Abby Lodge
The Origins of Birds

The animal kingdom is divided into groups recognized by key traits and scientists have long sought to discovered how animals and their key features have evolved. Our world has more than 10,000 species of birds with feathered wings. Where did birds come from and how did wings and feathers first arise? Charles Darwin argued that every major group of animals evolved from a pre-exiting one. He predicted that we would find fossil with features that linked one major group to another. Yet during his time, no fossils were known to reveal these transitions. Then just two year later in a quarry in Germany, a 150-million-year-old fossil, named Archeopteryx was discovered – it preserves in fine detail, feathers along the wing and feathers along the tail, just like those we see in living birds today. However, the boney features tell a different story – teeth in the jail, claws in the hand and a long boney tail, which are all lacking in birds today but present in things we would think if as traditionally reptilian. Archeopteryx pointed to a close link between birds and reptiles, but which group of reptiles?

Flying pterosaurs have been discovered with light hollow bones but their wings are constructed very differently than the wings of Archeopteryx and bids of present day. Pterosaurs have three small digits and a fourth which is really long – the membrane of the pterosaurs attaches to this long digit and along its body and hind limb. In contrast, the wings of Archeopteryx and birds have only three digits and their feathers attach individually along their arm and hand bones. These differences tell us that Archeopteryx and pterosaurs evolved flight independently. Archeopteryx must have be descended from different reptiles.

Thomas Huxley, Darwin's champion, was astonished by the Archeopteryx's resemblance to a turkey sized dinosaur called Compsognathus. Their hands also had three digits, hollow bones, and stood on two legs. These similarities led Huxley to propose that birds are related to the branch of reptiles called dinosaurs. But other scientists question this conclusion because birds appear so different from dinosaurs and some characteristic features of birds – like wishbones – seem to be missing from dinosaurs but were present in other reptiles. Scientists thought that dinosaurs were cold-blooded and slow moving like other reptiles. People just couldn't imagine dinosaurs being agile and hopping around – they think they are lumber – no way to relate to birds.

In 1963, John Ostrom discovered a fossil badlands of Montana that challenged this view. He discovered a claw, but not a claw for walking on but rather for slashing. Deinonychus was small with a delicate build – running up right on two legs, and a long stiff tail for balance. This proved not all dinosaurs were big and lumbering. Ostrom's discovery set off a revolution, what if dinosaurs weren't slow but warm blooded and fast-moving like birds? When Ostrom compared Deinonychus and Archeopteryx he saw that they both had lightly built, hollow bones, long arms, similar hip and shoulder bones. Ostrom concluded that birds did descend from dinosaurs – not from lumbering sauropods, but from another linage called therapods that walked on two legs – and included t-rex and agile predators like Deinonychus.

While some scientists did not accept this idea at first, supporting evidence continued to accumulate, including the discovery that therapods had a feature similar to birds not previously found: a wishbone. When scientists analyzed the skeletons of therapods and birds, they found too

many similarities for any explanation but common ancestry. Then new kinds of evidence also emerged. In 1978, Ostrom made the surprising discovery of a vast dinosaur nesting ground – dinosaurs nested in colonies, cared for their young, brought food to their babies. He also found evidence that they came back probably over and over again for many years to the same site. In a radical shift, by the 1980s, a consensus was finally building that birds descended from theropod dinosaurs, but scientists were about to discovery the most startling evidence of all.

In the mid-1990s, farmers in northeast China, began unearthing dinosaurs that were 120 million years old. A chicken-sized theropod, named Sinosauropteryx – did not have scales but rather it was covered in some primitive kind of feathers. This was the first of many fuzzy and feathered theropods to be uncovered. There was no longer any doubt that birds were related to theropods. But while feathered theropods settled one question, they raised a new one, these animals could not fly, so why were they feathered? It was long assumed that feathers evolved for flight, but it is clear that feathers predated flight and arose for some other purpose. It is hard to tell just from the fossil evidence why feathers evolved, but living birds may offer the answer: feathers provide warmth, so the first feathers might have helped keep dinosaurs warm. Birds also use colorful feathers in communication, in courtship, and in territorial displays. So, dinosaurs may have used feathers in the same way. Feather might have played different roles at first and then were modified for flight.

The modification of an existing structure for a new use is called co-option – this is a common way new structures and abilities evolve. Bird wings are modified forelimbs once used for grabbing and feeding. So, the co-option of feathers for flight enabled the Archeopteryx and its relatives to take to the air. 66 million years ago during a global mass extinction, only a small group of toothless birds survived and they evolved into the 10,000 species of birds we see today.