So far as the metatarsal bones are concerned, it appears from the observations of Gegenbaur,[1] that even in those birds in which the metatarsal bones ultimately fuse to form a single undivided mass, these bones originally present the form of four distinct and separate elements. It seems, therefore, if conclusions based upon embryology are of any value, that we must conclude that birds as we now know them were derived from an ancestral group, the members of which, along with other peculiarities, were possessed of at least four distinct and separable metatarsal bones. These four bones were originally separate and distinct, but subsequently became more or less completely fused together to form the single metatarsal bone which is characteristic of the majority of birds. Inasmuch as the Penguins retain the individuality of the separate metatarsal bones to a greater extent than other birds, it would appear that they are the modern representatives of a group which had diverged from the primitive avian stem at a time when as yet the metatarsal bones had neither lost their individuality nor had become fused together to form the single bone which is one of the characteristics of the majority of birds of the present day.

This conclusion can only be denied on the supposition that the earliest members of the group of the Spheniscidæ were derivatives from the avian stem, at a period when the separate metatarsal bones had been already fused to form a single mass, as in modern birds; a supposition which appears to the last degree improbable, when we consider that in accepting it we must suppose that the avian metatarsal bones must in the first instance have undergone coalescence, and thereafter became differentiated from one another in the members of one particular group, and in one only. It would therefore appear that the group Spheniscidæ is one of considerable antiquity, and that it must have diverged from the avian stem at a time when as yet the metatarsal bones formed distinct and independent entities in the members of the entire class of birds.

At this time, moreover, birds had so far become differentiated from their reptilian ancestors, that their anterior extremity, instead of forming organs of support adapted to terrestrial progression, had become modified to form wings adapted to aerial progression. This conclusion is forced upon us by an examination of the wing of the Penguin of the present day, in which we find nearly every muscle which is characteristic of the wing of the ordinary bird represented, but represented not by muscular but by tendinous bands, which have attachments similar to those of the muscles in question. These tendons, inasmuch as they are functionally useless, could only have been derived through a process of structural degeneration from muscular bands which had at one time been functionally active in the ancestral Penguin, but which, in accordance with the law that when highly-organised tissues become functionally useless, they gradually degenerate and assume a lower form of organisation, and were consequently converted into tendon.

In the Penguins apparently the muscles of flight originally present had proved to be

[1] Untersuchungen, Heft i., 1864.