *Triceratops*

If the *Triceratops* model in your local museum stands with four straight legs planted firmly underneath its body, ask to have a word with the curator. A new analysis indicates these dinosaurs could not have walked with such a posture.

For two decades, paleontologists have hotly debated the limb position of ceratopsian dinosaurs, which include *Triceratops*. Early fossil collectors pictured these huge horned herbivores ambling with forelimbs sprawled lizard-like from the sides of the body. Hindlimbs projected down underneath the body, like the legs of an elephant. But then Robert T. Bakker of the University of Colorado in Boulder challenged that slowpoke image by showing ceratopsians in a stance with all legs descending directly under the body — a posture that would have allowed the animals to gallop like rhinoceroses. Some museums have mounted ceratopsian dinosaurs in this position.

Now Rolf E. Johnson of the Milwaukee Public Museum and John H. Ostrom of Yale University think they have evidence that kicks the legs out from under the rhino-postured stance. While preparing to mount a recently discovered skeleton of *Torosaurus* — a close relative of *Triceratops* — the researchers tested the rhino-gaited and sprawling postures by constructing a flexible model using fiberglass casts of the shoulder and arm bones. This model shows that placing the *Torosaurus* forelimbs upright causes the elbow joint to point in an impossible position. Johnson says that *Torosaurus, Triceratops* and probably all ceratopsian dinosaurs had sprawling lizard-like forelimbs after all, and therefore could not gallop. However, he adds, they could move quickly when necessary.

Other scientists contend the posture debate is not over.

Dinosaur digestive aids

Paleontologists rarely find hard evidence concerning the internal organs of extinct animals because fossilization usually does not preserve soft tissue. But an excavation in New Mexico of the largest known dinosaur has unearthed unusual clues about this animal's digestive tract.

David D. Gillette and his colleagues have discovered about 180 small stones buried right next to the skeleton of a seismosaurus, a 140- to 160-foot-long diplodocid dinosaur that they have been excavating for five years. Most of the smooth, rounded stones are the size of a plum, although their diameters range from as small as a dime to as large as a grapefruit. Gillette, Utah's state paleontologist, identifies the rocks as gastroliths — so called "stomach stones" that certain animals hold within their digestive tract to grind food.

Paleontologists often treat reports of gastroliths skeptically because rivers can produce very similar stones. But the seismosaurus skeleton lies in a sandstone that contains no other rocks or pebbles aside from the ones found next to the bones. The researchers even uncovered some stones buried within the seismosaurus' rib cage. The stones were arranged in two distinct clusters: one smaller group near the pelvic region, and a larger assemblage near the base of the neck. The region between these groups contained no stones.

The placement of the stones indicates seismosaurus had a crop and a gizzard, somewhat similar to the organs in many modern birds, suggests Gillette. He says it therefore appears that as the dinosaur swallowed, its diet of plant material would pass from the crop — where gastroliths ground it — to a gastrolith-free stomach where digestive enzymes attacked the food, then into the gizzard for more grinding, and finally into the intestines.

The one grapefruit-sized gastrolith puzzles Gillette because all the other rocks have far smaller diameters. He speculates that ingestion of the huge stone may explain the death of this seismosaurus, which otherwise appeared healthy.

Space Sciences

Bound for the sun, by Jove

The Ulysses probe, launched by the space shuttle on Oct. 6, becomes the fifth spacecraft sent toward Jupiter. But its 16-month trek to Jupiter is just a side trip — and a means to an end: The European craft's actual objective is the sun, and the first study ever made of the solar poles.

Other spacecraft have flown sunward, including various U.S. and Soviet Venus probes, the German Helios 1 and 2 craft, and the U.S. Mariner 10 (whose orbit gave it three close encounters with Mercury). But these missions all approached the sun in orbits in a plane near the sun's equator. Accelerating sun-bound craft out of that plane and up over the sun's poles required a rocket more powerful than any the U.S. now possesses. As a result, previous sunward probes were limited to the same low-latitude window — near the solar equator — that restricts solar viewing by observers on Earth.

Ulysses, however, is scheduled to pursue a path around Jupiter that will harness the giant planet's gravity to twist the plane of the spacecraft's orbit so that it ends up nearly perpendicular to the solar equator.

After a scheduled rendezvous with Jupiter on Feb. 11, 1992, the new European Space Agency (ESA) probe should follow an orbit back toward the sun. On Aug. 6, 1994, Ulysses should pass about 330 million kilometers beneath the sun's south polar region, reaching a latitude of about 80°S. This orbit should carry it up and across the solar equator around Feb. 2, 1995, at a distance of 195 million km, then fling the craft over the solar north pole on July 12, 1995, again at a latitude of about 80°S and distance of roughly 330 million km.

Flying where no craft has gone before, Ulysses will study how the sun's poles differ from its lower latitudes in such characteristics as flares, magnetic field, and the speed and composition of outflowing ions known as the solar wind.

Missing, however, is a camera to record the new views. When work on this mission began in 1978, scientists and engineers envisioned two spacecraft — one each from Europe and the United States. That original International Solar Polar Mission had also included a coronagraph. But plans for the camera died in 1984 when NASA, pressured by budget problems, canceled development of the U.S. craft that would have carried it. This decision not only caused anti-NASA feelings within ESA, but also eliminated one fundamental goal of the mission: the simultaneous crossing of opposite solar poles by the U.S. and ESA spacecraft.

Delays in the shuttle's development also forced NASA to postpone the original launch date of the European craft — initially for three years to 1986. Then, when safety concerns following the 1986 Challenger explosion caused NASA to cancel a powerful, upper-stage booster that had been under consideration for kicking shuttle payloads out of Earth's orbit, NASA then reassigned the ESA craft to a less potent rocket. This necessitated Ulysses' long swing by Jupiter — instead of a direct launch toward the sun.

The fastest solar wind in 50 years

Even though there were no spacecraft aloft during much of the last 50 years to measure the sun's continuous outpouring of ionized particles, or solar wind, scientists have established the date and rate of the highest solar wind over the past half-century: 7.8 million kilometers per second on Aug. 4, 1972. E.W. Cliver, of the geophysics laboratory at Hanscom Air Force Base, Mass., and J. Feynman and H.B. Garrett of Jet Propulsion Laboratory in Pasadena, Calif., calculated this record by comparing ground-measured delays between solar flares and the turbulence (geomagnetic storms) they cause in Earth's magnetic field. The researchers report the finding in the Oct. 1 Journal of Geophysical Research.