

more energy than when they ran. The water drained their heat, even though they lived in the tropics and had coats of fur. They had become *Pakicetus* and its peers—in other words, they had barely become whales.

Gingerich thinks that only 2 million years separate *Pakicetus* from the first, still-undiscovered true whale. Perhaps 3 million more years passed before *Ambulocetus* arose—Hans Thewissen isn't sure yet of its precise age. Evolution worked quickly in this time. New species of whales swam into deeper, wider water, maturing from a dog paddle to a yapok paddle. Their legs grew short, their hind feet long and probably webbed. Following Fish's model, it's likely that their fur, now buoyant, helped to keep their bodies straight as they swam. New species arose that could swim like otters, switching from surface paddling to a galloping kick, flexing their now loosening vertebral column, that could drive them down into deep river water. Why should whales bother to make such a transition? *Pakicetus* and its contemporaries did well only visiting the water—in some Eocene sites in Pakistan their teeth are now the most common fossils found. A coincidence may be a clue: at the same places where paleontologists find early whales, they find anthracobunids, those ancestors of elephants and manatees, followed in time by the earliest sirenians. Perhaps sirenians were the sleepy pioneers that went into the water first. They grazed like hippos underwater on grass at the bottom of rivers and coastal salt marshes, and whales, a lineage of predators that had already been flirting with the water, followed them in.

Yet *Ambulocetus* had not yet followed them in all that far, according to Thewissen. In his mind, they were furry crocodiles. They lay on the shores much of the time, their heavy heads resting on the sand or some high rock, and it may have been in this position—not underwater—that whale hearing got its start. Low-frequency sounds can travel rapidly through the ground, and some vertebrates can detect it. A sitting turtle, for example, can sense earthbound vibrations when they flow into the underside of its shell because the bone and the earth are acoustically similar. The vibrations travel through its skeleton to its skull, where they make its stapes vibrate against the cochlea. As *Ambulocetus* basked in the Pakistan sun with its massive head on the ground, these sound waves could have traveled up its bony jaw and channeled through its pad of fat to its ears. If Thewissen can confirm his speculation, whale ears may turn out to be like tetrapod legs: an exaptation so exquisitely well suited for one kind of environment that it is hard to believe that it originally evolved for life in another.

Like crocodiles, *Ambulocetus* was a different animal altogether when it slid into the water to hunt. It could ambush an animal by paddling slowly, its eyes