Coming Out With Their Shell

Turtles are another fascinating example of a group of animals that appears abruptly in the fossil record. The order Chelonia, to which turtles and tortoises belong, appears suddenly in the late Triassic, around 200 million years ago. The very first time turtles appear, their body plan is already fully developed, and they appear in the fossil record without intermediates. Furthermore, turtle and tortoise shells contain more than 50 bony "scutes" that appear in no other vertebrate order, nor anywhere else in the fossil record. What's more, the turtle scapula is positioned underneath its ribs and scutes, unlike any living or fossilized vertebrate. Scott Gilbert, an evolutionary biologist who works on this puzzle, says that "the turtle shell represents a classic evolutionary problem: the appearance of a major structural adaptation." According to Gilbert, this problem is made even more difficult by "the 'instantaneous' appearance of this evolutionary novelty."* Because "the distinctive morphology of the turtle appears to have arisen suddenly," Gilbert and his colleagues argue that evolution needs "to explain the rapid origin of the turtle carapace [shell]." They are studying turtle embryology to investigate how this might have happened.** ■

*Scott Gilbert, "Morphogenesis of the Turtle Shell: the Development of a Novel Structure in Tetrapod Evolution," *Evolution & Development* 3 (March-April 2001):56.

**Judith Cebra-Thomas, Fraser Tan, Seeta Sistla, Eileen Estes, Gunes Bender, Christine Kim, Paul Riccio, and Scott F. Gilbert, "How the Turtle Forms Its Shell: A Paracrine Hypothesis of Carapace Formation," *Journal of Experimental Zoology* (Mol Dev Evol) 304B [2005]:1-12.

radiation." Not only do new mammalian orders appear suddenly, but when they appear, they are already separated into their distinctive forms. For example, during the Eocene epoch (just after the Paleocene), the first fossil bat appears suddenly in the fossil record. When it does, it is unquestionably a bat, capable of true flight.[9] Yet, we find nothing resembling a bat in the earlier rocks.

Critics of the fossil succession argument point out that what is true of animals is also true of plants. For example, flowering plants appear suddenly in the early Cretaceous period, 145-125 million years ago. This rapid appearance is sometimes called the angiosperm big bloom. "The origin of the angiosperms remains unclear," writes one team of researchers. "Angiosperms appear rather suddenly in the fossil record…with no obvious ancestors for a period of 80-90 million years before their appearance."[10] This contradiction was so perplexing that Darwin himself referred to it as "an abominable mystery."[11]

As a result, critics say the pattern of fossil appearance does not support Darwin's picture of a gradually branching tree. *{cont. on page 26}*

Fossil Nautilus Shell

Modern Nautilus Shell

Fossil Shell Cut Away

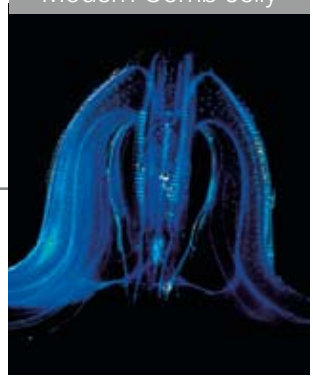
Modern Shell Cut Away

Fossil Ginkgo Leaf

Modern Ginkgo Leaves

Fossil Comb Jelly

Modern Comb Jelly



Fossil to Modern Comparisons

The fossil record provides many examples of living organisms that have remained stable in their form and structure over many millions of years—sometimes over *hundreds* of millions of years. These photos show several examples of such stability over time. The top two sets of pictures compare the internal and external structure of a chambered nautilus shells. The photos on the left show pictures of fossilized nautilus shells from the Devonian period. The photos on the right show modern nautilus shells, virtually unchanged after 400 million years of geologic time. The third set of pictures compares fossilized Ginkgo leaves with modern Ginkgo leaves, showing no change in structure in 135 million years. The final set of pictures is perhaps one of the most dramatic examples. The picture on the left shows a fossilized comb jelly from the Cambrian period, 530 million years ago. The picture on the right shows a modern, living comb jelly at home in the water. The form of the two organisms is identical. ■

Fossil Nautilus Shell Photo: Alex Kerstitch/Visuals Unlimited; Modern Nautilus Shell Photo: iStock Images; Fossil Shell Cut Away: iStock Images; Modern Shell Cut Away: iStock Images; Fossil Ginko Leaf Photo: Brian Gage; Modern Ginkgo Leaves Photo: iStock Photo; Fossil Comb Jelly Photo: Chen, et al.; Modern Comb Jelly Photo: Tom Stack Photo.