Paleontology

Flat-footed fossil of former flyer

Before birds evolved, winged reptiles called pterosaurs ruled the skies. These ancient aerialists were clearly adept fliers, but paleontologists cannot agree on how they moved while on the ground. Some researchers envision pterosaurs as crawling awkwardly on their hands and feet, while others argue that they ran swiftly on their toes, as an ostrich does.

Now, with the discovery of a well-preserved fossil in northeast Mexico, paleontologists have caught pterosaurs flat-footed. The foot bones of this 180-million-year-old specimen from early in the Jurassic period contradict the idea that pterosaurs ran on their toes, says James M. Clark of George Washington University in Washington, D.C. Clark and his colleagues describe the fossil in the Feb. 26 NATURE.

The Mexican find, a new species of the genus *Dimorphodon,* is a primitive pterosaur with a long tail and a wingspan of 6 feet. The researchers discovered it in 1985, but excavating the fossil at the field site took 3 years and freeing the bones from the surrounding rock required many more years of work in the laboratory.

The fossil is unusual because the bones of the foot are whole and attached to each other as they were in life, providing evidence of how the bones moved when the animal walked. Clark and his coworkers observed that the joint between the toes and foot could not have flexed enough to make possible the digitigrade movement, or toe-walking, seen in birds and some dinosaurs. "They had to be flat-footed. They had to walk on the soles of their feet," says Clark.

Their conclusions contradict part of the swift-pterosaur hypothesis put forward 15 years ago by Kevin Padian of the University of California, Berkeley. Padian calls the new observation interesting but says that researchers must examine the other bones of the foot to rule out digitigrade motion in pterosaurs. "You can't really explain locomotion from looking at only one joint," he says.

Clark and his colleagues contend that pterosaur toes could grasp in much the same way as the feet of perching or climbing birds do. This finding agrees with theories that pterosaurs arose from tree-dwelling reptiles rather than from running ground dwellers. The new findings do not, however, resolve whether pterosaurs were swift or slow or whether they walked on four limbs or two, he says. *—R.M.*

Dinosaur denizens of the dark

Fossils of a duck-billed dinosaur have turned up in Antarctica, recalling a time 66 million years ago when the now-frozen continent bore forests and a bountiful ecosystem.

In January, researchers working on Vega Island near the Antarctic Peninsula discovered a tooth and toe bones of a hadrosaur, formerly known to have lived only in the Americas, says Michael O. Woodburne of the University of California, Riverside. From past finds, paleontologists know that the Vega Island area was home to ankylosaurs and other herbivorous dinosaurs. On the Antarctic mainland, researchers have unearthed the bones of much older, carnivorous dinosaurs (SN: 10/23/93, p. 261).

Along with the hadrosaur remains, the Vega Island site has yielded fossils of marine reptiles and a flock of four or five different birds, says Woodburne, the scientist in charge of the project.

The Antarctic finds raise questions about the lifestyle of these animals during winter. Although the climate was warmer during the Cretaceous period, when the hadrosaurs lived, Antarctica was situated near the pole and would have been dark for several months each year. Researchers do not know whether the dinosaurs were adapted to living in the prolonged night or whether they migrated along a land bridge to South America, says Woodburne. *—R.M.*

Physics

Watching washes out interference

Quantum mechanics posits that a particle such as an electron can also behave like a wave. Thus, electrons that pass through a pair of narrow slits create an interference pattern—in the form of an oscillating signal—analogous to that generated by overlapping ripples on the surface of a body of water. Simultaneous observation of an electron's particle and wave aspects, however, is forbidden. Determining the specific path taken by an electron, for example, inevitably suppresses any wavelike behavior, such as interference.

Mordehai Heiblum and his colleagues at the Weizmann Institute of Science in Rehovot, Israel, have now demonstrated experimentally that a detector's sensitivity to electrons has a dramatic effect on the observed results. Increasing the ability of a detector to determine whether an electron has passed through one slit or the other reduces the amount of interference observed. "We find that by varying the sensitivity of the detector, we can affect the visibility of the oscillatory interference signal," the physicists report in the Feb. 26 NATURE.

To demonstrate the effect, Heiblum and his coworkers constructed a miniature device, less than 1 micrometer across, that incorporates an electron source, an interferometer, and a detector. By changing the tiny detector's electrical conductivity, the researchers could alter its sensitivity and observe its effect on electrons streaming through two microscopic openings in a semiconductor barrier. The results showed that by adjusting the properties of a quantum observer, it's possible to control the extent of the observer's influence on electron behavior.

"We believe that similar experimental setups, but with higher detector sensitivity, may be used to study other fundamental problems in quantum mechanics," the researchers conclude. *—I.P.*

Frigid running

From the days of generating a blaze by rubbing wood on wood to the modern-day tribulations of lubricating computer disk drives rotating at tremendous rates, friction has been both a blessing and a curse. The basic rule of friction—that it depends on the strength of the force pressing two surfaces together but not the contact area between them—was discovered centuries ago. Only recently have researchers begun to understand the origin of friction on an atomic scale (SN: 4/15/95, p. 239).

Now, Jacqueline Krim and her colleagues at Northeastern University in Boston have measured the friction that arises when a solid nitrogen slab only a few molecules thick slides across a lead surface at temperatures above and below the transition temperature at which lead becomes a superconductor. They observed that friction drops abruptly when lead enters its superconducting state at temperatures below 7.2 kelvins.

Reported in the Feb. 23 PHYSICAL REVIEW LETTERS, the results provide the first direct experimental evidence that interactions between electrons may contribute to friction.

Theorists had previously suggested that a sort of electronic friction could arise between the free electrons of a metal and those associated with atoms of another material. When a metal turns into a superconductor, free electrons in the superconductor begin to pair up and travel through the material without resistance, or loss of energy. That pairing process—which makes the electrons unavailable for producing friction—generally occurs gradually. Hence, Krim and her colleagues expected to see a modest decline in friction. Instead, they observed a sudden, large decrease.

"The number of superconducting electrons does not increase abruptly at the transition, so the new phenomenon we are observing may involve other effects," the researchers note. "It remains open for theoretical interpretation." *—I.P.*