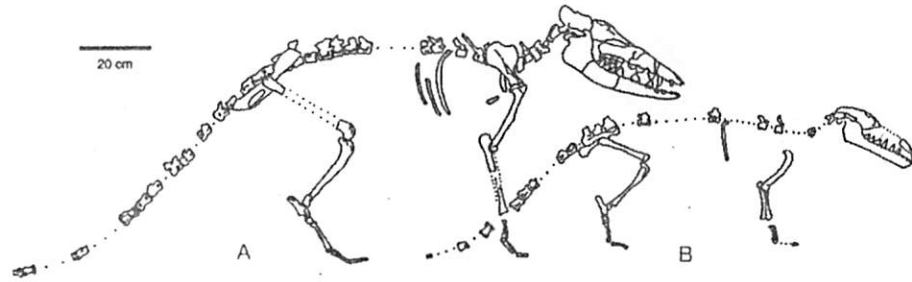
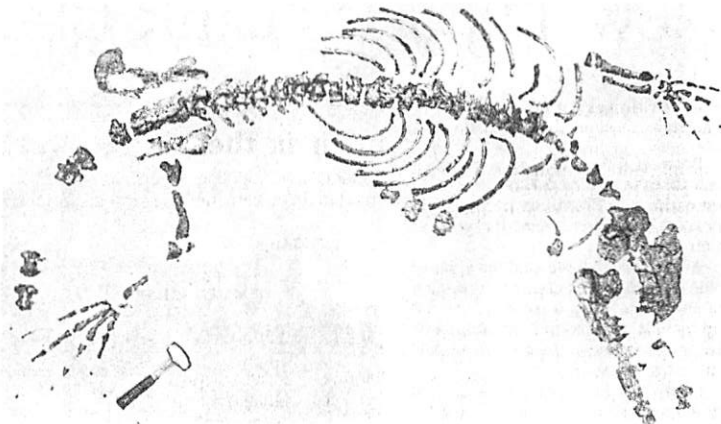


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The wolf-size Pakicetus (a) and the fox-size Ichthyolestes (b) are believed to be ancestral whales. Line drawings of their skeletons depict

slender limbs capable of running. Right, a fossil of an Ambulocetus, part of the amphibian stage of the whale's transition from land to sea.



Photographs and drawing courtesy of Dr. J. G. M. Thewissen

Experts Trace Whale's Family Tree to the Hippo Clan

By JOHN NOBLE WILFORD

New fossil discoveries in Pakistan appear to have answered a long-standing question about the ancestry of whales, establishing that animals like the hippopotamus may be their closest living relatives.

Two teams of paleontologists, in separate reports last month, said the fossils showed that whales, porpoises and dolphins, all cetaceans, are more closely related to some of the oldest known even-toed ungulates — a group of hoofed mammals that today includes cows, camels, pigs and hippos — than to any other mammals.

A group of paleontologists led by Dr. J. G. M. Thewissen, an anatomist at Northeastern Ohio Universities College of Medicine in Rootstown, described the skeletons of two early whales that lived 50 million years ago. They were fully terrestrial mammals, capable of efficient running on their four slender limbs. They had the ankle bones of even-toed ungulates, or artiodactyls, and bones in their ears that are unique to cetaceans.

An analysis of the two presumably ancestral whales, the fox-size Ichthyolestes and the wolf-size Pakicetus, was reported in the Sept. 20 issue of the journal *Nature*.

The new fossils "superbly document the link between modern whales and their land-based forebears, and should take their place among the famous 'intermediates' such as the most primitive bird, *Archaeopteryx*," Dr. Christian de Mui-

Dr. J. G. M. Thewissen and Ellen Williams, a researcher, examine some discoveries from five years' worth of archaeological digs in Pakistan. Dr. Thewissen led a group of paleontologists that found fossils of early whales believed to have lived 50 million years ago.



zou of the National Museum of Natural History in Paris wrote in an accompanying article in the journal.

Scientists had long assumed that whales evolved from land-based hoofed mammals, but until now the most archaic fossils had reflected only the amphibian stage of their land-to-sea transition, like the specimen *Ambulocetus*, not their earlier land origins as hoofed animals.

The other new discovery seemed finally to extend the whale's evolu-

tionary history across that transition. Digging in Pakistan a year ago, a paleontological group led by Dr. Philip D. Gingerich of the University of Michigan found the telltale ungulate ankle bones in the remains of an early aquatic whale, which lived 47 million years ago. They described the fossils in the Sept. 21 issue of the journal *Science*.

Dr. Kenneth D. Rose, an anatomist at the Johns Hopkins School of Medicine, said these were the first well-

preserved ankles to be found in archaic whale fossils and "were the most important region morphologically for establishing evolutionary relationships as early whales were in the process of becoming aquatic."

Dr. Gingerich was especially surprised by how much the ankle bone in the 47-million-year-old whale resembled that of the ungulates known as artiodactyl. It forced him — and apparently is forging other paleontologists — to forsake long-held ideas

about whale evolution.

Until now, paleontologists, citing anatomical evidence, had contended that whales evolved from an order of ungulates called mesonychians, an extinct group of land-dwelling carnivores that resemble but are unrelated to hyenas. Molecular biologists, on the other hand, argued from genetic and immunological studies of living animals that whales must be more closely related to the artiodactyls than other ungulates. After reviewing the new evidence, Dr. Gingerich reluctantly conceded that the paleontologists had been wrong.

"Now I even admit the possibility that hippos are a side line of artiodactyls that might be closer to the whales than any other living animals," he said in a statement issued by the University of Michigan.

Dr. Rose said the new findings "provide compelling evidence that whales are not just related to, but descended from, artiodactyls rather than mesonychians."

While Dr. Thewissen and his colleagues reached the same broad conclusion about whale ancestry, they stopped short of identifying any particular artiodactyl family — hippos, for example — as the closest living kin. They suggested that the closest fossil relatives of the cetaceans were probably the earliest known and previously described artiodactyls, like one named *Diacodexis*.

Still, the paleontologists noted that molecular analysis, which they have had to bow to in the new research, has indicated that, as Dr. Thewissen wrote, whales "are a sister group to hippopotamids."