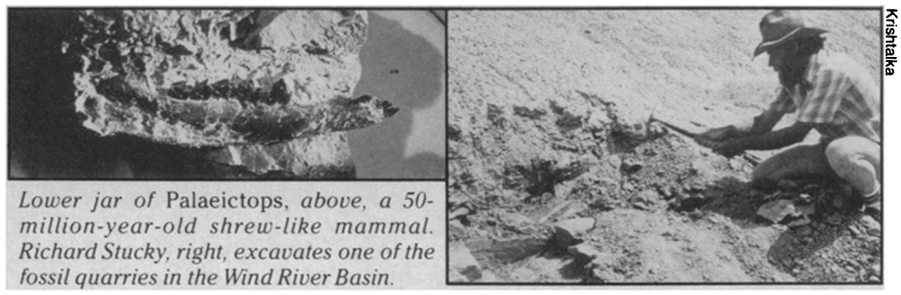
Fossils may clarify mammal evolution



Krishtalka

Lower jar of Palaeictops, *above, a 50-million-year-old shrew-like mammal. Richard Stucky, right, excavates one of the fossil quarries in the Wind River Basin.*

The remote Wind River Basin of central Wyoming is a semi-arid badlands populated by scattered groups of antelope and prairie chickens. From underneath its rolling grasslands, however, scientists have unearthed what appears to be the largest and best preserved collection of 50-million-year-old fossils ever found.

It is too early to tell what scientific knowledge will emerge from the find, but the quantity, quality and diversity of species from this ancient period should shed light on a time in which many modern mammals first appeared, say Leonard Krishtalka and Richard Stucky of the Carnegie Museum of Natural History in Pittsburgh.

"The Wyoming location is unique in the number and quality of well-preserved skull and bone remains from this critical time period," Stucky told SCIENCE NEWS.

The two paleontologists and several colleagues excavated the site, which contains eight small quarries, over the summer and came up with the fossilized bones and eggs of 65 species of mammals, lizards and frogs. The fossils include 19 skulls—16 of which represent animals that were previously unknown or identified only by fragments of bones — as well as 200 jaws and hundreds of limbs.

Most of the remains come from small mammals such as primates and rodents. Several of the species are "new to science," says Krishtalka. These include shrew-like animals related to modern hedgehogs, and bat-like animals related to modern bats.

The largest mammal the investigators found is a three-toed horse known as hyracotherium, which is the oldest known horse in North America. A partial skull and skeleton of this "dawn horse" were recovered. Another important find is the partial skull of a monkey-like creature, known as shoshonius, that may have been the ancestor of the tarsier, a primate now living in southeast Asia.

Five other skulls belong to ancient primate relatives of living monkeys, lemurs and tarsiers. "We can compare these finds to other known fossils and living primates to explore the origin and geographic movement of New World monkeys and Old World tarsiers," says Stucky.

Although the fossil site is desert-like today, during the Eocene epoch that stretched from 53 million to 38 million years ago, it was a subtropical forest teeming with streams, marshes and wildlife. This was a critical time in evolution, says Krishtalka, in which many mammals became extinct and modern mammals originated. Dinosaurs had disappeared about 15 million years earlier.

Animals in the Eocene forest were buried in a succession of marshes that are ideally suited for fossil preservation. The remains of small mammals from 50 million years ago are rare because predators and natural forces usually destroy the bones before they can be buried and preserved.

There are several reasons for so many creatures turning up in a few small quarries, notes Stucky. Carcasses may have been left in the area by carnivores or carried to the site by streams; other animals probably died of old age.

However they got there, the bones fill in a crucial gap in the fossil record, he explains. They may add significant evidence to the scientific debate about whether evolution occurred gradually or proceeded in rapid bursts followed by long periods of little change.

Scientists from the Carnegie Museum hame been collecting fossils in the Wind River Basin since the 1930s. Krishtalka and Stucky's team noticed a promising quarry last year. They returned this past summer and struck paydirt. So far, says Stucky, only about 10 percent of the fossils at the site have been uncovered. The investigators plan to continue the excavation next summer. They will present their preliminary findings in November at scientific meeting.

"[The quarries] are linked to geologic markers," adds Krishtalka. "White limestone layers bedded within clay and mudstone are good indications that a site contains fossils. This should help in future fieldwork." *—B. Bower*

Mouse procreation is mom-pop affair

It takes a mother mouse and a father mouse to make baby mice, even in these days of sophisticated embryo manipulation. To geneticists this limitation is somewhat surprising. A basic rule of mammalian genetics states that each parent contributes equivalent genetic information — one set of chromosomes — to an embryo. And lower animals can reproduce by a process called parthenogenesis, in which the mother contributes both sets of chromosomes. So there is no reason to anticipate problems from performing the following simple manipulation: exchanging in a just-fertilized egg a sperm-derived set of chromosomes for an egg-derived (maternal) set, or vice versa.

The result should be a mouse with two mothers or two fathers. But recent work in two laboratories indicates that successful embryonic development just doesn't occur unless one set of chromosomes comes from a female parent and the other from a male.

The genetic contribution of mammalian mothers and fathers appears to be equivalent only in structure, but not in function. The paternal and maternal chromosomes each undergo a specific imprinting during sperm and egg formation, and the resulting differences influence the genes' roles during embryo formation, suggest Sheila C. Barton, M.A.H. Surani and M.L. Norris of the AFRC Institute of Animal Physiology in Cambridge, England. They report in the Sept. 27 NATURE experiments indicating that pregnancies are deficient in extraembryonic tissue when the fertilized egg has been manipulated to contain two egg-derived sets of chromosomes. In contrast, when there are two sperm-derived sets, there is substantial extraembryonic development, but the embryo itself is severely retarded. In neither case do any births result.

Earlier work had given a few clues that the maternal and paternal genes do not function interchangeably. For example, the maternal X chromosome is preferentially active in extraembryonic tissue. James McGrath and Davor Solter of the Wistar Institute in Philadelphia recently described a mutation that is lethal only in embryos that inherit it from their mothers.

McGrath and Solter also have performed experiments exchanging male- and female-derived genetic material. Like the Cambridge scientists, they hypothesize that genes are somehow conditioned during egg and sperm formation, and that this conditioning is completely reversed in the developing animal. They speculate in the May CELL that experiments in another area of reproductive biology — the cloning of mammals from adult body cells — perhaps will never succeed because the chromosomes of these cells lack the sex-related conditioning of the maternal and paternal genes, required for full embryo development. *— J.A. Miller*