From Water To Land Essay, Research Paper

From Water to Land (Revision)

Abstract:

The early tetrapods were the first vertebrates to actually walk the solid earth. They began their conquest of land in the Paleozoic era around 360 million years ago. The question many paleontologists have been asking for a long period of time is whether the anatomy for locomotion on land was developed in water for swimming purposes, or if it was adapted after the creatures became terrestrial. Recent findings of fossils indicate that the transformations of the aquatic creatures happened underwater in order to help them survive in the changing world. When looking for answers, they had to examine forearm, hip, wrist, finger, and other bones, as well as the lungs or gills of the early tetrapod fossils. This information is critical in understanding the history and the process of growth and change. It aids in learning about human evolution.

Background:

Tetrapods are creatures with four limbs, hips, shoulders, fingers, and toes, which developed sometime after lobe-finned fish, and before the first fully terrestrial vertebrates. The earliest tetrapod known is Acanthostega. It is also considered the most primitive tetrapod. It is very close to its fish ancestry, but still anatomically far from its terrestrial relatives. These creatures still lived in water, but they had a lot of the terrestrial tetrapod anatomical characteristics.

Introduction:

Before tetrapods existed, all vertebrates were confined to living in aquatic habitats. The only animals that lived on land were arthropods. Through natural adaptations, the fish developed into amphibians. This colossal stage of change made necessary the evolution of new ways of breathing, locomotion, and reproduction. Paleontologists needed to understand how this transition took place. If the changes in anatomy of the fish developed on land, then they served the same purposes they serve today, such as walking. But what advantages would those same body parts give to the aquatic creatures still living in water? This is one of the questions the scientists are asking themselves. There have been a few hypotheses on this matter. The most recent one states that the transformations of the aquatic creatures happened underwater in order to help them survive. This time period is very difficult to study because there is a very small amount of fossils preserved. After all, this occurred approximately 350 million years ago; and since the first tetrapods lived in water, their remains were damaged as time went on.

Summary:

. In 1940 Alfred Romer of Harvard offered a powerful scenario about the process of evolution of the fish into amphibians. He argued that the freshwater pools that the early tetrapods lived in were suffering seasonal droughts. He compared these early creatures to lungfish. Because of the draughts tetrapods evolved lungs and were able to breathe air when necessary. This happened over a long period of time. The lungs came to the rescue when the oxygen became scarce in water or when the ponds dried out. Romer also suggested that instead of digging burrows with their teeth, such as lungfish do in similar situations, tetrapods used their fins to struggle over the harsh land to the nearest pond. By the process of natural selection, fish with weak fins died along the way, but fish with strong ones lived to reproduce and pass on their genotype to their offspring. Gradually fins turned into limbs, which are much better for overland travel. At the same time, many other parts of the body, such as eyes, ears, and skin, changed to better cope with this new environment (Gardiner, 1998, p.659).

Romer s theory was very controversial because there were a lot facts and findings that did not support it. The anatomy of the tetrapods teaches us a lot about their lifestyle. We notice that the radius and the ulna of the bones of the forearm are of different lengths. They are thinner at the wrist and thicker at the elbow. This implies that they would have been very poor at supporting the animal on land. The forearms were not adapted to give enough range of movement for walking action. This implies that the limbs first evolved in water and not on land.

The next question is whether the hips developed to aid the creature in traveling distances on land or for some other reasons. According to Carl Zimmer, a walking animal s hips have to be attached to its spine in order to support it against gravity. The hips of the early tetrapods did not have the attachment of strong ligaments. Their hips were loosely attached to their spines. If the tetrapods tried to walk, they probably would have flopped around defenseless on the ground. Therefore the rear limbs were not designed for locomotion on land. The creatures wrists were very weak, but surprisingly they had eight fully developed tetrapod fingers. These fingers were multijoined and sophisticated, but they were attached to the insubstantial wrist. They were virtually useless for helping the creatures walk on land. The early tetrapods had the body of a land animal but could not survive on land in theory.

Another controversy was in the fact that the early tetrapods had gills; they breathed just like fish. This is a major implication that this animal lived in water and probably never left it. According to Kathleen McAuliffe, tetrapods probably lived in the swamps for at least 20 million years, after developing the anatomy, before moving to dry land.

To summarize all of the findings stated above we must refer to the most logical explanation of all. Jenny Clarck proposed that fish must have evolved into tetrapods for life underwater. The lagoons were a new ecosystem in the Devonian period, but bacteria used up too much of oxygen. This was hard for the tetrapods that lived in water. Therefore they evolved lungs to help them survive. The limbs and hips aided the creatures to walk on the bottom of the wetlands. According to Zimmer the fish had to keep its fins in motion in order to remain motionless and unnoticed by the predators and the prey. The first tetrapods however, could grab rocks while waiting for prey to swim by. This shows that the tetrapods first evolved their limbs underwater, and later they started to use them on land, but for completely different reasons.

Conclusion:

As we have seen, the features of the early tetrapods indicate that they were excellent swimmers but unable to walk on land. The evidence shows that they were descended from a fish ancestor. This means that legs were not evolved for use underwater, and that they adapted for the task of locomotion much later. Evolution always adapts existing structures to perform new purposes, rather than creating new structures. The principle of evolution is sometimes called preadaptation. There is no foresight involved; simply the lucky coincidence that a feature evolved to do one thing may turn out later to do another thing even better.

References

Gardiner, David M., Torok, Maureen A., Mullen, Lina M., Bryant, Susan V. (September

1998). Evolution of vertebrate limbs: robust morphology and flexible

development. American Zoologist, v38, n4 659

McAuliffe, Kathleen. (August, 1993). Retracing the footsteps of evolution. (fossil

remains of an early tetrapod discovered in a museum) Omni v15, n10, 16

Zimmer, Carl. (June, 1995). Coming onto the land. Discover v16, n6 , 118