# Adding flesh to bare therapsid bones

The glorious dinosaurs: They captured the human imagination with their size and the mystery of their demise, but in so doing they overshadowed a group of slightly earlier animals of considerable significance. Now scientists are beginning to focus on the therapsids, the mammal-like reptiles that not only dominated animal life on earth for more than 40 million years, but also are thought to be our ancestors.

"The great forgotten" is how one scientist described the mammal-like reptiles at a meeting of paleontologists, physiologists and ecologists. It was the first major scientific conference on therapsids.

"Origins of qualities of 'mammalness'" are being sought by studying therapsids, says Nicholas Hotton III, a paleontologist at the Smithsonian's National Museum of Natural History and one of the conference organizers. From abundant fossils it is known that the ancestors of the therapsids were the first group to depart from the basic reptilian style, more than 300 million years ago. These ancestors, called Pelycosaurs, increased rapidly in size, and changes in their teeth, skulls and jaw musculature allowed them to become ferocious carnivores and long-lived herbivores.

Reptiles that began to acquire mammalian characteristics arose from the Pelycosaurs and were so successful that there were eventually more than 300 genera of mammal-like reptiles, ranging from the size of a rat to the size of a rhinoceros. They progressed from a sprawling, crawling lizard-like posture to a more erect walk, with all four limbs swinging under the body. Some were carnivorous, some herbivorous, some fleet and some plodding. "They had a peculiar mixture of reptilian and mammalian lifestyles," says George Zug of the Smithsonian.

Chemical communication may have been part of the therapsid lifestyle. David Duvall of the University of Wyoming suggests that fossil skulls show evidence that the animals had a well-developed vomeronasal organ, the tissue that detects pheromones, chemicals released for communication by present-day mammals and reptiles. Smooth, not scaly, skin is apparent in a fossil impression recently discovered in the Soviet Union. There was no indication of hair, but a possibility of glands under the surface, suggesting a mammal-like hide, soft and pliable and capable of releasing secretions. "A pheromone is inexpensive; any goo will do, even sweat," says Duvall.

Reproductive characteristics are a major distinction between reptiles and mammals. Therapsids are generally thought to have laid eggs, but no fossil remains of eggs have yet been discovered, says Jan Roth of the National Institute of Mental Health's Laboratory of Brain Evolution and Behavior. A hypothesis for how egg-laying reptiles may have evolved into live-bearing, nursing mammals was presented by Louis Guillette of the University of Colorado and received somewhat skeptically. On the basis of observations of egg-tending reptiles, Guillette speculates that egg guarding could lead to egg brooding, and secretions produced by a brooding parent could lead to milk. Egg brooding could also evolve into egg retention and eventually to live births.

Another question is whether the therapsids produced body heat internally (endothermy) or whether like lizards they depend on their surroundings for heat (SN: 4/22/78, p. 260). "Is endothermy a mammalian invention or a trait of the ancestors?" asks Albert Bennett of the University of California at Irvine. He reports that there is no evidence that the therapsid ancestors generated their own heat, but a variety of skeletal data suggest that later therapsids had the high metabolic rates characteristic of modern-day endotherms.

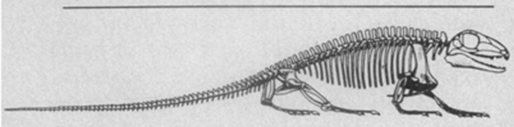
Bennett points out that monotremes, like the platypus, share with other mammals a suite of characteristics associated with high body temperature and energy levels. These include sweat glands, hair, lung alveoli and breathing with a diaphragm. Because monotremes seem to have derived from therapsids independently of other mammals, Bennett suggests they inherited these characteristics from a common, endothermic ancestor.

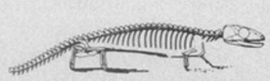
Researchers are also suggesting a well-developed system of hearing in the advanced therapsids. "We hear with bones that reptiles chew with," says A. W. Crompton, who described the transition of bones from the reptilian jaw to the mammalian middle ear. Fossil records of mammal-like reptiles trace the change in the jaw joint that allowed the animals to pick up high-frequency sounds, an ability important for eating insects, says E. L. Allin of the Chicago College of Osteopathic Medicine. The new style jaw was also more effective for chewing food because it permitted finer muscle control, and eventually specialized teeth appeared. "They started with better hearing and it leads to new teeth," muses Crompton of Harvard's Museum of Comparative Zoology.

If therapsids were so diverse and so successful, what became of them? As in the case of more recent extinctions, the answer is not fully known. The rise of dinosaurs is generally blamed for the fading of the therapsids into a nocturnal niche of relatively few types of very small animals. But that is not the whole story. During their years of dominance, the therapsids evolved to smaller and smaller forms. The early therapsids weighed several hundred pounds; the late ones had skulls only 2 inches long, says John Ruben of Oregon State University.

Hotton concludes that, for whatever reason, "The therapsids left a thin shadow of their former selves, but that gave rise to all mammals." □

*Two wolf-sized predatory therapsids feed on a herbivorous therapsid while a smaller carnivorous therapsid darts about getting the scraps. This reconstruction represents therapsid life in South Africa 250 million years ago. Skeletons below show a Pelycosaur, the ancestor of the therapsid, and the smaller reptile from which it evolved.*





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